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INFORMATION TECHNOLOGY 3 & 4/1999

CONTENTS

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

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TO OUR READERS

This is the last issue edited by Ms. Diana Rhind, who retired from the Organization, in her capacity of Editor for the *Emerging Technology Series.* I have the honour to address a short preface to our readers of this issue of Information Technology. Information technology is a vast and wildly advancing field. Although it is very difficult to draw an actual or a foreseeable overall picture covering everyone's concerns in this field, Diana has anyway selected and edited a broad scope of papers in this issue of *Information Technology* to elaborate various specific perceptions through neutral eyes. This has formulated a group of highlights.

Of special interest in this issue of *Information Technology* is a paper on Information Systems for Public Sector Management, written by Professor Richard Heeks of the University of Manchester, who took the Indian reality as an example to thoroughly analyze the major components in public sector reform and the role of information technology in the related process. Through the case study, you may discover that some findings would also hold true for many other developing countries. A potential value added in this paper would be that it provides a pattern for analyzing the efficiency and pitfalls of the application of information technology in public sector reform.

For those who would like to have a glance at the Internet and its contribution to development, they may wish to refer to several solid information sources at their fingertips, such as reports from the ITU on challenges to the network: Internet for development, and the ITU's new report on regulatory issues for electronic commerce.

Wireless Application Protocol and bandwidth are currently the hottest topics in telecommunication, but is it also valid for LAN? Please read a piece of news on the wireless market. Those market trends can only reflect some specific extents in the information industry. This issue of *Information Technology* strives for delivering various aspects to readers for their own judgement.

A very interesting item in the section devoted to Applications is on a smart solar energy system that is heading for the public. This item has described an efficient energy system merged with many different technologies and having quite a broad scope of usages. Many readers may find it useful as commercial information.

Weixi Gong
Industrial Information Officer

(on behalf of Ghislain Robyn,
Director of Statistics and Information Networks Branch)

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A. SPECIAL ARTICLE

Information Systems for Public Sector Management

Working Paper Series

Paper No. 6

INFORMATION AGE REFORM OF THE PUBLIC SECTOR: THE POTENTIAL AND PROBLEMS OF INFORMATION TECHNOLOGY FOR INDIA

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October 1998

Abstract

As in many countries, public sector reform in India has consisted of five main components: increased efficiency, decentralization, increased accountability, improved resource management, and marketization. "Information age reform" means delivering these ongoing reform components with a more overt role for information and with greater use of information technology. A review of global experience suggests that information age reform has great potential to improve public administration and other components of the public sector.

However, the Indian reality—like that for many developing countries—has been more problematic, with many failures of such reform; failures that can be described as total, partial or failures of sustainability and replication. The explanation for such failure lies partly in the approach to reform adopted by senior public officials. A "four Is" model of approaches is described: the pre-information age approach of "ignore", and the information age approaches of "isolate", "idolize" and "integrate". Analysis of Indian cases suggests it is the last approach that is most likely to deliver reform objectives; yet it remains the least commonly-adopted. Changes are therefore required in current strategies for public administration training and the management of change. Such findings will hold true for many other developing countries.

A. Introduction

A.1. The reform agenda in India

Public sector reform is, if generally defined, change within public sector organizations that seeks to improve their performance. As such, reform can be seen as an ongoing process in India since the inception several centuries ago of institutions that we now label "public sector". However, reform is typically defined more narrowly. It is often associated with the ideology of the "New Right" towards the public sector; an ideology that grew up especially from the 1970s and which sought particular types of change in the way the public sector was run. This ideology has, albeit slowly and by "fits and starts", increasingly begun to shape the agenda for change in the Indian public sector.

What constitutes the public sector reform agenda in India? There has been no consistent menu of elements but typical components—driven by the global agenda of new public management—including those listed below (Bhattacharaya, 1996; Maheshwari, 1996; Sengupta, 1995; Singh, 1996).

- *Increased efficiency*: improving the input:output ratio within the public sector. The rationale of such reforms is to address the large size of public sector expenditure and/or the inefficiency of many of its processes;
- *Decentralization*: the transfer of decision-making to lower, more localized levels of the public sector. The rationale of such reforms is to reduce the costs of centralized decision-making, and to create more flexible and responsive decision-making;
- *Increased accountability*: making public sector staff more accountable for their decisions and actions. The rationale of such reforms is to increase the pressure on staff to perform well, to make them more responsive to recipient groups, and to reduce inefficient or corrupt practices;
- *Improved resource management*: increasing the effective use of human, financial and other resources. The rationale of such reforms is clear from their definition. It often includes a refocusing of the way the performance of these resources is planned, measured and managed;
- *Marketization*: increasing the use of market forces to cover relationships within the public sector, relationships between citizens ("consumers") and the public sector, and relationships and boundaries between public and private sectors. The rationale of such reforms is that market relations will drive costs down and increase efficiency and/or effectiveness of service delivery.

There has been much criticism of the components listed: of what they seek to achieve in theory, and of what they do and do not achieve in practice. In this paper, we are not going to participate in that particular debate because that is not our purpose. These components will be taken as a given; as initiatives that are being ever more widely undertaken or imposed. For increasing numbers of Indian public servants, the issue is not the rights and wrongs of reform, but how best to implement reform initiatives in which they find themselves involved.

A.2. The information age in India

Almost simultaneous with the development of a reform agenda, there has been a growing sense in India of a real or impending "information age".

The roots of ideas about a new "information age"—treated here as synonymous with emergence of an "information economy", "information society" or "post-industrial society"—are invariably traced back to the work of writers such as Daniel Bell, Fritz Machlup, Yuji Masuda and Alvin Toffler (e.g. Bell, 1974; Machlup, 1962; Masuda, 1983; Toffler, 1980). Through analysis of extant trends, they described a vision of a new world paradigm that was already coming into existence and that would increasingly develop. General features of this new paradigm include a domination of services over other economic sectors, niche instead of mass markets, and the emergence of a "post-bureaucratic" form of organization.

The early, and optimistic, writings about the information age have been much criticized. Critics argue:

- That things have not changed as much as predicted. Peasant farmers—who, with their families, form a major proportion of the world's population—continue to live and work much as they have ever done. They have yet to appreciate the pleasures of surfing the Net or teleworking. Even in the high citadels of the new world, shifts in working patterns and social life may be tangible and important, but they are not yet revolutionary. A modified criticism is therefore that change has been, and will be, a very uneven process that creates inequalities;
- That, when things do change, there will be problems as well as benefits. The information age may be marked by higher living standards but also by unemployment, insecurity, electronic surveillance and alienation;
- That the technology focus of information age writing distracts us from the human, social and political factors which explain—and therefore ultimately determine—what happens in our world.

There is a great deal of validity in these criticisms, but what they do not deny is that—albeit slowly and unevenly, for better or worse—there are identifiable information age trends. Thus, while the concept of an information age retains a large measure of hyperbole, it does serve to highlight important trends that are shaping the world in which we live.

It is certain that they have begun to shape the economic and political context in India. Whilst many see the 1970s as something of a "lost decade" for India in computing terms, the country more than made up in the 1980s. The 1984-1987 period in office of "Rajiv and his computer boys" marked a defining moment during which India's image and activity as a global software player really began to take off, and during which a clear link was made between computing and reform of Indian public administration.

Although information technology (IT) has never since been so heavily championed at such a high level in government, the catalytic actions of the mid-1980s set loose two specific, related and seemingly unstoppable information age trends in India:

- The increasing importance of information, including the increasing visibility and value of information systems (see Box 1);
- The increasing use of information technology (see also Box 1).

For the public sector in India, this means that one can therefore see a trend of "information age reform" that combines the existing reform agenda with the promise of the information age. Indeed, from humble beginnings in the Indian Statistical Institute in 1956, government

expenditure on IT has grown to average more than US$ 350 million per annum by the late 1990s (Dataquest, 1998).

Box 1. Defining IT and IS

Information technology can be defined as computing and telecommunications technologies that provide automatic means of handling information. IT is therefore taken here to represent equipment: both the tangible hardware and the intangible software. A computer linked to other computers on a local area network represents one example of IT.

Information systems (IS) can be defined as systems of human and technical components that accept, store, process, output and transmit information. They may be based on any combination of human endeavours, paper-based methods and IT. A financial information system of staff and computers that gathers data and processes it into reports used for managerial decision-making represents one example of an IS.

Thus:

- IT on its own does not do anything useful; in order to do anything, it must become part of an information system.
- Information systems do not necessarily involve computers and telecommunications equipment.
- Even when they do, information systems are much more than just IT because they involve people and their actions.

Information age reform is therefore a growing reality for India which means two things that are different from traditional reform:

- First, a much greater (i.e. more overt) role for information and information systems in the processes of change in the public sector;
- Second, a much greater (i.e. more widely employed) role for information technology in the processes of change in the public sector.

B. The promise of information age reform

There is great potential for these trends of information age reform to bring significant benefits to India because government has been, and still remains, the single largest collector, user, holder and producer of information. Information is a central resource for all staff levels and for all activities: "In pursuing the democratic/ political processes, in managing resources, executing functions, measuring performance and in service delivery, information is the basic ingredient" (Isaac-Henry, 1997, p. 132)

The work of government is thus very information-intensive, and four main types of formal information are identifiable:

- *Information to support internal management.* This includes information about staff for personnel management, and information about budgets and accounts for financial management. Like the other three types of information, it can be used for everything from day-to-day operational implementation up to long-term policy analysis and planning;
- *Information to support public administration and regulation.* This includes information that records the details of the main "entities" in India: people, business enterprises, buildings, land plots, imports/ exports, etc. It is used for a variety of purposes such as legal, judicial and fiscal;
- *Information to support public services.* Examples include education (e.g. school staff records), health (e.g. patient records), transport (e.g. passenger reservation information) and public utilities (e.g. customer billing information).
- *Information made publicly available.* This includes:
  - Information government wishes to disseminate such as press releases, consultation papers, details of policies, laws and regulations, and details of benefits and entitlements;
  - Information government collects that it may make available, such as demographic or economic statistics;
  - Information government is required to supply such as audited accounts, internal policy documents and correspondence, and responses to requests from politicians, journalists or citizens.

Given this information intensity, changes in information systems must be an essential part of all reform initiatives in India, and changes in information technology will also have a great potential. In theory, everything that IT can do could be done by some other means. In practice, its ability to increase the speed and/or reduce the cost of information tasks mean it can do things that would not otherwise be contemplated. IT therefore can bring change and has three basic change potentials within reform:

- *Supplant*: automate existing human-executed processes which involve accepting, storing, processing, outputting or transmitting information. For example, the automation of existing clerical functions;
- *Support*: assist existing human-executed processes. For example, assisting existing processes of government decision-making, communication, and decision implementation. (This can also be seen as a potential to empower if IT assists the activity of citizens outside government.);
- *Innovate*: create new IT-executed processes or support new human-executed processes. For example, creating new methods of public service delivery.

IT can bring five main benefits to the reform process. In practice, these are not neatly differentiated but they can be summarized as:

- *Cheaper*: producing the same outputs at lower total cost;
- *More*: producing more outputs at the same total cost;
- *Quicker*: producing the same outputs at the same total cost in less time;
- *Better*: producing the same outputs at the same total cost in the same time, but to a higher quality standard;
- *For the first time*: producing new outputs.

The first three represent efficiency gains for the public sector; the last two represent effectiveness gains. Of course, these are the direct and objective benefits. IT can bring many others such as better staff motivation, greater political control, or an improved public image for the organization (with Indian Railways being a case in point for all three of these indirect benefits).

IT is therefore seen to have a great potential to contribute to reform (Traunmuller and Lenk, 1996), with this potential being illustrated by the following examples from around the world:

- *Increased efficiency.* IT's role in increasing efficiency has been described above, mainly relating to its "supplant" role. In the US, the Lawrence Livermore National Laboratory developed a World Wide Web-based system to reduce the cost and increase the speed of parts procurement (Gebauer and Schad, 1998);
- *Decentralization.* IT can provide support for more efficient and effective decision making at decentralized locations and create new information flows that incorporate those locations. In Ireland, the Department of Social Welfare created more than a dozen computerized applications in order to support the decentralization of responsibilities from Dublin to outlying offices (Cooney and O'Flaherty, 1996);
- *Increased accountability.* IT can create new accountability information and can deliver accountability information to new recipients, providing for more efficient or effective accountability. In the US, "collusion detection software" was developed and applied to root out impropriety in bids and contract awards for supply of public school milk (Anthes, 1993);
- *Improved resource management.* IT can create new performance information and deliver it to decision makers, providing more effective managerial control over government resources. In Malaysia, government development authorities collaborated to develop a computerized system to facilitate land resource management (Raman and Yap, 1996);
- *Marketization.* IT can supply the new information necessary for the establishment of market relations, and can also form the conduit for delivery of new forms of public service. "In Spain and Portugal, smart cards are issued to people to claim unemployment benefit at kiosks, and to check on job vacancies and training opportunities." (Gosling, 1997, p. 69).

C. Indian realities of information age reform

Globally, then, new information systems and new information technology are both supporting and driving forward the process of public sector reform. But what of India? Has the country unleashed the power of information age reform, or does the potential still lie mainly dormant?

Objective reporting of information age reform cases in India (and elsewhere) is rare. Many reports are written from a "rose-tinted" viewpoint by those with a vested interest in the reform initiative. Their glowing and uncritical claims of success frequently bear little relation to reality. Nonetheless, reliable cases can be found and one can place these into three categories.

Success

Computerization of the Indian Railways' Passenger Reservation System may be branded a success (Heeks, 1996a). Not only did it significantly increase the efficiency of the reservation process, but it also reduced corruption (although it did not eliminate it), increased rail staff morale, and improved the quality of customer service. Beyond these reform components, it also gave Indian Railways (and India more widely) a more modern image, and it helped to build information age capabilities within the country. Sadly, this case remains almost a lone beacon in India which "seems to stand out as a solitary example of success". (Bhatnagar, 1997, p. 5).

Open verdict

A few ongoing information age reform projects have yet to fall clearly into the categories of either success or failure. Perhaps the best-known of these is CRISP, the Computerized Rural Information Systems Project. When initially analysed, after some five years of operation, this appeared to have made little impact and to be heading for failure (Madon, 1993). Subsequent analysis, however, revealed "sparks of life" within the project, with some computers being used to support analytical management decision-making, thereby enabling decentralization and improved delivery of assistance (Madon and Sahay, 1996).

Failure

By far the largest category of reports—both from the formal literature and from the dozens of Indian public servants trained each year by the author—is that of failure. There are no cast-iron statistics on this and there are unlikely ever to be. Nonetheless, based on the available evidence, one can state with some degree of certainty that the majority of information age reform initiatives in India end in failure. This may be the total failure of an initiative never implemented or in which a new system is implemented but immediately abandoned; the partial failure of an initiative in which major goals are unattained or in which there are significant undesirable outcomes; the sustainability failure of an initiative that succeeds initially but then fails after a year or so; or the replication failure of an initiative that succeeds in one place but cannot be repeated elsewhere.

Formally-reported examples include the following:

- The Director of Adult Education in the National Literacy Mission Authority was smitten by the potential of IT to improve the management of literacy programmes (Jain, 1994). Having seen a software firm's demonstration, and despite glaring technical

and data constraints that were obvious to any neutral observer, he commissioned a complex executive information system (EIS) that soon fell squarely into the "total failure" category;

- Part of the Income Tax Department's tax system was computerized. The project ran into difficulties due to political antagonisms between various groups; notably between regional tax commissioners and the central tax board, and between management and unions. As a result, only parts of the information system and only a subset of intended process reforms became operational and even these were resisted by staff. There was therefore only very limited achievement of reform objectives (Singh, 1990);
- A computerized decision support system (DSS) was created for the Narmada Irrigation Project Authority (Rama Rao, 1990). The system was initially used to increase efficiency by helping engineers save time in their cost estimations of canal engineering work. However, the system was never properly used for its main intended purpose: the production of improved canal design. Upon retirement of the Chief Engineer who had championed use of the DSS, even the estimation use was discontinued;
- A computerized management information system was developed in Surendranagar district, Gujarat State, to demonstrate the feasibility of providing computer support to planning and monitoring tasks at the district level, thereby enabling decentralization (Bhatnagar, 1992). Although the system proved useful, it was never adopted elsewhere because other district officers had a "not invented here" mentality that rejected innovations made by anyone other than themselves.

C.1. Understanding information age reform failure in the Indian context

One is naturally drawn to analyse why failure should be so prevalent in India. There are almost as many explanations for failure as there are information systems. However, one key factor that emerges again and again from case study analysis is the attitude and actions of senior public officials, both politicians and managers (Gupta, 1996; Bhatnagar, 1997; Peterson, 1998). Based on discussions with such officials and their subordinates, and a review of relevant cases, we can create a "four Is" model of different approaches to information age reform that appear over time, as described below.

The "ignore" approach

In this case, public officials are ignorant about IT and information systems. They therefore do not include consideration of either in their plans for reform. IT expenditure is minimal or non-existent. This approach does not constitute information age reform and will therefore not form a major focus of this paper. Nevertheless, this approach is still found in many—perhaps even most—Indian public sector organizations. This is sometimes even so when computers are present for, in some cases, those computers remain unused and merely act as costly "executive paperweights".

The "isolate" approach

In this approach, public officials remain computer-illiterate and lack an understanding of information's role. They nevertheless are aware of IT and its potential. Investment in IT is therefore included in reform plans but is seen as the separate responsibility of "computer experts". It is mainly associated with automation and some (often spurious or concocted) idea that efficiency gains will result. For other reform agendas, it is added as an afterthought and is not linked in any systematic way to the process of reform. This, nonetheless, represents the first step on the path of information age reform.

Both the early years of the CRISP project and the Indian Income Tax project cited above are examples of the isolate approach. In these cases, the introduction of computers was seen as the responsibility of technical staff rather than being something in which mainstream managers should become involved. As a result, huge investments made very little, if any, contribution to reform agendas in these Indian public sector organizations.

This approach should not be seen as some historical aberration for it can still be found. The recent Asian Development Bank-supported project for restructuring of Gujarat's financial sector provides an example:

"Yet when it comes to computerisation, the cart has been put before the horse. There is a separate allocation for computerisation ... The type of hardware and its allocation to various tax collection agencies has already been decided. It was envisaged that the process of computerisation would be completed even before the thinking on financial sector reform made any headway." (Bhatnagar, 1997, p. 8)

The "idolize" approach

In this approach, public officials have become semi-literate. They use computers and are over-aware of IT's potential. They believe that IT can transform the business of government (or at least transform their own career/ political prospects if they are seen to initiate a high-profile IT project). They are dimly aware that information is something important. The public sector becomes awash with IT-driven reform projects which place technology at the heart of the change process.

This approach has recently leapt to prominence thanks to N. Chandrababu Naidu, Chief Minister of Andhra Pradesh State. In 1997, he launched a high-profile project—the LEAP21 (Leadership and Excellence in Andhra Pradesh in the twenty-first century) initiative—that exactly fits the idolize description. This initiative aims to use IT as a main lever in the creation of better government in Andhra Pradesh and, more generally, "focuses ... on using Information Technology as a strategic tool for improving the quality of life for the people of Andhra Pradesh". (Naidu, 1997, p. 1).

The jury currently remains out on LEAP21. Chief Minister Naidu's intention of using promotional interven-

tions to support the development of the IT industry and IT technological capabilities is based on sound historical precedent (Heeks, 1996b). However, his hopes of driving public sector reform with IT are not. There is a long history of failure to deliver reform objectives via technology-driven projects, of which the literacy EIS case cited above is but one example (Kraemer et al., 1981; Davies, 1997).

Even where technology-centred projects initially appear to succeed in delivering reform objectives, Bhatnagar (1997) warns that they may not be sustainable or replicable since they so often depend on a single "idolizing" figurehead. When that senior official transfers to a new post, the project often collapses; when other organizations try to copy, failure ensues because the originator's drive or skills are lacking; and copying rarely takes place because "a replication will never attract the same attention as a first time use" (Bhatnagar, 1997, p. 6). In all situations, the cause is the lack of the original IT-focused champion.

Examples of these sustainability and replication failures from India include the canal design and district administration cases cited above, and another DSS used to support improved planning of resource usage in two zonal railways which was never used in other zones (Ramani, 1994). With LEAP21 so focused on Naidu himself, prospects are limited for the sustainability and replication of any successes it may fortuitously achieve.

The "integrate" approach

In this approach, public officials have become information-literate. They recognize information as a key organizational resource that is central to all government functions. IT is relegated to a secondary role: it is seen as a valuable means to achieve certain reform ends, not as an end in itself. The re-engineering of information systems and the introduction of IT are now fully integrated into the process of organizational change, driven by reform objectives.

The integrated approach therefore places information in the driving seat, relegating technology to an important but enabling role. In very simple terms, we can see four main steps in initiation of this approach:

- Acceptance by key stakeholders of the need for reform;
- Identification and communication of an agenda for reform;
- Identification of the new and/or re-engineered information systems requirements of this reform agenda;
- Identification of the role, if any, that information technology has to play in meeting these requirements.

The successful computerization of passenger reservations on Indian Railways can be seen to have followed this route. The need for reform of reservations was understood since at least the mid-1970s, with an agenda of modernization widely discussed and the need for re-engineering of systems to escape the old "one-train-per-clerk" situation widely accepted (Jain and Raghuram, 1992). Information technology was then identified as the servant of this pre-existing reform agenda, not as the master of reform. Despite undeniable hiccups, this project was kept on track thanks to a vision of efficiency, accountability and customer service objectives that was shared by key stakeholders, not held by just one champion. As a result, technology solutions were shaped to fit reform objectives rather than vice versa, as is so often the case in examples of the "idolize" approach.

However, other examples of the integrated approach hardly exist in India. Approaches and chronologies remain unevenly distributed in India, but Bhatnagar (1997) sees much of the public sector still struggling to move away from the "ignore" stage. If anything, it seems likely to move on to "idolise", as exemplified by the LEAP21 initiative, rather than "integrate".

D. Conclusion

Information age reform is seen as a relatively new activity in the Indian public sector that recognizes a significant—at times even central—role for information systems and information technology. Information systems change has always been an essential part of all organizational change in government (though this may not have been well recognized at times). But what is palpably new in information age reform is the presence of information technology, which has been seen to have great potential to contribute to the reform process.

Public officials are central to information age reform and they can take different approaches in trying to realize the potential of information and IT. These approaches are summarized in table 1.

Despite the potential of information age reform, there remain substantial problems: (a) for the Indian public sector to enter the information age reform era at all; and (b) for it to move on within that era to an integrated approach that will use IT to effectively enable delivery of reform objectives.

There is no magic recipe for ensuring widespread use of the integrated approach but education and training must surely form a substantial part of the package. Yet any review of current public administration training programmes in India will show that most can be described as "ignore going on idolize" in their approach. There is little attempt to build the hybrid managers—spanning managerial, IT and IS skills—that information age government requires (Mundy, forthcoming). These skill sets remain unintegrated within current training and often ignored. Some potential public employees and in-service trainees may gain computing skills on their training programmes, but they do not gain information or information systems knowledge and skills. Any view of IT beyond the hands-on is typically simplistically-positive.

Not only does this hamper integrated approaches today, it also hints at a dangerously self-reinforcing spiral. If the present generation of Indian public managers cannot value or manage information, that sets the "information-

blind" agenda for current training and debate, thus ensuring that the next generation, too, will be unable to value or manage information. A similar spiral runs the risk of developing a "blinded by computers" agenda of IT idolatry.

Indian public managers will also need to adopt a more strategic approach to change that drives technology needs from information needs, and information needs from reform objectives. Strategic systems planning of this type is very much in vogue in the private from reform objectives. Strategic information systems sector, though the application of such techniques in practice and in the public sector remains questionable (Ballantine and Cunningham, forthcoming). Perhaps more realistic is a "core-periphery" approach that balances strategic and tactical, central and local needs (Heeks, 1997).

Finally, encouraging an integrated approach will require cultural and structural changes in the Indian public sector to ensure that technology is the servant of reform. Such changes are never quick and so the move to an integrated approach can only be seen as a long-term process. In the interim, such information age reform initiatives as do take place in India are likely to remain dominated by "isolate" and, increasingly, "idolize" approaches. The true potential of information technology will therefore remain untapped in most cases, with initiatives undershooting in their delivery of reform objectives.

Table 1. Summary of approaches to information age reform

Approach	*Role of IT in reform*	*Role of IS in reform*	*Delivery of reform objectives*	*Prevalence*
Ignore	None	Unrecognized	Weak	Widespread, but declining
Isolate	Peripheral	Unrecognized	Weak	Relatively limited, perhaps static
Idolize	Primary role	Limited recognition	Weak	Limited, probably growing
Integrate	Enabler	Central role recognized	Strong	Very limited, growth constrained

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B. NEWS AND EVENTS

Two African "Centres of Excellence"

The International Telecommunication Union, Nortel Networks and The Acacia Initiative of Canada's Inter-national Development Research Centre have announced their intent to provide solutions to the challenges of universal access and rural connectivity in Africa. Two African "Centres of Excellence" will be located in Nairobi, Kenya and Dakar, Senegal, and will focus on human resource development in the critical information and telecommunications sector, serving all countries of sub-Saharan Africa. (Source: *CIA*, August/ September 1999)

ITU looks to expand e-commerce in developing countries

The International Telecommunications Union (ITU) has teamed up with the World Trade Center and World Internet Secure Key to expand e-commerce in developing countries. Yoshio Utsumi, the ITU's secretary-general, has signed a trust fund partnership agreement with the president of the World Trade Center in Geneva and the president of World Internet Secure Key (WISeKey SA), with the specific aim of encouraging e-commerce in non-industrialized nations. (Source: *Newsletter* No. 19, 24 September 1999, UNESCO Observatory on the Information Society),
http://www.unesco.org/webworld/observatory

ITU endorses multiple 3G

The International Telecommunications Union (ITU) has decided to avoid a standards battle over third generation (3G) wireless communications technologies by endorsing multiple technologies.

The ITU has left the issue in the hands of wireless operators worldwide to come to a mutual agreement that could result in a single set of worldwide standards.

The battle over which technologies will make up 3G systems has pitted US wireless companies against their European counterparts resulting in a standards struggle.

The ITU has decided that "a number of radio interfaces is therefore needed to encourage rapid deployment of IMT-2000 services globally". (Source: *Electronics Weekly*, 24 March 1999)

European network runs 1,000 Tbits/s

A European data network capable of carrying over 1,000 terabits/s will be operational in May next year.

The network which is being launched by i-21 Future Communication, a subsidiary of Interoute Telecommunications, will connect 17 European countries using over eight million kilometres of optical fibre.

Alcatel is the main contractor for the network which will use dense wave division multiplexing (DWDM) technology and be 90 per cent complete by the end of 2000.

The network contains 192 fibre pairs and it is anticipated that up to 160 light channels will be available on each pair running at 10 Gbits/s. This means each duct will carry more than 300 terabits and five ducts will eventually be available in the network.

Managed bandwidth and IP-based services will be offered. (Source: *Electronics Weekly*, 7 July 1999)

Beam us up: telemedicine at work

It is easier to move information around than seriously ill people, or doctors. It is also cheaper. With this in mind, UNESCO and the European Union have thrown their weight behind a project that could revolutionize health care for people living in isolated areas such as islands, rural zones and in crisis situations.

Basically, this project—known as TeleInVivo—involves the development of a lightweight, transportable telemedicine workstation containing an ultrasound device plus computing and telecommunication capabilities. This workstation will be capable of scanning patients and transmitting the three-dimensional data to another medical specialist who could virtually be anywhere in the world. The doctors carrying out the scan and receiving the data will be linked online and able to "read" the images and make their diagnosis without any time lag.

This means, for example, women in isolated areas requiring urgent gynaecological or obstetric treatment or patients suffering form abdominal problems, or people injured in war zones or requiring surgery, could be diagnosed more accurately and treated far more quickly and efficiently. (Source: *UNESCO Sources*, No. 114, July-August 1999)

Internet for all

The United States has launched an "Internet for Economic Development" initiative to encourage Internet access in 10 developing countries, including Egypt, Morocco, Ghana, Guinea, Uganda, South Africa and Mozambique.

The initiative seeks to provide regulatory and technical advice and training to assist in creating an attractive, pro-competitive environment where the Internet can flourish. It also aims to mobilize multinational organizations, NGOs and the private sector to help spur the deployment of an advanced information infrastructure to remote areas.

In addition it will provide e-commerce training to local regulators, entrepreneurs, and artisans to foster the deployment of specific Internet applications such as e-commerce, telemedicine, distance education and improved access to government services.

The plan is promoted as part of a broad effort by the US to foster development of the information industry worldwide. The World Bank will be an active partner. (Source: *CIA*, August/September 1999)

French-led global sub-cable provides connectivity in Asia

France Telecom announced that Sea-Me-We 3, the world's longest submarine cable network, is commercially available. The European telecom giant was the initiator and one of the principal sponsors of the project, which was launched in 1997 by a consortium of 92 international telecommunications operators. The service launch covers segments linking Singapore to southern China, Australia and Europe, transiting via India and the Middle East. Spurs extending to Japan and Shanghai will enter service in September and November 1999, respectively. The Sea-Me-We 3 system stretches nearly 40,000 km to link 33 countries on four continents: Europe, Africa, Asia and Australia. According to French Telecom, the 39 landing points provide unprecedented connectivity, making a new communications resource available to about three-quarters of the world's population, around 4 billion people. (Source: *Newsletter* No. 16, 3 September 1999, UNESCO Observatory on the Information Society),
http://www.unesco.org/webworld/observatory

PCB body continues lead free campaign

The PCB industry has failed in its bid to delay the proposed European ban on lead in solder, but it is not giving up the fight.

The waste from electrical and electronic equipment (WEEE) directive is expected to take effect in 2004 and the recently released third draft still includes plans to ban lead.

What really concerns the EC is the problem of lead in landfill sites. What the industry is lobbying for is the dumping of scrap electronic products in landfills to be illegal from 2004 but for the ban on lead in the products to be delayed until a globally acceptable alternative is agreed. (Extracted from *Electronics Weekly*, 1 September 1999)

Research into smart recycling approach

Researchers at Brunel University have been investigating the use of smart materials to ease disassembly at the end of a product's life cycle.

The work so far has revolved around shape memory alloys and shape memory polymers. These smart materials can be deformed but when subjected to a trigger temperature, will revert back to their original shape. This means fasteners release their grip at the trigger temperature and actuators force pieces apart.

Using this technology could have an influence on the cost of dismantling equipment, an important factor when the EC's directive on waste from electrical and electronic equipment comes into force. This will make manufacturers responsible for products at the end of their life.

The work has already attracted industry attention, according to Professor Eric Billet, pro vice chancellor at Brunel University. Nokia's mobile phones have already undergone preliminary work. (Source: *Electronics Weekly*, 8 September 1999)

Search engines can't keep up

The amount of information on the World Wide Web is outstripping the ability of search engines to index it, according to a new study.

There are about 800 million publicly available pages on the Web, but even the best search engines index only about 16 per cent of them. Two years ago, the best engines indexed a third of the 320 million pages that were on the Web.

Steve Lawrence and C. Lee Giles of the NEC Research Institute in Princeton, New Jersey, arrived at their estimate of the size of the Web by sampling all possible Internet addresses to see which ones actually represented servers, then sampling servers to see how much information was available. They found 2.8 million servers with an average of 289 publicly available pages each.

But when they submitted test queries to the 11 most popular search engines, they found that the vast majority of pages out there simply did not show up. The news is a little better if you conduct a metasearch, submitting the same query to as many different search engines as possible. Together, they cover about 43 per cent of the Web.

The average time between a new page going up and the time it shows up on a search engine is six months, the pair report.

Some hope that a new Web language using metatags, which show what kind of information each page contains, will make indexing easier. However, the researchers found that only 34 per cent of all pages use the simple metatags that are already available, making it unlikely that many will trouble to use the more complex language.

The good news for scientists is that only about 6 per cent of the material on the Web is scientific. Since that is only about 4.8 million pages, it is conceivable that a specialized search engine could maintain a complete index of all the science information out there, say the researchers. (Source: *New Scientist*, 10 July 1999)

A wireless-wide web?

Thanks to Novel wireless data technology, Internet Service Providers can offer high-speed Internet access straight to customers' homes or businesses, without relying on phone or cable companies for the elusive "last mile".

Since mid-April, privately held Rooftop Communications Corp. in Mountain View, CA has been selling so-called Internet radios that deliver one megabit per second of wireless bandwidth. About the size of an external modem, the radio connects to a 12-inch-long roof antenna. As soon as the device is switched on, it searches the surrounding area and communicates with other similar devices. Each radio is simultaneously a receiver, a transmitter, and a router that can forward traffic to other radios or to the ISP's Internet backbone.

Other companies, such as WinStar Communications Inc. and Teligent Inc., offer high-speed wireless data services. But they follow an expensive cellular model, in which each radio maintains line-of-sight contact with a base station. In contrast, Rooftop's operating system lets the ISP start from a tiny base and add antennas only as needed. "It's a self-configuring network that scales beautifully", says Robert W. Lucky, vice-president of applied research at Telcordia Technologies (formerly Bellcore) in Morristown, N.J. "You don't need central control. You don't need a common carrier." Rooftop charges $2,000 for radios with a six-mile range. But since the devices operate in the unlicensed 2.4-gigahertz band, ISPs save on costly spectrum licenses. (Source: *Industry Week*, 25 May 1999)

Internet users heading for the half-billion mark

Here are some facts about the growth of the Internet since its origins in a laboratory test in 1969: there are an estimated 183 million users of the Internet today, with access to around 800 million pages of data. The number of users is likely to top half a billion users by 2003.

- In 14 countries, 40 per cent of the population will be online by 2003. Together they will account for 50 per cent of the world economy.
- At present, there are 44 million European users on the Net. The online population should reach 170 million over the next four years, outstripping the US tally for the first time.
- Online commerce conducted over the World Wide Web will top a trillion dollars by 2003.
- A quarter of retail stocks on Wall Street are already traded on the Net.
- Internet companies lured 3.5 billion dollars in venture capital last year, an increase of 67 per cent over 1997.

(Source: *Newsletter* No. 18, 17 September 1999, UNESCO Observatory on the Information Society) http://www.unesco.org/webworld/observatory

IT Institute

IBM has created a $29 million deep computing institute at Westchester, NY. It will focus on super computer-scale processing initiatives that combine massive computation and sophisticated software algorithms to tackle problems unsolved by traditional information technology. Deep computing techniques include optimization, simulation, visualization, and advanced pattern matching and discovery. IBM says it considers deep computing a primary technology trend driving the next stage of e-business. (Source: *Chemical Week*, 9 June 1999)

Laptop phone promises speedier transmission

A satellite communications system due for launch in August may spell further trouble for Iridium, the global satellite telephone company which has been struggling to attract subscribers since its launch last year.

Inmarsat, the maritime satellite communications organization, is to launch a laptop-style satellite phone unit that can send or receive data at ISDN speeds—64 kilobits per second—from anywhere in the world except the polar icecaps. This compares with the 2.4K data rate possible with the Iridium phone network.

When Iridium was conceived by Motorla in 1987, PC modems were just reaching 2.4K speeds, so Iridium's data speed was set at that level, but with modems now routinely handling up to 56K, 2.4K is painfully slow and one quarter the speed of a GSM cellphone.

Iridium's hand-held receiver works like a cellphone, continually switching from one low Earth orbit satellite to another as they come over the horizon and pass overhead. The company's $2 billion satellite service was ready by November 1998, but has been slow to take off, with only around 10,000 subscribers worldwide. In the US, Iridium is already promising price cuts.

Unlike Iridium's phone, which looks and handles like a large cellphone, Inmarsat's Global Area Network terminal has to be pointed at a geostationary satellite using a compass built into the laptop. Inmarsat says it will be fast enough to send and receive videophone pictures. High-quality video can be transmitted slowly, stored at the receiver and then replayed at normal speed—so it should be a boon for TV news crews. (Source: *New Scientist*, 3 July 1999)

Computer viruses are getting nastier

A rogue program that destroyed computer files all over the world recently and forced thousands of companies to shut down their e-mail systems could have been written by a novice. Experts say that the virus, dubbed ExploreZip, continues a disturbing trend towards more infectious and damaging viruses.

ExploreZip was written in a high-level computing language called Delphi. But its author may not have been an expert programmer, says virus expert Simon Shepherd of Bradford University. "Point and click" software could have allowed a relative novice to create a virus that combines some of the nastier features of several of its predecessors, he says. "They can download a virus construction kit from the Internet."

ExploreZip reproduces by e-mailing itself. This feature allows viruses to spread rapidly—the most prominent example being Melissa, the virus that earlier this year set new records for its rapid transmission. But ExploreZip is far more malicious than Melissa. While Melissa is a relatively innocuous "macro" program hidden in a Microsoft Word document attached to an e-mail, ExploreZip arrives as an e-mail attachment called ZIPPED_FILES.EXE, giving it the appearance of a compressed file. When the user tries to open it, ExploreZip gives a false error message, pretending that the file cannot be read. Instead, it has secretly installed itself onto the user's hard drive.

It then starts searching the hard drive, or any network drives the host computer has access to for files created by Microsoft's Word, Powerpoint and Excel programs, as well as any files written in the C programming language. It replaces them with files containing no data. Deleted files can usually be retrieved, but overwritten files are much more difficult, if not impossible, to rescue.

ExploreZip also employs some trickery to lull its intended victims into a false sense of security. Rather than sending itself to the first 50 people in the user's e-mail address book, as Melissa did, ExploreZip replies to e-mails in the user's inbox. While many people are wary of opening files attached to unsolicited e-mails, they may relax if they think they are dealing with a reply to a genuine message. (Source: *New Scientist*, 19 June 1999)

Global phones

The next generation of mobile phones looks likely to use a single, global technology. Currently, different systems are used in different parts of the world, such as the Global Mobile System that is predominant in Europe but nevertheless incompatible with two of the US standards. Nine major phone companies, including AT&T and British Telecom, have agreed to work together to produce a Universal Mobile Telephone System (UMTS). This move is the first positive step towards a truly universal standard, as there were fears that UMTS would be less than universal despite its name. The new standard will also cover wireless video and Internet services. (Source: *New Scientist*, 19 June 1999) www.newscientist.com

Packet in

There has been much talk recently about congestion of the telecommunications networks and the strain they are under with the increase in traffic. A large part of the reason for the boom is due to the rising amount of data being sent along the wires, mainly from the ever increasing popularity of the Internet. BT said last year that over 50 per cent of its traffic is now data.

The problem is only going to get worse. According to some telecoms market experts data traffic on the world's networks as generated by e-mails and Internet usage is growing at over 36 per cent a year.

"In five to ten years there will be as many Internet addresses as people in the world", proclaimed Dr. Robert Martin, v-p and chief technical officer of Lucent Technologies' Bell Laboratories.

Martin believes that the Internet today tends to be slow, unreliable and prone to failure. "It's not the sort of network we need in the future. The next generation of networks will be much, much more than the Internet." And according to Martin the future networks will be based on packet switched circuits with the dominant protocol almost certainly being IP (Internet protocol) rather than ATM (asynchronous transfer mode).

The main claims being made for VoIP is the cost savings and extra services that can be offered to users.

The system allows users to take control of which network is used for each call so that the most cost effective route is used simply by dialling the appropriate access number.

Users can also have access to such services as caller ID, call waiting and diversion.

Corporations are the main proponents of the technology currently because they already have data networks and want to intensify their use.

The general public are being given a taste of the technology by Delta Three, a subsidiary of global telecommunications company RSL Communications. It launched what it claims is the first commercial voice over Internet service in Europe in May 1998. The system is based on an IP telephony platform, IPTC, developed by Ericsson Infocom Systems. Delta Three claims the system "dramatically cuts the cost of placing international calls from Western Europe to a range of worldwide destinations".

IPTC (Internet Protocol Telephony for Carriers) works by taking phone and fax calls which have originated in the public switched telephone network (PSTN) and switching them to the IPTC platform which carries them over the Internet to a node near their destination. The call is fed back into the PSTN for final connection. (Source: *Electronics Weekly*, 24 March 1999)

Challenges to the network: Internet for development[1]

What is so special about the Internet? The underlying technology, pricing, traffic flows and value flows. While it took the telephone close to seventy-five years to reach 50 million users, it has taken the World Wide Web (WWW) only four years to reach the same number, says a new report published by ITU in February 1999. On the supply side of the equation, the number of international carriers grew to more than 1,000 in 1998—but this is still a long way behind the estimated 17,000 Internet service providers that have mushroomed around the world.

Entitled *Challenges to the network: Internet for development*, the new report looks at the role of the Internet in economic and social development, with a focus on developing countries. It is the second report in the series, "Challenges to the network". The first was published in

[1] This report was prepared by a team of ITU staff and is available in English only at the price of CHF 100. Discounts are available for ITU Members and customers from least developed countries. To order your copy, please contact: "ITU Sales and Marketing Service. Place des Nations, CH-1211 Geneva 20 (Switzerland). Fax: +41 22 730 5194. e-mail: sales@itu.int".

September 1997 and highlighted the challenges the Internet poses to public telecommunication operators (PTO).

The new report's seven chapters deal with:

1. What is so special about the Internet?
2. Internet in developing countries
3. Internet for commerce
4. Internet for health
5. Internet for education
6. Internet for public telecommunication operators
7. To regulate or not to regulate?

A statistical annex to the report presents data on Internet development throughout the world (for example, the number of Internet hosts and their density, Internet access tariffs, estimated number of users in major economies). In addition, the report provides data on the status of the public telephone network, PC penetration and ISDN and data communications.

The following excerpts from the executive summary of the report give an overview of the situation today.

What can the Internet do for those regions of the world that have traditionally had only limited access to information and communication technologies? In theory, it can widen and enhance access in developing nations because it offers a relatively cheap, versatile and technically efficient service that complements standard telephony.

Furthermore, the Internet can allow businesses from developing nations to "leapfrog" into the development mainstream because Internet commerce will allow them to sell their wares and their services directly to customers. The Internet also offers considerable promise in facilitating the delivery of basic services, such as health and education, which are unevenly distributed at present. In this utopian view, the Internet is a way of levelling the playing-field and rendering less onerous the traditional disadvantages of the developing world. These include distance from markets, under-invested basic infrastructure and under-utilized capacity.

But how realistic is this viewpoint? As with other new technologies, the Internet has the potential to support development activities, but, at the same time, it poses serious challenges and threats to pre-existing institutions. Is there, for example, a possible "cost" of the Internet for PTOs of developing countries? In situations where resources are limited, are hospitals or schools in developing countries justified in paying for an Internet connection?

This report explores the current and likely impact of Internet development in a number of areas of social and economic concern, such as commerce, health and education. It also analyses the features that make the Internet different from existing communication services as well as its current diffusion status around the world. Finally, the report explores the Internet's potential impact on the PTOs of developing countries and highlights some of the regulatory challenges posed by the unique nature of this new and revolutionary technology.

Internet in developing countries

On a global scale, Internet growth has been little short of phenomenal. The network has increased from 213 host computers and several thousand users in August 1981 to more than 43 million Internet hosts by January 1999 (see figure 1, left chart), supporting an estimated 150 million Internet users. Perhaps even more impressive is the number of countries connected to the global network. From just over 20 in 1990, there were more than 200 nations connected by July 1998.

Though these figures are impressive, a closer look (see figure 1, right chart) reveals the great disparities in Internet hosts between high and low income regions. For example, there are more hosts in Finland than all of Latin America and the Caribbean, there are more hosts in three highly developed countries of the Asia-Pacific region (Australia, Japan and New Zealand) than all the other countries in the region combined and there are more hosts in New York than in all of Africa.

The majority of Internet hosts are in developed countries, suggesting that wealth and education are major factors driving Internet diffusion. Profiles of Internet users confirm that they are, on average, wealthy and educated as well as young, urban, and male.

What are the barriers to increased Internet usage? The precise ranking of different obstacles differs, according to the level of economic and social development, but users around the world are unanimous in finding the price of Internet access to be a major constraint. Internet access prices for end users can be broken down into three components: hardware/software, Internet access provision and telephone service charges. In relative terms, the costs to get connected are much higher in developing countries. While prices may not differ drastically in absolute terms, there is a large gap between high and low income countries when costs relative to per capita income are considered.

A shortage of infrastructure, notably of telephone lines, is a further big obstacle to increasing Internet access in developing countries. The high visibility of the Internet and the growing awareness of the importance of information and communication technology for socio-economic development is driving policy changes aimed at increasing the supply of telephone networks.

Countries are tackling this problem through a variety of options including granting incumbent operators more freedom to reinvest their earnings and attracting fresh investment from the private sector by selling shares in State-owned telephone companies, and/or by allowing new market entrants.

Internet for electronic commerce

The concept of electronic commerce (e-commerce) is not new. However, the rapid rise of the Internet has made the potential of e-commerce more promising. It is now widely stated that the Internet and e-commerce will transform traditional business and consumer life. By one estimate, Internet-based sales reached US$ 43 billion in 1998. Many analysts expect online business to be worth more than 300 billion early in the next decade while the more optimistic estimates range between 1 and 3 trillion. Growth rates are also expected to be particularly high in Asia (see Figure 2).

The Internet enhances the possibility for developing and emerging economies to participate in the emerging digital economy. Internet-based e-commerce is likely to promote economic growth and welfare in developing countries significantly. New export opportunities should attract new foreign and domestic investment and thereby enhance growth. Most large industrial companies in developing countries already use the Internet, and what is perhaps surprising is that a growing number of small and medium-sized firms are also becoming users.

Internet commerce has not penetrated all economic sectors equally. Sectors that were expected to grow by more than 150 per cent in 1998 include: computer hardware and software, real estate, publishing and information services, finance, and Internet services.

Tourism, which is an increasingly important source of growth for developing countries, also looks set to be boosted by e-commerce. Analysts estimate that the travel industry accounted for some 20 to 30 per cent of total online revenues in 1997. Online travel sales are expected to grow to almost US$ 9 billion by 2002. Financial services is another area of great potential growth in the online world and Internet banking is already available in many developing countries enabling customers to pay bills, check account balances, or transfer funds (see figure 3, right chart).

What does Internet commerce mean for firms? The benefits of e-commerce are certainly compelling. Internet commerce can substantially improve productivity by lowering transaction and production costs, facilitating market entry, improving customer service, extending geographical coverage and enabling a new potential source of revenue.

Although Internet commerce potential appears promising, many challenges still remain. Barriers to Internet commerce are to some extent the same as those for Internet use in general. But several of the challenges are specific to e-commerce, and they include the need for a legal and financial framework for Internet transactions and the provision of market access and trade logistics.

What steps should policy makers in developing countries take to ensure that the benefits of the Internet are as widely distributed as possible? Promote the industry, build infrastructure, expand access to infrastructure and services, promote growth of Internet access market, promote production of local content and stimulate usage. One way forward would be to provide reasonably priced access for schools, universities, libraries and other public service institutions. (Source: *ITU News*, May 1999)

Intelligent agent developments in knowledge management and information retrieval

The Web provides a window on the world of information, but at the same time there is a need to prevent users from being subjected to too much information and too much complexity. Intelligent agents provide a mechanism for this.

Intelligent agents are software packages which possess a degree of autonomy. Given a set of instructions by the user, they interact with resources on the Net, take certain decisions based on that interaction, and then return with the information required. There is no generally accepted definition of an agent, and a wide variety of software packages are referred to as such. They have been available in one form or another for at least the last five years, and have been employed in such diverse applications as air traffic control, complex automated manufacturing tasks, telecommunications network fault analysis and Web search engines.

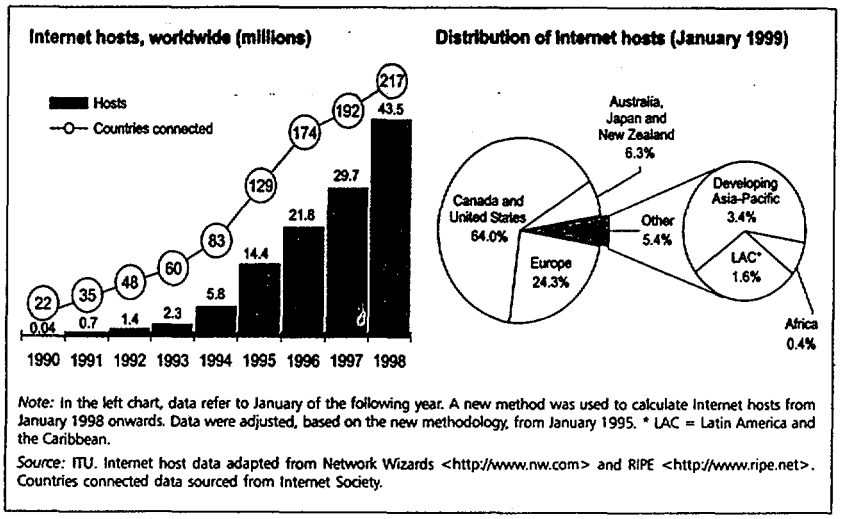
To be effective, an agent must perform three key functions: profiling (taking an enquiry), matching (exact match plus related items) and filtering (excluding irrelevant items). Various means are employed to undertake these functions. The traditional way of searching for information is to create an index or classification scheme. The latter suffers from the disadvantage that it requires a high level of manual intervention, but it is possible to generate indexes automatically, based on the content. A second approach is to employ vector space modelling (VSM), which in fact many Web search engines do. A third is to use neural network techniques. Other approaches include genetic algorithms and collaborative filtering.

Corporate users need to organize internally generated databases of information accessed via an intranet, but not those available in the outside world. A product such as the *CKI Company Briefing Pack* enables them to select and manage the quality of the material displayed on the end-user's desktop, whilst leaving the organization and maintenance of publicly available information to its publishers. (Source: *Business Information Review*, 16 (1) March 1999

Giants count the cost of great PC giveaway

PC retail prices in the US have fallen so fast in recent months, with Compaq shares e.g. plunging 44 per cent this year, that analysts are predicting that standard PCs will become little more than giveaway items in the next few years. Companies such as DirectWeb, NuAuction, Free-PC and PCFree all offer customers deals that hinge mainly on paying a monthly Internet-access fee but nothing for the PC. It is feared that the increasing miniaturisation and adaptability of microprocessors will mean other gadgets will prove to be far more popular and easier to use than PCs especially for Net access. For example, Sony's latest PlayStation costs about £250, and is faster and more powerful than any PC. Although designed to play video games, it can do far more and is highly popular.

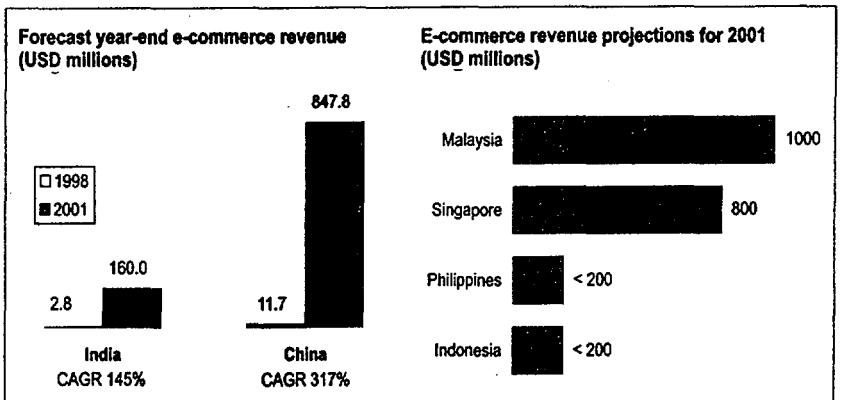
Compaq has been trying to add value to its PCs by moving into Web services—its PCs promote its AltaVista Web search engine, and Shopping.com, an online store bought in March. It is already providing 10,000 333 MHz Pressario PCs at around $600 each to Free-PC which, has received 1.25 million applications for a free computer.



Note: In the left chart, data refer to January of the following year. A new method was used to calculate Internet hosts from January 1998 onwards. Data were adjusted, based on the new methodology, from January 1995. * LAC = Latin America and the Caribbean.

Source: ITU. Internet host data adapted from Network Wizards <http://www.nw.com> and RIPE <http://www.ripe.net>. Countries connected data sourced from Internet Society.

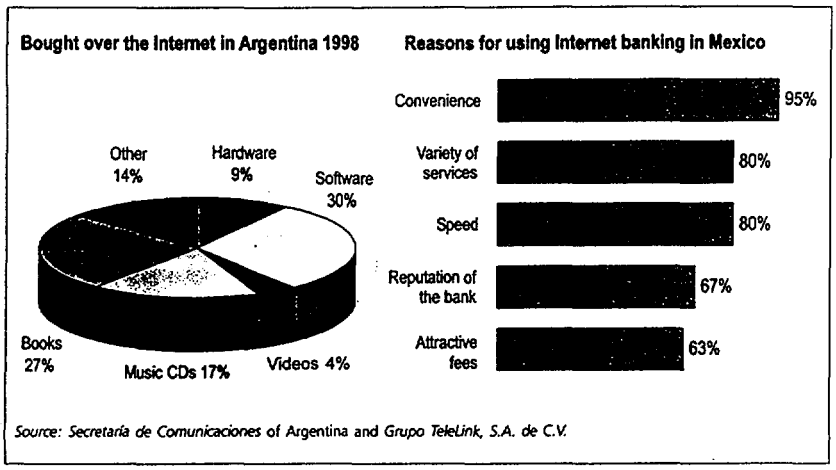
Figure 1 — Growing but still unequal (installed base of Internet hosts, January 1991–January 1999, and distribution by region, January 1999)



Note: IDC's revised projections for China's e-commerce revenues in 2002 total USD 1.87 billion, while the Republic of Korea is expected to generate USD 2 billion. CAGR = compounded annual growth rate.

Source: Left chart IDC, *Market forecast for Internet commerce*. Right chart IDC, as reported by *CommerceNet*.

Figure 2 — E-commerce revenue projections in Asia (1998 and 2001, selected countries)



Source: Secretaría de Comunicaciones of Argentina and *Grupo TeleLink, S.A. de C.V.*

Figure 3 — Online shopping in Argentina and online banking in Mexico (what people buy over the Internet in Argentina and why they use Internet banking in Mexico)

However Dell and other successful PC makers say Compaq's problems are not due to an industry slowdown but to its failure to cut costs and move away from retailers to direct marketing. In fact more than half of American homes have at least one PC, and PC shipments grew 14 per cent last year, although sales value rose just 1 per cent as prices fell. IBM expects an increasing proportion of sales and profits to come from selling its technology to other manufacturers and providing services to companies that prefer it to run their more critical and complex computer operations. Moreover, as the Net's capabilities expand and the bandwith provided by modems and transmission lines becomes ever broader, IBM foresees that many of the storage and computing functions of today's PC will be provided by its centralized servers communicating with ultra-simple home-based machines over the Net.

Finally, on the subject of giving away free PCs, David Stremba of Dataquest analysed Free-PC and One Stop Communications and decided they were not sustainable business models. Free-PC obliges customers to share personal information about their lives and buying habits, and give up half their hard drive and half the computer screen to advertising—as well as using the PC for at least 10 hours a month. One Stop obliges customers to spend at least $100 a month in online shopping. Downside is that advertisers are realizing that at least half of Net viewers do not look at the advertisements on their screen. According to Stremba, the more successful free PC companies are the ones offering a computer bundled with an Internet access service—e.g. Direct-Web which in return charges $19.95 a month for unlimited Internet access. The most realistic among the free PC companies is probably Gobi, which has multiple revenue streams from a monthly fee of $25.95 for three years, a signing up fee of $30, $45 shipping costs, as well as fees from advertising, a share of e-commerce transactions, and an extremely tough contract termination fee. (Source: *Sunday Times Business*, 25 April 1999)

Digital World Research Centre

Based at the University of Surrey (UK), the recently launched Digital World Research Centre (DWRC) enjoys support from a collection of commercial partners, including One2One, Orange, Cellnet and Vodafone. The Centre has a budget allocated from the University's Foundation Fund, and has also received funds from the DTI's Foresight Link panel, ICL, the Post Office, as well as form the mobile phone network companies who—along with Granada Media Services and Lionhead Games—are bankrolling the centre's mobile communications research project. This is called STEMPEC which stands for "the socio-technical shaping of multimedia personal communications".

The Centre's Research Projects include communications regulation, the paperless office, medical informatics and virtual self-organizing communities. Across the full research range its scientists will be conducting long-term studies designed to assess how people actually interact with digital devices. Much of this activity will consist of observing how people use mobile phones and personal digital assistants (PDAs) in their day-to-day lives.

The DWRC's projected work in the area of medical informatics is a good example since it will, providing it receives Government funding, look at the interaction of information consumers and digital appliances in a social context of some significance: the doctor-patient relationship. If the Government is serious about offering remote support to patients, then one of the problems they will have to face is that when you offer people the opportunity to receive medical information on the Web, there is currently very little understanding of how effectively people understand the information provided, or how they navigate through it. (Source: *Information World Review*, April 1999)

Who's afraid of big, bad bug?

Americans are taking the Millennium Bug very seriously, stockpiling cash and food in case of severe disruption.

A recent survey in the US found over half of respondents will withdraw cash in case banks foul up, while a quarter said they would stockpile food and water.

Electricity companies are also not trusted—21 per cent said they would buy a generator or extra batteries.

More than 40 per cent will avoid flying and 46 per cent will have a full tank of petrol going into the year 2000.

Over half of those questioned will be staying at home on New Year's Eve in case some disaster befalls them. (Source: *Electronics Weekly*, 7 July 1999)

ITU releases new report on regulatory issues for electronic commerce

The ITU has released a report on the role of national telecommunications policy makers and regulators in the development of electronic commerce. The report also reviews the possible role of the ITU in facilitating electronic commerce. The report, a product of the eight Regulatory Colloquium held at ITU Headquarters in Geneva last December, is designed to assist telecommunications regulators and policymakers, particularly in developing countries, in grappling the many issues they are confronted with as a result of the rapid uptake of e-commerce.

Participants agreed that electronic commerce carried the potential to bring great benefits and opportunities to individuals, businesses, and societies worldwide, and should therefore be encouraged in its fledgling development as much as possible. They underlined that the opportunities were particularly critical for developing countries, and for small and medium enterprises in all countries, as e-commerce could help reduce barriers and costs for many forms of global and domestic commerce. The Colloquium reached five key conclusions:

- Electronic Commerce is driven by market forces and technological change, not by regulation

- The Regulator's main role is mainly to assure open access to telecommunications
- New developments such as Internet telephony pose new challenges to the telecommunications regulator that need to be tackled by regulators such as the interconnection rights and obligations of various Internet players in relation to the public telephone network
- Many critical issues raised by e-commerce including intellectual property rights, taxation, dispute resolution and contract issues, fall outside the telecommunications' regulator's scope although they should endeavour to keep abreast of developments in the full range of policy issues and provide advice whenever necessary
- The ITU has an important role to play in e-commerce, largely within its current agenda.

The Colloquium took place from 14 to 16 December 1998 under the chairmanship of David Leive of Latham & Watkins. Funding was provided by The New ITU Association of Japan, the Infodev programme of the World Bank, and the Friedrich Ebert Foundation of Germany.

In each case, it sought to develop straightforward analyses and practical recommendations on how such matters should be addressed in an era of telecommunications deregulation.

Both the Chairman's Report of the Eighth Colloquium and the previous reports are available free of charge form the Strategic Planning Unit (by e-mail: *marianne.lathuille@itu/int* or by fax *+41 22 730 5817*). They are also available on the Internet on ITU Web Site at
http://www.itu.int/itudoc/osg/colloq/chai_rep/index.html.

For further information, please contact: Mr. David Leive, Latham &Watkins, Tel: +1 202 637 2200, Fax: +1 202 637 2201, e-mail: david.leive@lw.com (Source: *News release*, 13 July 1999)

Ernst & Young's Centre for Business Knowledge

Many have interpreted growing end-user access to information as a threat to the information profession, since it apparently eliminates the need for intermediaries. An alternative view, however, is that knowledge management may be best served within an environment embracing both "self service" and value added services.

In 1994, Ernst & Young introduced a new information management strategy, intended to lever the intellectual capital generated by an $11,000 million business employing 85,000 people. The strategy embraces content, processes, people, organisational structures, relationships, services and infrastructure. It is concerned with creating the processes which enable the company to collect and distribute both internal experience and externally-acquired information, to best advantage.

This strategy is implemented by the Centre for Business Knowledge (CBK). Within this, specialist teams are responsible for activities such as knowledge training, knowledge management, the sponsorship of knowledge networks within the various business units, the development and maintenance of the technological infrastructure, and the provision of research and analysis services.

The CBK incorporates both those responsible for deploying desktop services for end-users, and teams adding value to basic information. The former activity only became a reality following the deployment of Lotus *Notes* in 1995, and the introduction of *Reuters Business Alert* early in the following year. Since early in 1998, however, the company has become increasingly focused on delivery via the Internet/intranet. Professional staff involved in the handling of clients are supported by a three-tiered structure of navigation, research and analysis services.

Staff dealing with external clients, therefore, are supported by a combination of end-user desktop services and added-value, professional services. (Source: *Business Information Review*, 16 (1) March 1999)

The environment

Global environmental issues will continue to spur electronics industry innovations in 1999. Activities ranging from reducing greenhouse gas emissions, to developing strategies for taking back products, to reducing water use are receiving the go-aheads as a result of ever more international concerns.

Legislation set for enactment could radically alter how products are handled at the end of their lives, worldwide. A law passed in Japan mandates takeback of air conditioners, television sets, and large home appliances. The rest of the electronics industry is watching closely.

Motorola has already joined other electronics companies in setting up an infrastructure for taking back products in Switzerland, an activity Swiss law demanded of all electronics manufacturers in 1998. The Dutch also have legislation due to take effect in 1999, with the rest of western Europe being led by the Nordic countries and Germany. Meanwhile, the European Union's European Commission (EC) is planning to vote on adopting a directive that would eventually require product takeback in all the member countries.

Among other things, the directive stipulates that the EC's member states must "take the necessary measures to ensure that producers set up systems so that last holders and distributors can return end of life electrical and electronic equipment". Manufacturers are also held responsible for financing the collection system, which is to apply to all products, new and old.

Pending US legislation includes a regulation in Massachusetts that will prohibit cathode-ray tubes and products containing them from being disposed of in the waste stream, as of 1 July 1999, according to David Isaacs, director of environmental affairs for the Electronic Industries Alliance, in Arlington, VA. Florida is considering such legislation, and Minneapolis—St. Paul has designated used electronics as "household hazardous wastes".

Taiwan has taken an approach that tacks on a disposal fee when electronics gear is first sold to the consumer.

Despite the reliance on municipal waste recycling in the United States, there has been some move toward product takeback. Compaq, Dell, and Gateway are developing infrastructures for disassembling computers through contracts with third-party electronics remanufacturers. And IBM Corp., which has some 14 recycling facilities around the world, is operating the "largest electronics recycling setup in the world." The IBM Endicott, NY, facility accepts almost 14,000,000 kg of outdated electronic equipment traded in, returned at the end of leases, or sent from IBM's own facilities every year. It also accepts equipment from other manufacturers at no charge. Only 4 per cent of it ends up in landfill.

This year, the IBM centre hopes to form an industrial partnership in cooperation with the local municipal landfill. The goal is for enterprises in the Endicott area to pool their recyclable wastes in order to entice a recycling outfit to locate there. With a recycler nearby, area businesses would not have to pay to ship their wastes off-site, and waste resources could also be used by other businesses.

To facilitate the municipality-based approach to recycling, the US Department of Energy is in the initial stages of creating a National Electronics Recycling Center through its Oak Ridge National Laboratory in Tennessee.

Another option that manufacturers are considering is leasing their products, and taking them back at the end of the lease. Companies may refurbish them for resale, or reclaim valuable materials and dispose of the residue in an environmentally sensitive way. Xerox Corp., Stamford, CT, pioneered the concept with its copiers years ago. Last year Gateway Inc., North Sioux City, ND, and Dell Computer Corp., Austin, Texas, began to promote leasing for their personal computers.

Reducing water consumption, as ever, matters in the semiconductor industry, where a single fabrication facility uses millions of gallons of water each day. Here, chip fabricators are making headway by optimizing their rinse processes. Some of the gains to be realized in 1999 are the result of common sense improvements.

An industry goal is that 300-mm-diameter wafers use no more water than smaller wafers. Research has shown that out of concern for contamination, chip makers have used higher flow rates than necessary. It was found that water use could be reduced substantially during the idle cycle of the rinse.

Newer chip fab lines are also beginning to recycle rinse water. At the front end of the chip-making process, the rinse water is fairly clean and relatively easy to recycle. The waste water that is recycled is selectively collected only from fairly clean stations and tools. With good selection and purification methods, the end result may be better water than that originally supplied to the site. After water is used in the fab, it is channelled back into the water-conditioning system, where it is reconditioned by reverse osmosis. It then goes back into the fab process. Typically, Asian chip makers recycle 60-80 per cent of their process water, the technique is just at the point of being tried out in the United States.

Following the December 1997 Kyoto, Japan, summit meeting on global warming, most electronics companies are becoming even more aware of their greenhouse gas emissions. Now that the industry has all but eliminated its use of chlorofluorocarbons and hydrofluorocarbons (CFCs and HFCs), it is knuckling down to the challenge of reducing the amount of perfluoro-compounds (PFCs), used for cleaning reactor chambers and plasma etchers.

The US Bureau of the Census, Suitland, MD, reported that semiconductor fab energy use rose form about 8,100 GWh in 1994 to 8,400 GWh in 1995, and the US Environmental Protection Agency, Washington, D.C., is projecting a 50 per cent increase in overall semiconductor energy use by 2010.

To date, the semiconductor industry's efforts to increase its energy efficiency (and so indirectly reduce its carbon emissions) have focused on the energy expended per square centimetre of silicon.

A working example of the value of energy efficiency improvements is the Ang Mo Kio (AMK) fab operated in Singapore by ST Microelectronics SA, which is headquartered in St. Genis Pouilly, France. By making often quite simple changes—such as resizing electric motors so they run at optimum efficiency and removing unnecessary bends from pipes—the fab is already using just 0.5 kWh/cm^2 of silicon. (According to an EPA survey of 12 chip fabs, average energy use was 1.8 kWh/cm^2 of silicon.)

So far, general-purpose Design for the Environment software aimed at the semiconductor industry is limited, according to Duffin of Sematech. Most of it analyses the environmental costs incurred over a product's lifetime, from manufacture to disposal. In 1999, Sematech hopes that a beta version of software for determining the bottom-line cost of the chemicals used in semiconductor manufacturing, in terms of environmental safety and health, will be available. Being developed at Oregon State University in Corvallis under contract to Sematech, the software "looks promising".

The printed wiring board industry has been involved in two different EPA Design for the Environment projects that attempt to gauge the value of using cleaner technology substitutes. In 1999, a project will assess lead-free alternatives to the hot-air solder levelling process, which applies tin-lead solder to circuit boards before the assembly process.

The directive, which the European Commission is scheduled to vote on in early 1999, also mandates the phase-out of lead—as well as cadmium and mercury—from many electrical and electronic products by 1 January 2004. (Extracted from *IEEE Spectrum*, January 1999)

ITU releases its Year 2000 Guide for telecommunication operators

On 10 February 1999, the International Telecommunication Union released its Year 2000 Guide which seeks to provide telecommunication operators with a high-level overview of the process for dealing with the Year 2000 compliance problem.

Also known as ITU Y2K Guide, this first document draws heavily on the efforts and experience of members of ITU's Year 2000 Task Force established under the auspices of Study Group 2 of the Telecommunication Standardization Sector (ITU-T).

In his foreword to the Guide, Yoshio Utsumi, ITU's Secretary-General states that "the Year 2000 problem is unique in the history of the world in that it is a major, global challenge, created not by the force of nature, but by man himself".

Mr. Utsumi explains that in an effort to harness the most power out of the newly developing computing systems of their day by saving as much data storage space as possible, computer programmers developed a convention of shortening dates which seemed harmless enough at the time, but which has proved to be a very costly and difficult issue to address. As we all move inexorably towards a world economy based on information and the electronic storage and transmission of data, this is a timely and humbling lesson in man's vulnerability.

On the positive side, Mr. Utsumi said that the Year 2000 challenge has also demonstrated the strength of the human spirit in jointly tackling problems of a worldwide nature. In this regard, he praised the successful work of the Union's Year 2000 Task Force. This work has been conducted in an atmosphere of cooperation, mutual support and enthusiasm, not just between ITU's Telecommunication Development Bureau (BDT) and the Tele-communication Standardization Bureau (TSB), but also between these Bureaux and experts of the Task Force.

The Guide will supplement these activities and provide all countries, especially the developing ones, with practical advice on how to prepare their telecommunication infrastructure for the millennium change.

Clearly, the release of Y2K Guide a few months after the Minneapolis Plenipotentiary Conference last autumn (12 October-6 November 1998) shows that ITU is wasting no time in dealing with crucial issues affecting its constituents. It is worthwhile recalling that in Minneapolis the Union's supreme organ passed a resolution stressing the "urgent need for prompt action to address the Year 2000 problem". In particular, the resolution calls on ITU to give every possible encouragement and support to the efforts of telecommunication operators and carriers around the world to deal with this problem and prevent system failures at the turn of the century.

In a letter sent to all Member States and Sector Members of the Union along with the Y2K Guide, Mr. Utsumi called for a wide circulation of the Guide to those engaged in Year 2000 compliance projects. While much progress has been made to date, there is still much work to be done to successfully tackle the Year 2000 problem on a global scale.

"You may also wish to transmit the document to the coordinating agency of Year 2000 matters in your country and to other entities. The ITU will endeavour to bring to you more material on this subject in the near future", the Secretary-General concluded.

The Guide at a glance

Time-scales

Many large organizations had set December 1998 as the target for achieving compliance in a bid to secure business continuity for any contracts or services which are twelve months ahead (many operate with a financial year covering the period 1 April 1999-31 March 2000). This time-scale was intended to allow a full year for more testing of networks, systems and business processes.

However, if your organization has not yet fully started its Year 2000 compliance programme, or has commenced but is now looking for assistance to re-focus and speed up the process, the following tips should be kept in mind.

Keeping Y2K in perspective[2]

The approach you adopt should be driven by business criticality

Only those systems which have the potential to cause serious disruption to your business need to be examined in detail.

Whilst this is a serious issue which needs serious attention, bear in mind that most of the hype or scare stories, and quite a lot of more sensible material, comes from the Information Technology (IT)/Data Processing (DP) world. Do make sure that any advice you see is aimed at telecommunications and not re-cycled from the IT world.

Quite a lot of the underlying assumptions or background "facts" which originate from IT/DP just do not apply to the telecommunications world, or at least not in the same way.

The table below summarizes some of the more striking contrasts.

Identify the critical dates for your circumstances

These are dates which trigger (or might be expected to trigger) unusual or undesired operation(s). Typical examples are:

- 31 December 1999 and the roll-over to 1 January 2000: first occurrence of "00" year;
- 29 February 2000: the leap day, frequently not correctly implemented;
- 31 December 2000: day 366, again often not correctly implemented.

However, you need to review any list of dates carefully in the light of your own circumstances.

You must create your own inventory

Time spent creating an accurate inventory will be repaid many times over as the project evolves. It is worth considering:

- What level of detail is required before sending out the team which will undertake the audit;
- Giving some basic telecommunications awareness training to the audit team before sending them out.

[2] This section was prepared by Colin McEwen of Nortel Networks (Canada) for the ITU Year 2000 Task Force and updated in February 1999.

Avoid unnecessary changes to interfaces

Telecommunication interfaces are well standardized and evolve relatively slowly. It is critical to avoid unnecessary changes to interfaces so as to avoid network issues.

However, many real-time interfaces used in telecommunications only support limited date information, because the records concerned are rarely more than a few days old. This leads to an apparent conflict with compliance standards and with advice originating from the IT/DP world, where it is usual to recommend adoption of a 4-digit year. This point is addressed by the British Standards Institution (BSI).

Compliance/conformity definitions

The British Standards Institution document DISC PD2000-1:1998, "A Definition of Year 2000 Conformity Requirements" is available without charge, provided that the text is reproduced in full, the source acknowledged, and the reference number of the document quoted.

The online address is http://www.bsi.org.uk/bsi/disc/year 2000.html, or you can obtain the information from BSI Customer Services, 389 Chiswick High Road, London W4 4AL, United Kingdom.

Useful commentary, plus Frequently Asked Questions (FAQ), is contained in DISC PD2000-4 "Guidance and information on PD2000-1:1998", which is also available without charge on the same terms.

Appropriate and careful use of testing

Testing in a live environment needs to be approached very carefully. Quite a few networks cannot handle gross differences in dates between elements. For example, some client/server systems ignore clients with "wrong" dates.

Developing a Year 2000 plan

Typical phases of a Year 2000 project include: Inventory • Risk assessment • Impact analysis • Remedial action • Validation • Integration • Contingency planning.

Other considerations include: Insurance • Legal issues • Communications • Project Plan and Organization • Suppliers.

For more information on the Y2K Guide, please contact the members of the ITU Year 2000 Task Force: Ron Balls, ITU Year 2000 Task Force Chairman. Tel.: +44 171 843 8533; e-mail: ron.balls@bt.com; Tomas Nylund, ITU Year 2000 Task Force Vice-Chairman. Tel.: +46 8 713 3319; e-mail: Tomas.e.nylund @telia.se. Mick Heduan, Chairman, Year 2000 Sub-Group on Inter-Carrier Testing. Tel.: +44 181 587 6908; e-mail: mick.heduan@bt.com. Vishnumohan Calindi, Telecommunication Development Bureau. Tel.: +41 22 730 6073; e-mail: vishnu-mohan.calindi@itu.int. Zoltan J. Tar, Counsellor, Telecommunication Standardization Bureau. Tel.: +41 22 730 5887; e-mail: john.tar@itu.int

Information is also available on the ITU Y2K Web site at: http://www.itu.int/y2k (Source: *ITU News*, March 1999)

Table
Contrasts between the telecommunications and IT/DP

Topic or issue	*Telecommunications*	*IT/DP*
Downtime and crashes	Less than four minutes per year	Down once a week
Interfaces and formats	Rigorously standardized	Varied and frequently changed
Lifetime of software version	One year	Several years, sometimes many years
Downtime for upgrade installation	Zero, or a few minutes (the upgrade may take a weekend, but does not require loss of service)	Hours, or weekend
Expected date range (data)	Real-time (i.e. NOW), up to a few days or months; unusually a year or so	Tens of years, may well be more than one hundred years

Does mobile data comms spell bonanza for PC makers?

PC manufacturers have been searching for that elusive "killer application" for many years and some companies believe the industry may have found it in mobile data communications.

In the past the PC industry's attempt to boost sales has led them into dead-end applications such as video-conferencing and wireless LANs. But when a mobile phone supplier like Ericsson identifies mobile data as the next big application for PCs then the doubters start to listen.

The problem with video-conferencing and wireless LANs in the past was that there were not enough people outside the PC community convinced that the market was ready for the technology. What is different about mobile

data in 1999 is that everyone wants it to happen, and that includes mobile phone suppliers, operators, software developers, as well as the PC manufacturers.

Add to that the Internet bandwagon, and it would take a brave person to deny that mobile data communications will be the PC industry's next big driver application.

Ericsson was one of the founder members of the Symbian mobile computing joint venture, which also includes Psion, Nokia and Motorola. Symbian has been created to set-up the EPOC operating system developed initially by Psion, as the industry standard platform for wireless data applications such as mobile Internet, e-commerce and video services.

According to Ericsson, the mobile phone market will grow to include 800 million users by 2003. The argument is that if the rate of growth of internet usage is extrapolated into the wireless market, where a PC is connected to the mobile phone network, then mobile data communications from tiny handheld terminals will account for a significant proportion of those 800 million mobile phone users.

Microsoft has teamed up with mobile communications technology firm Qualcomm to develop a version of its Windows CE operating system for handheld communicators.

To support that Microsoft has joined with BT to develop and try out new mobile Internet services. It is the success or failure of those services which ultimately will determine whether mobile data will be the next "killer application" for the PC sector. (Source: *Electronics Weekly*, 17 March 1999)

Joint R&D pays off for Europe

Fifteen years of co-operative R&D in Europe has paid off in achieving 13 per cent world market share in semiconductors, said Jürgen Knorr, chairman of Medea, at the ISS Conference in Rome.

The 13 per cent figure was reached in the second quarter of '98, said Knorr. It has been as low as eight per cent in the last 20 years.

The large losses at the big vertically integrated companies means that the semiconductor industry faces a new challenge: to rethink its business vision, its product portfolio and its value chain.

Only by doing this can Europe reduce its current trade deficit in IT. By 2010, half of all workers in Germany will be working in IT.

According to Knorr, IT will offer the most jobs in Europe but only for those who are globally competitive: "We need to shortcut the transfer time from sciences to products especially for semiconductors." (Source: *Electronics Weekly*, 24 February 1999)

For those with fewer options

Technology may eventually allow some people that have no speech or control over limb movement to express themselves through computers.

For instance, Ferranti Technologies is producing an eye-mouse. This is a small head-worn device that can position a cursor on a computer screen by measuring the direction that the user is looking. The operator only needs control over eye movement and with a little practise can operate a computer.

Mind control is another active field. With training, many people can control their thoughts sufficiently to move a cursor using a machine that picks up potentials from the scalp surface.

Although it requires an immense amount of concentration initially, this technology may be the way to enable completely paralysed individuals to communicate.

At least one game already exists that uses non-movement changes in a finger, controlled by thinking, to affect a virtual skier. (Source: *Electronics Weekly*, 17 March 1999)

Serving up bandwidth

It happened with the drafting of the GSM mobile phone standard and it is now happening with UMTS.

The European inspired third generation mobile standard is currently in the throws of a patent row. Yet however severe the resulting turbulence becomes, the outcome is predictable: the various players will reach a compromise to avoid delaying a market which will benefit them all.

With the spotlight on the patent row, perhaps it is not surprising that little is being said about the business case for UMTS, the technology which could be driving Europe's mobile phones in the next three years or so.

Potentially, UMTS promises higher data rates over the cellular phone radio interface, including also mobile multimedia: "an Internet capability over the phone". And as is already happening with the Internet, and soon with digital TV, it is services such as home banking and home shopping that promise to secure the future of UMTS.

At first glance a mobile phone—with its inferior sound quality and limited data handling capabilities—has little to commend it as an Internet service platform.

"Mobile is likely to be a subset of the services", agrees Dr. Alastair Brydon of Nokia's UK business development unit. "But with a mobile you can receive the service anywhere and you can respond anywhere." In turn cellular networks will soon exploit "location knowledge", prompting your handset with local service information.

The mobile phone has another factor greatly in its favour. There are now 13 million subscribers in the UK alone, far exceeding the combined number of Internet-enabled PCs and early digital TV set-top box users.

Mobiles are not proposed as a replacement, but rather as a complementary technology for PCs and set-top boxes.

The challenge facing mobile phone makers like Nokia is to convince content providers that the mobile market is one worthy of their attention.

According to Brydon, Nokia is already working with operators, service content providers, Internet and interactive TV players to develop the mobile environment.

Moreover, content providers do not need to wait for UMTS before developing services.

And with enhancements such as high speed circuit switched data, general packet radio service (GPRS), and the wireless application protocol (WAP), GSM is evolving from a circuit switch network to a packet based one, amenable to handling Internet traffic.

So if GSM can deliver interactive services, why is UMTS so important? The answer, in a word, is bandwidth.

"The more bandwidth, the more sophisticated the multimedia", said Brydon. If the services are "big", there is a danger of swamping capacity on the radio side.

"UMTS addresses this in all dimensions: in the numbers of users it supports, the usage levels and the intensity of the applications." (Source: *Electronics Weekly*, 27 January 1999)

Pretty poor privacy may lurk inside processors

Civil liberties campaigners in the US want microchip maker Intel to abandon its plan to incorporate an electronic serial number in all its future microprocessors. The buried code would verify the identity of any computer in an online transaction—a move activists complain will compromise personal privacy. They say totalitarian states could use it to track down dissidents, and that corporations will quietly build consumer profiles—and this will lead to more spam.

Intel's Pentium III will be the first with a Processor Serial Number (PSN) hardwired into the chip. Intel originally wanted the number broadcast the moment you connected to the Internet, instantly confirming the identity of your computer. Spokesman Howard High says the idea was to make home shopping, online banking and other e-commerce transactions more secure.

But Intel changed its mind after protests and calls for a boycott from the American Civil Liberties Union and the Electronic Privacy Information Center.

Now Intel will make the ID facility optional—it will be permanently "off"—unless you decide otherwise, says High. But the serial number will still be buried deep in the chip's silicon.

Caspar Bowden, director of the Foundation for Information Policy Research in London, a think-tank that analyses IT issues, says: "Even if they provide a mechanism in software to disable the serial number, it still might be possible for websites and software managers only to grant access to sites if this ID feature is switched on." And there are worries that hackers might be able to ferret out the ID code and use it for their own ends. (Source: *New Scientist*, 6 February 1999)

Africa establishes a "Telecom Think Tank"

Concerned about the slow pace of development of Africa's telecommunications, African professionals working in the field of telecommunications have resolved to establish an "African Telecom Think Tank" as part of the efforts to improve the telecommunications infrastructure on the continent.

The group was established during the Africa Telecommunication Summit, a gathering of telecommunication experts across the world, held in Accra in March 1999.

The group adopted a constitution and a tentative action plan for 1999. The plan envisages the establishment of an Internet Web site for the group, and provision of support to regional bodies such as the Pan-African Telecommunications Union (PATU), and the Telecommunication Regulatory Association of Southern Africa (TRASA).

The group will work to produce periodical reports that will assist key players, in the private and public sectors of telecommunications in Africa, to take decisions that will favour and influence a more rapid development of telecommunications on the continent. (Source: *ITU News*, April 1999)

Computer Gibirish

First your 1.4-gigabyte hard drive became obsolete. Now the term gigabyte itself may be headed for the trash heap, to be replaced by the more precise "gibibyte".

Computer users currently employ the metric prefixes kilo- (1,000), mega- (1 million), and giga- (1 billion) to describe the number of bytes of a system's capacity, but computers actually crunch numbers in binary, so the number of bytes accumulates as a power of two, not 10. Therefore, a kilobyte is really 1,024 (2^{10}), not 1,000 bytes. Mega- and gigabytes are off by a slightly higher factor.

To be strictly scientific, "there was a need to straighten this out", says Barry Taylor of the National Institute of Standards and Technology in Gaithersburg, Maryland. As a result, in December 1998, the International Electrotechnical Commission voted to enthrone a new set of prefixes. That means replacing kilo with kibi, mega with mebi (2^{20}), and giga with gibi (2^{30}). (Source: *Science*, Vol. 283, 12 March 1999)

Firms prepared to invest heavily in GSM mobile phone technology

Extending current GSM mobile phone technology continues to be a focus for equipment makers and silicon vendors despite the need for huge investments to develop third generation mobile standards.

The importance of the Phase 2+ data extensions in securing GSM's longevity was a view widely held at the GSM World Congress.

What is exciting the DSP vendors is general packet radio service (GPRS), a multi-slot packet scheme allowing users to send and receive data at up to 115 kbit/s.

Beyond GPRS, the EDGE (enhanced data for GSM evolution) standard enabling data rates up to 384 kbit/s is also being developed.

EDGE is already being spoken of as an attractive alternative for operators who end up without a UMTS licence. (Extracted from *Electronics Weekly*, 3 March 1999)

Equipment suppliers "are too far advanced"

The semiconductor equipment industry has spent billions developing next generation machinery that will not be required for years.

That was the message that came out of the ISS Conference in Rome, organized by the semiconductor production equipment trade association SEMI.

With techniques like phase shift able to stretch 248 nm wavelength steppers—the present generation of machine—to handle the 0.15 µm generation, 193 nm steppers are not now required.

Intel is drawing effective gate lengths of 0.13 µm with 248 nm steppers on a production process which will last the company until 2002.

So equipment makers will see no return on the development costs of 193 nm steppers until 2002.

The same has happened with the move to the larger 300 mm wafer size.

SEMI set up a programme called i300 to take soundings of the device manufacturers. In December 1997, the director of that programme, George Lee, said: "We've talked to fourteen device manufacturers and six say they'll have twelve inch pilot lines in 1998." In fact there is only one: the Motorola/Siemens pilot line in Dresden. (Source: *Electronics Weekly*, 3 March 1999)

Internet domain name consultations

The World Intellectual Property Organization (WIPO) is trying to "develop recommendations, on the basis of international consensus, for the reform of intellectual property law and practice in relation to Internet Domain Names", it said in an announcement. In accordance with its mandate, worldwide consultations are taking place for the purpose of:

- Developing procedures to prevent disputes involving trademarks and domain names, as well as to develop uniform ways to resolve disputes that do occur;
- Assessing whether there is a need to give special protection to famous and well-known trademarks on the Internet; and
- Evaluating the potential effects on existing intellectual property rights of adding new generic top-level domains.

From September to November 1998, WIPO officials and the panel of international experts appointed to assist them held meetings in 11 countries around the world, with a second series of meetings in January and February 1999 in Toronto, Singapore, São Paulo, Dakar, Brussels, and Washington. These consultations will serve as the basis for WIPO's final recommendations to be submitted to the Internet Corporation for Assigned Names and Numbers (ICANN). (ICANN is the corporation that has been established to manage the Internet Domain Name System.)

According to WIPO, a common thread in the consultations so far has been "the desire for harmonization of international practices throughout the domain name system". In addition, broad interest was expressed in the development of new alternative dispute resolution mechanisms to supplement traditional litigation, which might include the creation of administrative dispute resolution panels.

These discussions have run in parallel with discussions on a dedicated WIPO interactive Web site (http://wipo2.wipo.int).

For further information, contact Lucinda Jones, consultant to the Electronic Commerce Section of WIPO. Tel.: (+41-22) 338-8138; fax: (+41-22) 740-3700; e-mail: lucinda.jones@wipo.int (Source: *World Intellectual Property Report*, January 1999)

IBM launches supercomputing institute

Hoping to spur the use of supercomputers in science and business, IBM has formed a virtual "deep computing" research centre that will seek to interact with outside scientists, starting with sharing the secrets to IBM software that turns enormous data sets into images.

Scientists use parallel processing supercomputers—some of which can perform trillions of operations per second—to tackle giant problems like the way a protein folds, how weather patterns shift, and the big bang. IBM announced it is putting its $29 million a year of supercomputing research under one virtual roof, called the Deep Computing Institute (DCI). Named after Deep Blue, the chess-playing program that defeated Grand Master Gary Kasparov, the institute wants "to take the modelling that scientists are used to and extend it to business decision-making", such as managing investment risk and scheduling airline routes, says William Pulleyblank, DCI's director.

The institute also wants to get academic scientists involved, starting with a Web site[3] where it has just released the source code to IBM Visualization Data Explorer—software for turning data crunched on a supercomputer into understandable pictures. The site will also offer other freebies, like IBM problem sets for testing algorithms, and DCI will sponsor scientific conferences. (Source: *Science*, Vol. 284, 4 June1999)

Who's reading your e-mails?

The European Union could force Internet providers and telecoms companies to build data taps into their Net servers to allow government security agencies to siphon off e-mails, monitor individuals' Web activity and check newsgroup memberships. Details of the proposals were uncovered by Caspar Bowden, director of the London-based Foundation for Information Policy Research.

The data taps or "interception interfaces" would apply to any future digital communications media, as well as to the Internet. The proposals are backed by the International Law Enforcement Telecommunications Seminar (ILETS), an organization which includes security agencies from 20 countries. The European Parliament threw out measures backed by ILETS in April, but this decision could be reversed on security grounds by ministers of EU member states when they meet this month.

Bowden says the proposal probably infringes the European Convention on Human Rights. Even if Net

[3] www.research.ibm.com/dci

users encrypt their e-mails, analysis programs can reveal a lot about someone's Internet usage. (Source: *New Scientist*, 8 May 1999)

WIPO Groups review progress of global IP Office Network

Three working groups of the World Intellectual Property Organization's Standing Committee on Information Technologies met in November 1998 to discuss the further development of a global information network—WIPONET—WIPO.

At their meeting in Geneva, the groups reviewed the network infrastructure requirements and tendering process, considered a proposal for a secure document-exchange pilot project, and reviewed progress made in the WIPO international IP database project, the Intellectual Property Digital Libraries.

The network is intended to provide electronic connectivity and data exchange between intellectual property offices worldwide, in a cost-effective, secure environment. Additionally, it is to serve as a vehicle for disseminating published intellectual property information to the public, universities, research and development institutions, and copyright users. WIPONET will use standard Internet protocols, services and industry standards "wherever possible".

WIPO member states endorsed the establishment of the network in March 1998 and allocated some 22 million Swiss francs in the 1998-1999 biennium towards its development. The initial pilot phase of the project is scheduled for completion in the second half of 1999, and full deployment of the system is expected "in the next 2 or 3 years", according to WIPO.

Each of the three working groups considered a number of matters relating to technical, operational and procedural aspects of the development of the global information network.

The Information Infrastructure Working Group reviewed the status of the tendering process for the project and the Secretariat's progress in establishing an inventory to assess technical requirements for providing offices with network services. The network will offer a "base level capability" to accommodate the broad variation of automation and access arrangements which exist within member states' offices, WIPO said.

The Information Security Working Group considered technical issues relating to information security, and reviewed a proposal for a pilot project to exchange secure, authenticated requests for priority documents via the network. The project will use digital certificates and digital signatures to make and acknowledge requests to transmit documents. Secure electronic exchange of priority documents would "significantly reduce the cost and resources" consumed by the process of producing, transmitting and receiving copies in paper form, WIPO stated.

The Standards and Documentation Working Group reviewed the progress made in developing the Intellectual Property Digital Libraries (IPDL) project. The prototype IPDL provided access to data concerning international applications published under the Patent Cooperation Treaty; in the second phase, the IPDL will provide access to two major sources of international data in the area of patents and trademarks. Further plans call for the IPDL databases to offer full text of international applications filed under the PCT, and to include IP collections hosted by member states. (Source: *World Intellectual Property Report*, January 1999)

Knowledge management and intranets

The use of intranets has come to dominate the management of information in many corporations. The technology is now so advanced that, not only is it affordable and easily accessible, but is also very easy to use. This has led to a haphazard approach in many organizations, where people have not grasped that an intranet will only be as good as the information on it; many companies are putting data up willy-nilly, with no thought to its management and retrieval, far less its real benefit to the company.

E-knowledge combines knowledge management techniques with Web technology, and careful thought before embarking on any such project will result in a far better working tool. The first step is to think about the selection of data to be published on the intranet, and how it will be of use to users. This should be followed by identification of the information "owners" and who will keep the information up to date. Only then should the technology be considered.

Structuring information is vital and requires careful thought beforehand; it is not just a case of selecting a particular search engine—although this is important, too. Information mapping is recommended as a means of encouraging information owners to produce documents that can be easily retrieved by others. The intranet is no good if people do not actually use it, so it must be marketed within the company. Creating awareness will also help encourage people to contribute and share information, often a major problem for knowledge management projects. Finally, it may be a good idea to use push and pull technologies to enhance the basic search function on the intranet. (Source: *Information Management & Technology*, 32(1), 1999)

UN launches Information Exchange on Eco-Society

The Information Exchange Programme on Eco-Society, which will provide human resources development assistance to African and Asian cities, was launched on 21 December 1998 at the Untied Nations in New York.

The programme, which is co-sponsored by the United Nations and the Tokyo Metropolitan Government, is a follow-up to the EcoPartnership Tokyo Conference last May. A new Web site is planned to provide an "organized road map" and "search engine" to link Web sites and information relevant to ecologically sustainable societies. The Web site will offer information on such topics as waste management, urban transformation, water re-use, rainwater use, energy saving, toxic waste

management and gender in ecologically sustainable development. (Source: *Tech Monitor*, March-April 1999)

Consider the source

In the 1990s, businesses became aware that it is cost effective to outsource certain non-core business tasks. In the document storage and access area, companies have turned to service companies for microfilming, document scanning, data capture, and keying. When considering this, the first step is to identify the requirement which may be for simple, long-term storage of paper documents; microfilming for occasional retrieval and long-term storage; or scanning and digital storage for active retrieval. Once there is cost justification for converting paper documents to electronic format, the decision whether or not to outsource has to be made. When selecting a bureau, it is important to follow guidelines. These are consideration of bureau location; services (mail sorting, scanning, data entry, indexing, data storage, microfilming, paper storage); skill sets; specification agreement; and references.

Other factors to be considered are pricing; security which includes environmental security, systems management, backup recovery, system access control, network access control, and security monitoring; standards (adoption of relevant BSI codes of practice); and extending bureau services. Perhaps the most important point is attention to detail. The customer must be involved with bureau service activity as this will only be as good as the information and assistance provided. It is important that the bureau understand the whole process, rules, and expected deliverables. They should be provided with adequate contact points within the business and progress should be monitored. It is concluded that, although selecting a bureau may seem to be a minefield, by following the guidelines proposed it should be possible to forge a long-term, mutually beneficial relationship with a bureau. Taking advice, obtaining samples, and doing a trial run will assist in the selection process. (Source: *Document Manager*, January/March 1999)

Internet2 warms up for switch on

The first section of the next generation Internet2 network is about to be switched on.

The coalition of 150 US university and research centres said that a key part of Internet2, the Abilene project, will begin operating, connecting 70 university campuses. The 13,000-mile private network will offer researchers a bandwidth of 2.4 Gbit/s—1,000 times faster than the traffic-clogged Internet.

Internet2 is designed to link researchers to enable them to swap supercomputer data and operate sophisticated research equipment remotely. It is required to overcome the traffic limitations on the Internet, which itself was once only used by universities and government research centres.

"One key technology that is being tested on Internet2 is differentiated services, which prioritizes packets of data", said John Patrick, vice-president of Internet Technology at IBM. "Packets that contain, say, real-time video, get priority over less essential packets carrying e-mail."

Differentiated services are essential to a range of business services, added Patrick. "While Internet2 is a private network, the technologies developed will quickly make their way into the general Internet. It will take just months rather than years to make the transition." (Source: *Electronics Weekly*, 17 February 1999)

I2: Internet's welcome sequel

Internet2 (I2) is the sequel to the blockbuster runaway hit called the Internet. It has been conceived by a coalition of universities, government institutions, and high-tech businesses. The goals of I2 are to take the Internet to the next level and give I2 members a new and more powerful way to share information and to communicate. Initially I2 will be a semi-private network, but once the technology has been developed it will be used to upgrade the existing Internet. With respect to legal information, the quick and easy sharing of any kind of information will mean that large, powerful databases can be created so that law offices will have new tools to control and manage legal costs. As of December 1998, e-commerce was the greatest and latest Internet activity. However, video cannot easily be transmitted; searching can be frustrating; and access speeds can be slow.

Internet2 aims to create the next generation of Internet computing infrastructure and related applications. Plans for this were first announced in October 1996, when 34 universities agreed to create a faster, more powerful network, primarily for academic purposes. Today I2 has over 100 university members and 7 corporate partners (Ameritech, MCI, Cisco, Sprint, DEC, Sun Microsystems, and IBM). The infrastructure and tools required are being developed by I2 members. Details of most of these developments can be found on Web sites. It is concluded that I2 is blazing a trail for the Internet of the future which will support high-speed interaction and new sophisticated and interactive applications. (Source: *Information Today*, 1999)

Documents in space: where GIS meets EDMS

Enterprise document management systems (EDMS) have been employed for a number of years as a means of integrating islands of documentation. Now, geographic information systems (GIS) provide an additional means of structuring data.

GIS products have long been available in academic and other specialized environments, but have now matured into affordable (under £1,000 per seat) systems for general business use. Web browser access can mean that users obtain visual representations of business data in new and more powerful formats.

A vector map such as the OS Land-Line can be overlaid with additional vector layers or "themes", and datasets from any ODBC-compliant database attached to form "attribute" layers on top of themes. As a result, corporate data can be analysed by spatial divisions. An example might be, how many customers live within one hour of a retail outlet?

EDMS and GIS technologies can now be used in conjunction with each other. At the simplest level, documents (plans, photographs, correspondence or legal deeds) can be displayed by clicking on a map location. More sophisticated implementations use standard COM interfaces to embed modules of one application within another, enabling the user to click on the map to obtain a list of documents to view or to click on a button within the document to view the associated map reference.

Reflex Information Management and Graphical Data Capture, for example, have integrated the Keyfile document management system with a MapInfo GIS for use within the planning department of Wycombe District Council. Tower Technology has developed a general-purpose system which links its own document management system to the ESRI *ArcView* package. (Source: *Information Management & Technology,* 32(2) 1999)

Information as an asset

There can be no effective corporate knowledge without good information management. The latter, however, can only come about if an organization appreciates that information is an asset, requiring to be managed like any other. Information management, moreover, needs to be led by the board of directors, which must make it absolutely clear what it requires.

The value of the company's information resources (plus other intangible assets) constitutes the difference between its balance sheet value and its market value. Good information management enhances market value by supporting consistency and innovation: bad information management undermines it.

In the UK, the Hawley Committee was established in 1994 in order to encourage the adoption of good information management practices. Amongst other activities, it published a list (the "Hawley Agenda") of ten items (seven for the organization, plus three specifically for the Board) which delineate the structure of a policy for information management.

This was followed by two Reviews, one for Board members, the other for management charged with implementing procedures. A project undertaken for the European Commission identified a dozen different approaches to assessing the monetary value of information. The latest project is the creation of an Information Health Index (IHI), which permits a simple score (based on the Hawley Agenda) to be determined for the health of a given organization's information management. Unless the organization achieves a reasonable IHI, it is unlikely to be able to gain real benefit from its information and knowledge assets. (Source: *Impact*, 2(3) March 1999)

Embedded systems could be biggest hassle for year 2000

There is less than one year to go before the dreaded millennium bug strikes.

If some media reports are to be believed, chaos will reign, economies will collapse and aircraft will fall out of the sky. All very unlikely (one hopes).

While banks, businesses and services try to sort out their data processing computers, many have overlooked their embedded real-time systems.

The problem is bad enough for even governments to realize that embedded systems are going to be the biggest problem in the remaining 12 months.

Colin Walls at Microtec has given some insight into the various dates that might cause a problem.

"A two digit date alone is not a guarantee of a problem," Walls said. A two digit year can be safe if, for example, the century is assumed to be 19 when the year is greater than 50 and 20 if the year is less than 50.

"Systems could also have died at the end of last year", pointed out Walls. The number 99 is often used as an end of file marker or error code.

Other errors may be experienced by systems using an old Digital Equipment technique of representing the year in five bit starting in 1972. This would run out of space in 2004—the Y2.004K problem.

"And there's a whole bunch of other formats that will die at various times through the next millennium", said Walls.

In 2038, the Unix signed 32-bit timer rolls over, as does the time_t format in C. And 2040 is the end of the world as far as Apple Macs are concerned, said Walls.

Another problem comes much sooner. Hot on the heels of the year 2000, the first major problem will be the leap year.

The leap year is not a trivial problem. A year divisible by four is a leap year, unless it is a new century. But new centuries are a leap year, if the year is divisible by 400. Therefore, 2000 is a leap year—1900 and 2100 are not.

"Smart programmers may have put code in to deal with this", Walls said, but even then some may have made mistakes. "There is an RTOS where the code was done smart, but there was an error. After February 28, the date will move to March 0."

Finding out whether your embedded code has a date problem is going to be tricky in most cases.

Walls believes that if a system is likely to have a problem, the only way to find out for sure is to read through the code manually. (Source: *Electronics Weekly*, 6 January 1999)

Harmony in mobiles

Mobile phone operators from around the world have agreed on a single harmonized standard for third generation mobile phones.

The proposal for a single framework of technical standards was submitted recently to the International Telecommunications Union. This is based on wideband-CDMA technology.

Various organizations including the UMTS Forum and firms such as Ericsson have welcomed the proposal, which outlines three modes of operation for third generation phones, that combine both W-CDMA and cdma2000 technologies. (Source: *Electronics Weekly*, 9 June 1999)

C. NEW DEVELOPMENTS

These chips are wired from within

Transistors get smaller and smaller, yet chips grow ever larger. Connecting all those switches takes a maze of wires, and their complexity is growing faster than transistors are shrinking.

Researchers at Hewlett-Packard Laboratories and the University of California at Los Angeles (UCLA) are developing a way for chips to wire themselves. They envision chips that chemically assemble themselves from conductive molecules and tiny carbon-nanotube wires.

In the 16 July issue of *Science*, the team describes its first success: a so-called logic gate that self-assembled from special molecules designed by J. Fraser Stoddart, a UCLA chemist. To simplify laboratory experiments, the molecules are sandwiched between big metal electrodes. While the prototype gate has millions of molecules, future versions will need no more than a dozen. The next goal is self-assembled nanowires. The result could be chips 1,000 times more powerful than today's—and microprocessors smaller than pinheads. (Source: *Business Week*, 26 July 1999)

Optical disk stores 80 hours of video

Forty digital video films could be stored on a single disk using optical storage technology being developed in Japan.

The disk, with a potential storage capacity of 200 Gbytes, has been developed by Japanese government researchers working with Sharp. This compares with DVD disks that store 4.7 Gbytes of data.

Each 12-inch disk could store as many as 40 two-hour digital movies. The researchers said they will work with other Japanese electronics firms to produce commercial versions of the technology that will be available in two to three years.

But the future market for such devices is in doubt because of rapid advances in hard drive storage systems and multi-layer DVD disks that will have data storage capacities of as much as 15 Gbytes of data. Also, the large size of the disks will limit applications. (Source: *Electronics Weekly*, 1 September 1999)

G4 PowerPC emerges with billion Flops rating

The AltiVec instruction set from Motorola and IBM has finally surfaced in Motorola's latest PowerPC processor.

The G4 processor will be able to sustain a billion floating point operations per second, which makes it around three times faster than a Pentium III, claims Apple. The Macintosh manufacturer is using the G4 in its latest line of PCs.

AltiVec instructions allow parallel processing of several floating point numbers, improving 3-D graphics and signal processing performance.

The single instruction, multiple data technique is similar to that used by Intel and AMD in their latest x86 processors, although AltiVec is more flexible.

A 500 MHz G4 Power Mac is expected to cost around $3,500 while slower versions will start at $1,600. (Source: *Electronics Weekly*, 8 September 1999)

Oven-ready nanospheres

A new technique for fabricating precisely engineered nanometer-scale spheres from silica, developed by researchers at Sandia National Laboratories (Albuquerque, NM) may have a broad range of applications extending from electronics to biotechnology. By mixing the silica with a surfactant and spraying the mixture through a furnace in a fine mist, the scientists were able to form nanospheres ranging in size from 2 nm to 50 nm. The approach also allows experimenters to vary the size of the pores on the surface of a sphere and to produce intricate structures such as nested spheres. "Individual spherical shells could also be designed to dissolve at a particular physiological pH", explains Jeff Brinker. In addition to providing precise delivery vehicles for drugs, the spheres might be used in biosensors or as cages to confine an enzymatic reaction. (Source: *Nature Biotechnology*, vol. 17, May 1999)

Solid gel sequencing?

Gel technology appears to be in for a dramatic change. A tiny silicon device honeycombed with microscopic channels could one day replace conventional polyacrylamide gels. Harold Craighead and Stephan Turner from Cornell University (NY) have used electron-beam lithography and materials processing tools to manufacture a silicon chip containing a miniature labyrinth of vertical pillars (100 nm thick and 100 nm apart), analogous to the molecular structure of a gel. By mounting the chip on a slide, the researchers used an optical microscope to monitor the movement (at certain electric fields) of four different fluorescent-labelled DNAs. Preliminary data suggest that shorter molecules are readily separated. The researchers are currently testing different lithographic geometries, including one that has openings of varying diameters ("speed bumps") that will sort DNA fragments by size. One such chip has enabled the Cornell team to separate phage T2 and T7 DNAs

within seconds. According to Craighead, the technique can also be extended to macromolecular protein separation. (Source: *Nature Biotechnology*, vol. 17, May 1999)

Project heralds in a new era of memory

A memory device that could replace DRAM, flash and possibly SRAM has been developed by Hitachi and Cambridge University researchers. Called PLEDM, or phase-state low electron-number drive memory, it is half the size of DRAM, yet is non-volatile and can be made as fast as SRAM.

PLED memory uses standard silicon processes to manufacture, in 10 per cent fewer steps than DRAM. Its similarity to CMOS makes it easier to integrate with logic.

In the position the MOSFET's gate would normally occupy sits the second PLED transistor, but stacked vertically. The drain is at the bottom, the source at the top, with its gate on the side.

Because the PLED transistor is vertical, it can be manufactured in place of the MOSFET's gate with standard silicon processing.

In a memory cell, the word line switches the gate, while the bit line is attached to the source.

When the transistor is switched off, electrons (or lack of) are trapped in the MOSFET's gate region, storing one or zero.

Each individual cell has a read/write time of 1 ns, but when integrated in a chip will have times of tens of nanoseconds—comparable to DRAM.

Moving to the PLED structure also eases manufacturing by removing the need for large capacitors to store the half million electrons in a DRAM cell.

As process technology gets smaller, the number of electrons/bit will continue to fall. At the 64 Gbit stage, in around 2010, PLEDMs will be using about 50 electrons/bit, while DRAM will still be at 10^5. (Source: *Electronics Weekly*, 26 May 1999)

Self-scanning LCD process claims to cut costs

The Sarnoff Research Center has developed an LCD manufacturing process that it claims cuts costs by almost one third.

Called self-scanned amorphous silicon display (SASID), the process cuts manufacturing costs by up to 30 per cent and improves interconnect reliability tenfold.

Sarnoff has begun licensing the technology and predicts that it will significantly lower LCD prices which have recently gone up with increasing demand.

A key advantage of SASID is that it can be implemented using standard AMLCD production lines. The technology is already being used in Europe and Taiwan, but Japanese LCD makers, who dominate the market, have yet to license it.

SADID reduces the number of wiring connections around the edge of the AMLCD screen by up to 95 per cent. The number of connections required for an SVGA (600 x 800) display drops from 3,000 to just 202 using SASID. (Source: *Electronic Weekly*, 26 May 1999)

Bell Labs switches on

Researchers at Bell Labs are developing an optical switch using micro-electromechanical systems (MEMS) based on tiny mirrors.

Bell Labs has developed a prototype MEMS device that uses a microscale pivoting bar with a gold plated mirror. The mirror is placed between two optical fibres. When the switch is off, the mirror is below the axis of the fibres. Applying a voltage to one end of the seesaw results in electrostatic forces raising the mirror, reflecting the light from the optical fibre.

The researchers say that the device could be used to produce a cheap wavelength add/drop multiplexer, enabling the addition of signals at various points on an optical data communications line.

The switch could be produced for as little as $1 per chip. (Source: *Electronics Weekly*, 26 May 1999)

Motorola gets high on low-k to quicken ICs

Motorola has developed a technique for combining copper interconnects with a low-k dielectric material which could dramatically increase IC speeds.

The company claims it is the first to fabricate multiple layers of metal separated by a porous material.

This has proven difficult because the honeycomb-like material has poor thermo-mechanical properties: heat is not readily conducted away and stress causes fractures.

Although it does not say how the integration is achieved, Motorola claims to have manufactured sections of a PowerPC processor and SRAM using the technique.

The researchers have used materials with a dielectric constant of between 2.0 and 2.5. In comparison, the SiO_2 used today has a k value of 3.9 to 4.2. This could halve chip delays due to interconnect, which at 0.18 μm and below dominate overall device speeds.

Stress levels in the new structures are said to be the same as those in copper/SiO_2 devices.

Bringing this R&D work to commercial production will take three years, the firm said. (Source: *Electronics Weekly*, 26 May 1999)

Samsung unveils super chip

Samsung Electronics Co. has developed 16 M synchronous static RAM, the highest-capacity memory chip so far for networks.

The latest of Samsung's SRAM line, which comes out half a year ahead of its competitors, features an operating speed of 150 Mhz, the highest among SRAM chips for networks.

Samsung, the world's No. 1 supplier of SRAM chips with a market share of 20.5 per cent, said it provided samples of the new product to leading network manufacturers, including Cisco. (Source: *Newsreview*, 26 June 1999)

More bits

Seagate Technology, Bloomington, MN, recently unveiled a new type of computer hard drive that boasts a storage density greater than 16 billion bits/sq in. Not only

is this a world record for density, but it also bests current models threefold. Making this possible is a giant magnetoresistive (GMR) read/write head and a disk made from an ultrasmooth alloy storage media. The prototype disk contained 380,000 data bits/in. stored along concentric tracks spaced 43,000/radial in. The GMR head, riding just 15 nanometers above the disk surface, was able to sense the smaller, more tightly packed data bits. To put such a high-density level in perspective, 2,500 copies of Homer's *Illiad* could reside in a thumbprint-sized space. More about GMR hard drives is posted on the company's Web site: www.seagate.com (Source: *Machine Design*, 3 June 1999)

Micro jets help chips chill

Keeping ICs cool is becoming a bigger problem these days as transistor counts and circuit densities skyrocket. Impinging-jet cooling may be the answer, say researchers from the University of California at Los Angeles. Using photolithographic techniques, the team recently built a silicon-micromachined (MEMS) heat exchanger atop a 2 cm^2, electrically heated IC (as might be used to simulate a microprocessor, for example). Embedded in the IC to monitor temperature were an 8 x 8 array of 4 μm^2 thermistors set on 500 μm centres.

Jet nozzles with circular openings sized 0.5 to 1 mm diameter were fabricated by fusion bonding two separate chips—one containing the nozzles and the other gas inlets. The nozzle assembly was then bonded to the IC surface forming a sandwich-like structure. The nozzle-to-surface spacing ranged from 100 to 3,000 4 μm.

Results of preliminary experiments showed that a single 0.5 mm diameter nozzle, run at a 5-psig supply pressure, lowered chip temperature 53 per cent (from 70° C to 33° C), and cooling rates rose when a nozzle array replaced the single unit. Moreover, boosting driver pressure (up to choked flow) cooled the chip even further but at the expense of efficiency.

The ongoing project is sponsored by Darpa. To find out more about MEMS heat exchangers, contact researcher Chih-Ming Ho at the University via e-mail: chihming@ucla.edu (Source: *Machine Design*, 3 June 1999)

Drawing a fine line

Researchers from Michigan State University and the University of Toronto have designed a nanometre-scale "fountain pen" that they say will be able to precisely deposit atoms on surfaces with a kind of pump. Although it is still a design proposal and not a prototype, they say that all the technologies necessary to make their instrument are currently in use.

If it can be made to work, the atomic pen could take over from fine line lithography in microchip manufacturing, allowing the dimensions of written features such as connecting wires and transistor contacts to move below today's micrometre-scale limits. It could also be used for atom-by-atom construction of micromachines.

Developments in nanotechnology are hampered by a lack of tools for handling parts on atomic and molecular scales. The best current method of atomic manipulation, which uses a scanning tunnelling microscope (STM) to move single atoms around a surface, is slow and laborious. But David Tomanek and Peter Kral estimate that their atomic pump, which could be preloaded with atoms, might deposit them on a surface at a rate of one every 15 microseconds.

The "ink cartridge" of the pump is made from a carbon nanotube—a sheet of carbon atoms rolled into a tube—and can be filled with whatever atoms are required. Two interfering laser beams, one with twice the frequency of the other, control the flow of atoms. The lasers hit the tube and generate electrons from the tube walls by a photo-electric effect. Interference between the laser beams moves the electrons along.

Building the instrument will be an exacting test, the researchers say. Any constrictions and defects in the nanotubes would have to be smoothed out to avoid blocking the flow of atoms. Moreover, the geometry of the tip will be important in ejecting atoms from the tube efficiently. The best design for this is still unknown. Heating effects may also cause a problem, since very-high-powered lasers will be needed to generate a useful current. (Source: *New Scientist*, 26 June 1999)

300 mm yields more

Infineon and Motorola have reached yields of 60 per cent at Semiconductor300, their joint pilot plant for 300 mm wafers.

However, yields of the 64Mbit test chips must exceed 80 per cent in order to achieve the 30 to 40 per cent cost savings expected by the firms.

Meanwhile, Intel has reactivated plans to start 300 mm wafer processing during 2002. A pilot line will be set up in Oregon next year, with full production a year later.

It will use copper interconnect on the 0.13 μm process employed at the fab.

Infineon, Motorola and Intel are not alone in planning a move to 300 mm wafers, with NEC and Samsung expecting to enter the fray in 2001. (Source: *Electronics Weekly*, 16 June 1999)

3-D camera has no lens

Lensless cameras, in which a computer does the job of the lens and digitally processes light to make an image, are taking shape in the laboratory. Since the days of Louis Daguerre, cameras have captured reality in two dimensions, but the lensless camera that a team of electrical engineers at the University of Illinois, Urbana-Champaign, makes the jump to three.

By bathing an object in ordinary light, rotating it on a stage, and recording the interference of thousands of pairs of light rays reflected from or transmitted through the object, the system builds up a 3-D representation and captures far more information than a hologram or stereo images. The "lens" responsible for this feat is a pair of mathematical algorithms, one borrowed from radio astronomy and the other from X-ray imaging.

The technique could capture cells and tissues in three dimensions and give depth to machine vision.

The technique grew out of a mathematical insight that joined two traditionally separate imaging tools. One, widely practised in radio astronomy, is interferometry, in which radio waves collected by separate dishes from the same point in the sky are allowed to interfere. The waves' interference can be translated into the position and intensity of their source, and combining interference data from many different points yields precise 2-D maps of quasars, supernovae, or galaxies. The other mathematical tool is tomography—the T in X-ray CT scans, which pinpoint the body's internal structures by analysing X-rays sent through the body along many different paths. (Extracted from *Science*, vol. 284, 25 June 1999)

Card code

Counterfeiting of cash and credit cards has become a major problem. As the technology of copying advances detection of forgeries becomes more difficult. In Britain credit card companies now lose about £100 million a year through counterfeiting. Security measures, such as magnetic strips and holograms have had limited success, so the search is on for better alternatives.

At Trinity College in Dublin the Polymer Development Centre is leading a £400,000 EU Craft programme funded project to develop a marking system based on fluorescent polymers. A fluorescent marker would remain invisible under ordinary light, but under a UV lamp the identifying code would glow, showing that the card is genuine.

In collaboration with the Polymer Development Centre, Athlone, Horcom, a TCD campus company, Nelipak, a plastics moulding company in Galway, Vinifer, a security marking company, and two German partners, the Polymer Research Centre plans to develop a range of suitable markers. According to the group "these materials must be washable, durable, and have a high stability to both light and temperature". Apart from credit cards the fluorescent markers are expected to protect other items, such as CDs, mobile phones and clothes.

More information from Dr. Robert Howard, Materials Ireland, Polymer Research Centre, TCD, Dublin 2. Tel.: 01 608 2401; e-mail: rghoward@tcd.ie (Source: *Technology Ireland*, January 1999)

Superconducting sensor provides more sensitive AC measurements

Engineers measure alternating current (AC) voltage current by using devices known as "thermal transfer standards", where the temperature of a structure is elevated in a well-defined and predictable fashion when electricity is applied. An unknown AC signal is applied to the device and the temperature rise is recorded. A known direct current (DC) signal is then applied and adjusted until the same temperature rise is reached. This establishes a comparison between the unknown AC and known DC signals. If the error in the transfer standard is known (a quantity calibrated by NIST) and if the DC signal is known, then the AC voltage or current can be determined.

Present thermal transfer standards operate at room temperature, and are limited by the performance of their temperature sensors and by other effects that can be reduced at very low temperatures. Therefore, a NIST research team designed and built a new prototype standard cooled with liquid helium that uses a much more sensitive, superconducting temperature sensor. The new device operates at temperatures below 10 Kelvin (-263° C or -441° C).

Because of its high sensitivity, the superconducting sensor runs at millionths of a watt, where conventional thermal-transfer devices may require more than a hundredth of a watt to operate. This reduction in operating temperature and power allows for comparisons at unprecedented low signal levels with a level of precision comparable to (and potentially better than) the best room temperature measurements.

For more information, contact Joseph R. Kinard, NIST, 100 Bureau Drive, Stop 8111, Gaithersburg, MD 20899-8111. Tel.: (301) 975-4250; e-mail joseph.kinard @nist.gov (Source: *NIST Update*, 4 January 1999)

Scientists define complex chemistry in chip-making devices

NIST scientists are among the first to identify and measure the types of ions generated from gases used to process computer chips in the inductively coupled plasma reactor, a device rapidly becoming a favourite of the semiconductor industry.

The inductively coupled plasma reactor, steadily replacing its capacitively coupled predecessor because of the higher-quality microchips it creates, might be made more efficient if the complex chemistry taking place inside was better understood. Such knowledge could enable engineers to design reactors that consume less electricity and lower quantities of the required gases, some of which may contribute to global warming.

Both reactors work by ionizing gases into plasmas and triggering a series of chemical reactions. Researchers suspected that the inductively coupled reactor produced a far more complex combination of ions than the capacitively coupled version, making it extremely difficult to predict reaction outcomes and formulate theoretical models needed to improve the new device.

NIST researchers have now confirmed that inductively coupled plasma reactors do indeed produce a complex brew of ions. They also identified the specific ions and measured their proportions. The findings were reported in two research papers delivered during recent scientific conferences.

The research also raised further questions, when under certain conditions, different results were obtained in two seemingly identical reactors at NIST and Sandia National Laboratories. This means there are parameters that have yet to be adequately quantified.

For more information, contact James K. Olthoff, NIST, 100 Bureau Drive, Stop 8113, Gaithersburg, MD 20899-8113. Tel: (301) 975-2431; e-mail james.olthoff@ nist.gov (Source: *NIST Update*, 4 January 1999)

Avalanche cold cathode

The cathode ray tube (CRT) seems still to have some tricks up its sleeve to beat off the advance of potential rivals.

CRTs continue to out-perform all comers when it comes to brightness and colour. Now the latest technology from Philips Display Components is claimed to improve picture quality even further.

"It can produce a smaller spot at higher brightness", said Fritz Gehring, responsible for the Phililps development. "This will give you a brighter, crisper picture."

What Gehring and his team have done is develop a semiconductor replacement for the hot cathode electron-emitter, which has featured in CRTs since they first appeared more than 100 years ago.

Philips is calling it ACC, for avalanche cold cathode. A conventional CRT cathode is a metal surface, coated and electrically heated to red hot to excite electrons within the material sufficiently to allow them to be pulled off by a local electric field.

These electrons are then focused, deflected and further accelerated, forming the electron beam that writes the picture on the phosphors at the front of the tube.

By modulating the local extraction field, the beam strength is altered to produce a greyscale in the image.

The ACC electron source works in a completely different way.

It consists of a buried diode junction, made just below the surface of a silicon chip.

The p-type material is biased negative, reverse-biasing the junction, but the voltage applied is high enough at 5 V to push electrons through the junction by Zener action.

These electrons, flowing from the p-type material, accelerate as they cross the barrier. Some have enough energy to escape from the material surface into the vacuum beyond.

"The junction is less than 1 μm below the surface and you get a lot of field strength", said Gehring. "With a single atom layer of caesium on the surface to lower the work function, we get between five and ten per cent of the electrons flowing through the junction emitted."

Adjusting the junction current varies the number of electrons emitted.

The electrons are "hot", flying out of the surface.

An electrostatic lens, made on the surface, forms the fleeing electrons into a beam where they can be deflected and further accelerated. For a colour display, three ACCs are needed. (Source: *Electronics Weekly*, 6 January 1999)

Sieves to separate hydrogen by mass

Computer simulations of carbon nanotubes have shown that it might be possible to separate hydrogen molecules of different masses using molecular sieves. This research was carried out by scientists at the University of Pittsburgh and Carnegie Mellon University, both in Pittsburgh, PA, United States of America.

The technique is based on the quantum mechanical uncertainty principle, which predicts that, because hydrogen is less massive than its tritium isotope, its position will be less well defined. This means that the probability of a molecule of hydrogen being inside the tube is smaller. These simulations show that this method should be able to remove tritium selectively, even when the concentration of tritium in the surrounding gas is very low.

The models were based on a combination of path integral formalism and grand canonical Monte Carlo techniques, and are believed to be the first application of these methods for studying adsorption. Most of the code was developed in Fortran by Qinyu Wang of the University of Pittsburgh. Simulations were performed on SGI workstations and Intel PCs running RedHat Linux.

Future plans include studies of different adsorbents and adsorbates, and the effects of temperature and pressure on selectivity for various mixtures. The physicists also hope to compare the results of the simulations with real experiments. If these results can be reproduced in practice, this technique could filter the radioactive "heavy water" from the cooling tanks of nuclear facilities. (Source: *Scientific Computing World*, February/March 1999)

AMD is hot with cooling system

Advanced Micro Devices (AMD) has demonstrated a PC running at 1 GHz using an innovative cooling system.

The prototype PC, called the Super-G, uses AMD's forthcoming K7 microprocessor cooled by a system from KryoTech. Cooling the microprocessor allows engineers to increase the clock speed without worrying about overheating the chip.

The Super-G cooling system uses a vapour phase refrigeration technology similar to that used in refrigerators.

KryoTech said it will ship Super-G PCs later this year and will release pricing information at a future date.

AMD competitor Intel has also demonstrated a 1 GHz PC but it is believed to have used liquid nitrogen rather than a commercial system to cool the processor. (Source: *Electronics Weekly*, 5 May 1999)

Switch gives NEC key to take quantum leap

NEC says that its laboratories have fabricated a key building block which will bring closer the advent of quantum computers.

Its new quantum switch can operate using much fewer electrons than current transitors. It is made with features ten times smaller than today's gate lengths and is fabricated in the form of a superconducting Josephson junction.

Whereas other researchers have sought quantum effects through the spin of a molecule or laser-cooled ions, NEC has produced a quantum device in a transistor-like form which makes it more easily handled.

Quantum switches can simultaneously represent more than one binary state, making them the ideal component for fuzzy computing but are extremely difficult to programme.

NEC says that a quantum computer consisting of 10,000 gates could perform in a few minutes an operation which would take a supercomputer five trillion years.

A particular application which quantum computers would be superb at is pattern recognition, a task at which current computers are poor.

Also, quantum computers would be ideal for cracking encryption codes which are based on finding extremely large primary numbers. In theory a quantum computer could try every number in an encryption string in one step.

The significance of NEC's development is that it can control the ability known as "superposition" for quantum devices, i.e. that it can control which state a quantum device—capable of existing in several states simultaneously—is currently in. (Source: *Electronics Weekly*, 5 May 1999)

Bell Labs improves on optical lithography limit

Flash memory with a minimum feature size of just 0.08 μm has been manufactured using conventional optical lithography by Bell Labs.

Researchers claim this is the smallest working device ever manufactured using optical lithography. Stepper manufacturers and semiconductor engineers believed optical techniques would reach a limit at 0.12 μm, or 120 nm.

The achievement could result in big savings for semiconductor makers, by not having to switch to new manufacturing technology.

To make the device, Bell Labs used a 193 nm laser in combination with phase shift masks. Photoresists were also developed to work with the shorter wavelength light.

The resulting flash storage cell has a floating gate measuring 80 x 160 nm.

Beyond the 193 nm used by Bell Labs, semiconductor manufacturers are looking towards extreme ultraviolet (EUV) lasers, ion-beam and electron-beam. (Source: *Electronics Weekly*, 5 May 1999)

Memory link-up leads to magnetic force for PCs

Siemens, Bosch and government laboratories in Germany are developing Magnetic RAMs (MRAMs) which could be the ideal memory—dense, non-volatile, fast to read and write, low power and with infinite read/write cycles. MRAMs can solve the increasing problem of the slow access times of hard disks.

It would eliminate boot-up time in PCs, allow much quicker downloading of material over the Internet and it could replace flash memory in mobile phones and portable computers.

One gigabit MRAMs are considered feasible with sub-10 mW power consumption and access times of 40/50 ns.

MRAMs are based on the same "spin electronics" technology used for giant magneto-resistive (GMR) heads in disk drives.

Although GMR is the technology initially pursued for MRAM, most researchers are now focusing on a related technology called tunnelling magnetic resistance (TMR). (Source: *Electronics Weekly*, 12 May 1999)

SiC doubles conductivity with germanium implants

Adding germanium to wafers of silicon carbide could make the high-temperature semiconductor useful in high-speed electronics, according to research carried out by a professor at the University of Delaware.

James Kolodzey found that adding small amounts of germanium (Ge) to wafers of silicon carbide (SiC) doubled the conductivity of the material.

Kolodzey implanted germanium atoms into the crystal lattice of an n-type SiC wafer using an ion implanter.

X-ray diffraction of the modified material showed that adding the Ge atoms had strained the crystal lattice, so an annealing process at 1,000° C was used to reduce the strain.

X-ray diffraction and spectroscopy showed that a 0.16 μm layer near the SiC surface contained around 1.2 per cent Ge. This small amount almost doubles the conductivity of the material compared with pure SiC.

This could make SiC, which doubles the useful temperature range over silicon, useable in a wider range of applications. These could include aircraft and automotive sensors and even mobile communication radio frequency circuits.

Unfortunately SiC is the third hardest substance after diamond and boron carbide, making it difficult and expensive to process. (Source: *Electronics Weekly*, 12 May 1999)

UK team plans silicon-based electroluminescent displays

Producing electroluminescent displays based on silicon is the goal of research at the University of Birmingham.

The University's nanoscale physics research laboratory has developed regular structures featuring silicon pillars several nanometers in size.

By carefully controlling the pillars' dimensions, the group believes it can affect the band-structure of silicon, enabling visible light to be produced with the application of a voltage.

The team is currently working to characterize the structures it is producing. It has yet to demonstrate visible light being emitted from the pillars. However, the team is confident that working light emitting samples will be produced. (Source: *Electronics Weekly*, 9 June 1999)

Toshiba serves up wafer-thin chipset

A chip package thinner than a business card has been developed by Toshiba. At 130 μm, the package is only slightly thicker than paper.

Dubbed the paper-thin package (PTP), the packaging reduces thickness of ICs to around a tenth of today's devices. The widely used thin small outline package (TSOP) is around 1.3 mm thick.

In order to thin down the packages, Toshiba had to reduce the thickness of the semiconductor die.

Technology originally developed for 300 mm wafers was used to shave chips down to 50 μm.

Because of the sheer size of 300 mm wafers, Toshiba found it needed to dice the chips before grinding—the opposite to conventional processing. The small dice can then be ground down much thinner than is possible with a whole wafer.

And at 50 μm, the chips are flexible, leading to a wider variety of applications such as labels for goods.

For large memory devices, chips can be stacked within the package. A stack of eight chips would raise package height to just 1 mm.

This technique could be used to increase the amount of memory placed in flash memory cards, used in digital cameras and laptop PCs. (Source: *Electronics Weekly*, 9 June 1999)

E-strands of life

DNA strands might someday be used as wires in computer chips and transistors, say researchers at the University of Basel in Switzerland. The researchers found that DNA conducts electricity as well as a good semiconductor (barring copper) and claim there is no metallic wires that can be made as small or as regular as DNA strands, which are 2 billionths of a metre thick, or one-forty-four-thousandth of the diameter of a medium-sized human hair. DNA strands might even be able to wire themselves together; molecules at the end of strands might link themselves to other molecules, making it possible to create a wiring grid by laying down target molecules as terminals and letting the DNA attach itself. (Source: *Communications of the ACM*, vol. 42, No. 6, June 1999)

Plastic pavement

Old computers may soon be part of the highway, not the information superhighway, but used as pothole filler for repairing roads. The State Department of Environmental Protection and the American Plastics Council are promoting the recycling and marketing of plastics from electronics. A lightweight, asphalt-type mix made with the plastic portions of computers, printers, paper trays and scanners has been developed by Coniglairo Industries, Framingham, MA, a company that processes up to 12.5 tons of computer and other plastic housing every day. (Source: *Communications of the ACM*, vol. 42, No. 6, June 1999)

Till death do we chat

Records of electronic communication,. a growing factor in high-profile corporate cases have begun showing up in divorce proceedings and custody proceedings nationwide, reports the *Washington Post*. Some legal scholars are concerned, saying the practice raises questions of privacy and fairness. But that has not stopped clients from going into lawyers' offices armed with printouts of e-mail messages retrieved from home PCs. Lawyers seeking to use incriminating e-mail argue that such evidence is valuable because, unlike witness testimony, it provides a firsthand record of the writers' feelings. But there is plenty of room for legal challenges. When spouses share a PC, for instance, messages can be written under the other's name, and existing files can be altered. Regardless, family lawyers say the use of electronic files in court will continue to grow; they advise caution when sending e-mail. (Source: *Communications of the ACM*, vol. 42, No. 6, June 1999)

BT pushes optical fibres to 80 Gbit/s

BT researchers have demonstrated what they claim is the world's fastest optical fibre signal regenerator operating at a speed of 80 Gbit/s. The regenerator is a photonic component which removes distortion and restores digital signals that have deteriorated as they travel down optical fibres. The fastest commercial regenerators currently available operate at 10 Gbit/s. Lucent Technologies spoke about a 20 Gbit/s all-optical regenerator in March. (Source: *Electronics Weekly*, 7 July 1999)

1 Gbit DRAM at the double

Samsung has announced it has developed a 1 Gbit DRAM that uses double data rate (DDR) signalling to clock data at 350 MHz.

Commercial samples will be available before the year end, the company said. The devices will go into high-end servers, mainframes and supercomputers from early next year.

In order to be able to manufacture the device in commercial quantities, the firm has gone to a 0.13 μm process. This, Samsung says, makes the die 30 to 40 per cent smaller than any other 1 Gbit chip.

The process will also be applied to existing 64- and 256 Mbit chips, reducing size and cost. (Source: *Electronics Weekly*, 7 July 1999)

Internet catalyst for chip recovery

Sunny days ahead for the semiconductor industry, driven by the Internet, are expected by Wilf Corrigan, founder and chairman of LSI Logic.

He expects the growth of Internet traffic to be linear. By 2006 he expects 10 per cent of the world's commerce—worth $3 trillion—will be done on the Internet. Today it is $139 billion.

However, the growth of the Internet means that the system is becoming overloaded. Whereas the average US phone call takes three minutes, the average time spent surfing the Internet is 50 minutes. Hence the need for infrastructure investment.

While telecoms companies look for massive consumer revenues from the phenomenon by controlling the final link into consumers' homes, governments are trying to open up the final link to maximise competition among content providers. (Source: *Electronics Weekly*, 7 July 1999)

Electronic paper

Xerox has teamed up with 3 M to help it produce a futuristic type of display technology called Electronic Paper than mimics a plain sheet of paper.

Electronic paper uses a thin plastic display that is designed to act as a plain paper sheet that can be electronically overwritten with text and images. It can be dynamically updated, say in a newspaper, and could even display moving images. It could also be used to prepare custom text books and large billboards for public displays.

The technology is based on what Xerox calls gyricon, which uses tiny beads of a special ink contained between two thin sheets of plastic. The beads can be electronically controlled to show different colours for text and image display. (Source: *Electronics Weekly*, 7 July 1999)

Bell Labs adds life to transistor technology

Bell Labs believes it has bought another 12 years of life for silicon-based transistor technology by producing extremely thin silicon dioxide (SiO_2) layers just five atoms thick.

The semiconductor industry had feared the insulating layer would be the limiting factor in continuing to reduce the size of silicon-based transistors. But with the insulating layer reduced by a factor of at least five, the life of the technology would appear to have been doubled from the original estimate of less than six years.

The insulating layer in today's chips is typically 25 atoms thick but the researchers at Lucent Technologies' Bell Labs have produced a layer only five atoms thick. They also discovered that four atoms is the physical limit for SiO_2 based insulators.

The insulating layer, or gate oxide, lies between the transistor's gate electrode which controls the channel through which the current flows. It is necessary to insulate the two to prevent a short circuit. Reducing both the gate oxide thickness and the length of the gate electrode results in the transistor switching speed increasing—a process that has led to the switching speed doubling every 18 to 24 months.

The researchers grew SiO_2 layers that were perfectly uniform and smooth using a process called rapid thermal exidation. The silicon was first cleaned and oxygen was added to it using the unconventional process which exposes the silicon to 1,000° C for 10 seconds.

The resulting five atom gate oxide was built into a transistor which worked successfully.

Lucent Technologies plans to use the advances for its new generation of communication ICs. Although the findings are only based on research results, Bell Labs is confident the technology can be transferred to commercial production lines.

But this advance is only buying precious time—an alternative insulating material will still need to be found before 2012. If this does not happen, new technologies will have to be found instead. (Source: *Electronics Weekly*, 7 July 1999)

30 nm holes put in silicon

Contact holes in a silicon dioxide layer just 30 nm wide have been etched by researchers at Infineon Technologies.

Using deep ultraviolet (UV) lithography and a 193 nm photoresist, the researchers were able to make the 30 nm holes over 600 nm deep in the oxide layer. The company said contact holes smaller than 70 nm were previously considered a major hurdle to future reductions in process geometries.

Infineon is carrying out the work along with International Sematech from the United States, Clariant Electronic Materials and Trikon Technologies from Newport, South Wales. (Source: *Electronics Weekly*, 7 July 1999)

Synthesis tool takes control of self-timed circuits

Cogency, the Canadian expert in asynchronous circuit design, has developed a synthesis tool for the control parts of asynchronous, or self-timed circuits.

The tool, as yet unnamed, works alongside a conventional synthesis tool which handles the logic parts of the circuit. The Cogency tool converts the handshaking and control logic into a netlist.

It was originally thought that asynchronous circuit development would need a completely new design flow. Cogency has demonstrated it is possible to use today's flows with existing simulator and synthesis tools.

Some additions to the flow must be made, of course. These boil down to a superset of the Verilog design language, called self-timed Verilog (ST-V), a compiler to convert this to conventional Verilog, and a synthesis tool for the control portions of the circuit.

It is the latter which Cogency will be releasing before the end of this year. The first two parts are already available.

The asynchronous circuits offer better power consumption, reduced electromagnetic interference and are easier to reuse in later designs. (Source: *Electronics Weekly*, 7 July 1999)

Downsizing the future

We are one step closer to making molecular computers, which would use molecules to represent the 0s and 1s of binary code instead of today's much larger silicon transistors. A team from Hewlett-Packard and the University of California in Los Angeles has created a logic gate that uses a single layer of organic molecules as a switch. Applying a voltage to the switch causes the molecules to change shape, breaking a connection and preventing current from flowing (*Science*, vol. 285, p. 391). So far, the team can only stop the flow—they cannot restore it. (Source: *New Scientist*, 24 July 1999)

Power on tap

An ingenious device that uses the energy from typing on a laptop's keyboard to recharge the battery has been patented by Compaq in the United States. The keyboard generator could reduce the size of batteries or make them last longer.

In Adrian Crisan's design, published in US patent 5 911 529, the shaft of each key has tiny permanent magnets attached to it, and each shaft is surrounded by wire coils. Every time a key is depressed, the magnets move through the coils, inducing a tiny current that is used to charge a capacitor. When the

capacitor has a high enough charge, it recharges the battery.

The magnets, coils and charging mechanism will add to the cost and weight of a computer, but Crisan believes time and trends are on his side. (Source: *New Scientist*, 24 July 1999)

IMEC plans for 100 nm CMOS step

European microelectronics research centre IMEC has launched an initiative to develop 0.10 μm, or 100 nm CMOS technology by 2003.

IMEC plans to develop copper interconnect and low-k dielectrics for inter-metal material. Metal gate electrodes and improved gate dielectrics will also be part of the research.

Key to the process will be optical lithography using 193 nm wavelength lasers. Making features half the size of the laser wavelength will require better phase shift masks and optical proximity correction, IMEC said.

Europe's major semiconductor firms such as Infineon and STMicroelectronics, and equipment makers including ASM Lithography are joining IMEC's consortium. US companies are also expected to join the venture.

Major technological bottlenecks are predicted along the way to 0.10 μm circuits, explaining Belgium-based IMEC's proposal for a collaborative effort.

Meanwhile, it looks as if microprocessors will overtake memories on the process micron trail for the first time.

Whereas the Semiconductor Industry Association's (SIA) draft roadmap pencils in 2001 for 0.13 μm processes for micros, it has, so far, left 2002 as the year when DRAMs will be made on 0.13 μm.

The SIA is considering moves to keep DRAM die sizes constant at 22 mm x 22 mm. They have been growing at between 10 to 20 per cent with each succeeding generation. (Source: *Electronics Weekly*, 21 July 1999).

Fabric with electronic fibres

Electrotextiles, a United Kingdom start-up firm, has successfully developed fabrics that interface to electronics, giving position and pressure readings when pressed.

The fabric is being used to make products such as keyboards that can be rolled up and put in a pocket when not in use. (Source: *Electronics Weekly*, 21/28 July 1999)

National's chip cuts Web costs

National Semiconductor has developed an "information appliance on a chip", aimed at reducing costs of Web televisions, set-top boxes and any device that accesses the Internet.

Unveiled at a big event in London, the Geode SC1400 chip combines 43 different blocks to create a complete computer on a single piece of silicon.

Although the company would not give prices for the chip, a set-top box with Internet capability could be built for $200, the firm said.

Geode integrates an x86 processor, MPEG-2 decompression engine, video and graphics processor, PCI-bus, drivers for cathode ray tubes (CRTs) and televisions, and all the necessary analog components.

This level of integration also reduces power, allowing a complete system to fit in a small space with no fan. A system's total power consumption would be under 10 W.

Future devices in the Geode family will add an xDSL modem, MPEG-4 codec and perhaps a Firewire interface. (Source: *Electronics Weekly*. 21 July 1999)

Data transfer gets airborne

A fibreless dense wave division multiplexing (DWDM) technology, which uses light beams to transmit data through the air, has been developed by Lucent Technologies' Bell Labs. The optical system is claimed to be the first to use an airborne DWDM approach.

The WaveStar OpticAir system will use expanded-beam lasers, amplifiers and receivers for point-to-point transmission of voice, data or video traffic. Telecoms company Global Crossing will be the first to test the system.

The first version is expected by next March and will support one wavelength at speeds up to 2.5 Gbit/s. This will be followed in a year's time by a four-wavelength system with a maximum capacity of 10 Gbit/s for distances up to 5 kilometres. (Source: *Electronics Weekly*, 21 July 1999)

UK team makes 0.12 μm GaAs devices with an f_T of 200 GHz

A team of researchers at Glasgow University's Nano-electronics Research Lab have constructed 0.12 μm gallium arsenide (GaAs) based devices with a transition frequency (f_T) of 200 GHz.

While faster devices have been reported, these either use pure indium phosphide (InP), which is difficult and expensive to manufacture, or they have very small channel lengths, perhaps a few tens of nanometres.

Glasgow's work combines well understood GaAs substrates and manufacturing techniques with the speed and low noise of InP-type devices.

InP tends to come in two-inch wafers which are brittle and difficult to handle. Glasgow's team got round the problem by growing InP-type layers on a GaAs substrate.

Transmission gates were built using a 0.12 μm channel length and two fingers of 50 μm channel width. Device characteristics were measured from 0.04 to 110 GHz. In this frequency range, current gain roll-off was 20 dB/decade.

Transition frequency was extrapolated to 200 GHz. At 94 GHz maximum stable gain (MSG) was 4.7 dB.

Devices manufactured with a smaller channel width of 25 μm showed an improvement in MSG of 9.0 dB at 94 GHz, due to smaller gate resistance.

These devices could be used in broadband communication links that are opening up around the 60 GHz area.

Other applications include collision avoidance radar for cars at 77 GHz and weather radar above 100 GHz. (Source: *Electronics Weekly*, 21 July 1999)

IBM chip package compensates for hot and cold expansion/contraction

IBM has developed a new package for high-speed chips that compensates for the expansion and contraction due to the chip heating and cooling.

The package is designed to improve reliability of high-speed chips, doubling their effective lifetime. It works by having an expansion somewhere between that of the die and the circuit board.

The coefficient of thermal expansion of the chip die is three, so heating causes a slight growth. PCBs, on the other hand, have a typical expansion coefficient of 18, giving rise to much larger growth.

The choice of package makes a difference. Ceramic packages grow similar to the die, leading to large stresses at the package-board interface. Cheaper plastic packages grow like the board, so the stress on the die is much bigger.

IBM's HPCC grows at a rate somewhere between the die and PCB. There is still stress, but not at the same levels.

The package is aimed at devices in the high-speed telecoms world in products such as routers, hubs and switches, many of which are moving to Gbit/s speeds and above.

To cope with high-speed signals, a fluoropolymer dielectric is used to reduce capacitance between die and circuit board. Flight time of signals is claimed to be 5.6 ps/mm. (Source: *Electronics Weekly*, 21 July 1999)

Cadence unveils linking tool

Cadence Design Systems has officially unveiled its tool that links logic synthesis with chip layout.

Called "Envisia synthesis with physically knowledgeable synthesis (PKS) technology"—quite a mouthful—the tool brings physical data into the front-end chip design process.

The synthesis process is combined with floorplanning or placement of top level blocks and some global routing.

PKS then allows designers to gain a much better estimation of the chip's final performance before layout. This should reduce the number of iterations between synthesis and layout and the number of times the design has to be tweaked.

Instead of using wire-load models to estimate the delay on each net in the design, PKS uses the actual layout of the design to work out timing.

Estimations of timing and performance are claimed to be within 5 per cent of the figures after final place and route.

The cost of such a piece of software? United States list price is a cool $250,000. (Source: *Electronics Weekly*, 21 July 1999)

Stacking silicon to make superfast chips

Modern chips already have several layers of circuitry, or wires, but all of their transistors are at ground level. Stacking those transistors vertically has long been a dream, says G. Dan Hutcheson, president of San José (CA) consultant VLSLI Research Inc. Since chips keep getting bigger, "everyone knows we're going to run out of horizontal space at some point", he says.

Transistor towers promise not only smaller and thus cheaper chips but also better performance, says Gerold W. Neudeck, the electrical engineer heading the research, because the vertical connections between "floors" are just 0.1 micron long—a fraction of the distance between transistors spread out horizontally on a conventional chip's ground floor. So signals take much less time getting from place to place.

To build his silicon skyscrapers, Neudeck has cleverly tweaked several aspects of chipmaking technology. One key: creating electrical barriers so that each new silicon layer grows only straight up, not over the surrounding silicon-dioxide insulation. As a result, Neudeck says, his process can eliminate several steps now required to keep the two materials separate.

Many wrinkles must be ironed out before the technology can go commercial, but it may not be long before chip designers become high-rise architects. (Source: *Business Week*, 19 July 1999)

Seeing the light

Solar panels could be improved by mimicking the design of the eyes of a fly that lived 45 million years ago. A pattern of ridges found on the surface of the fly's eyes could reduce reflection and so allow panels to capture light arriving at very oblique angles.

The idea comes from Andrew Parker, a zoologist at the Australian Museum in Sydney. While visiting the Museum of the Earth in Warsaw, Poland, he noticed some electron micrographs of a fly from the family Dolichopodidae, preserved in amber during the Eocene epoch. On the surface of the ommatidia that make up the fly's compound eye, Parker noticed gratings consisting of a series of parallel ridges 145 nanometres high and 240 nanometres apart.

Parker suspected that the fly's eye structure could capture light arriving at up to 72 degrees from the perpendicular. The distance between the ridges is about half the wavelength of light, which greatly reduces the amount of light that they reflect. Parker believes that the ridges were probably an adaptation to allow the fly to see better at night.

Researchers at the University of Exeter, led by Roy Sambles, an expert in photonics, have now confirmed Parker's hunch by embossing the same pattern onto a film of light-sensitive emulsion. They fired laser beams of different wavelengths at the material from a variety of angles and measured how much light was reflected. "It turned out we had a really good antireflector over a whole range of angles", says Parker.

Armed with these results, materials scientist Geoff Smith and his colleagues at the University of Technology, Sydney, have calculated that the fly's eye pattern could boost the energy generated by a solar panel over the course of a typical day by 10 per cent. "It does

almost as well with the Sun way over near the horizon as it does at midday," says Smith.

This might eliminate the need for the expensive and cumbersome tracking systems currently required to keep solar panels pointing at the Sun as it moves across the sky.

Scientists at the Fraunhofer Institute for Solar Energy in Freiburg, Germany, have independently been working on films embossed with similar patterns and have reported increases in the amount of energy they absorb of about 3 per cent. (Source: *New Scientist*, 24 April 1999)

GaAs MOSFETs

Gadolinium oxide could be the key to making MOSFETs on gallium arsenide (GaAs), claims Bell Labs.

MOSFETs are the transistor building blocks of CMOS and as such find their way into almost all digital chips and many analogue ones as well.

Gallium arsenide, due to its high carrier mobility and semi-insulating nature, is the semiconductor commonly used in high frequency (greater than 2 GHz) chips.

GaAs MOSFETs would enable extremely fast, low-power digital circuits to be built.

MOSFETs require an insulating layer in their structure and GaAs does not form a satisfactory insulating oxide, unlike silicon which does. Instead it forms a mixture of gallium and arsenic oxides and the arsenic oxide upsets device operation.

In the last 35 years, since people realized gallium arsenide made faster semiconductors, thousands of Ph.D. theses have been written about oxides for GaAs, but none have worked.

However, Ming Hwei Hong, a Bell Labs scientist, has been investigating insulating oxides for GaAs for several years and was part of the team that produced both P- and N-channel MOSFETs in GaAs late last year. In this case, the material used was an amorphous mixture of gallium and gadolinium oxides.

The breakthrough has come with realization that gadolinium oxide, on its own, can form monocrystalline oxide layers on GaAs, despite having a lattice constant twice that of GaAs (Gd_2O_3 10.8, GaAs 5.65).

This lattice mismatch makes the single crystal oxide growth an entirely unexpected result.

The Gd_2O_3 film has been grown using molecular beam epitaxy and as such can be moved to production, said Hong.

The dielectric constant of Gd_2O_3 is ten, twice as high as that of SiO_2.

So far, the gadolinium oxide has only been tested in MOS diodes. "The electrical measurements show that Gd_2O_3 is an excellent dielectric. Furthermore, both inversion and accumulation layers were observed in the Gd_2O_3/GaAs MOS diodes", said Hong.

This bodes well for future work with MOSFETs and the work could be extended to other semiconductors. (Source: *Electronics Weekly*, 31 March 1999)

Tiny switches' secrets brought to light

Researchers at IBM, Yorktown Heights, NY, use a nonintrusive technique called picosecond imaging circuit analysis (PICA) to measure switching activity in CMOS devices. When FETs cycle on and off, electrons coursing through them emit infrared light in sync with the switching. These light flashes last only a few trillionths of a second, but are said to be predictive of certain failure modes.

PICA uses infrared optics to peer through thinned, polished sections of an integrated circuit (IC) substrate backside. These raw images are postprocessed to form useful data. For example, integration of a signal over time yields an emission photograph similar to that from a CCD. At lower magnification, thousands of switches within a chip can be imaged simultaneously. These snapshots help verify results from software-based failure and characterization diagnostics. A high-power objective could measure activity of individual transistors, say researchers.

PICA is becoming more important these days as ICs grow more complex. Where earlier-generation ICs had just one or two layers of connections, new ones contain as many as seven. This makes traditional electrical measurement techniques impractical because upper layers occlude the lower ones. PICA has proved useful as a troubleshooting tool, but may eventually help debug chips in production. To look further into PICA, check out the company Web site: www.research.ibm.com (Source: *Machine Design*, 11 March 1999)

New, brighter LEDs use less power

Nonresonant cavity (NRC) LEDs deliver more light with less electrical power, say researchers at the Institute for Microelectronics, Belgium. The new devices are said to be three times more efficient than resonant cavity LEDs and best conventional planar types tenfold.

NRCs are formed between a highly reflective mirrored surface and a rough scattering surface. The bottom layer is a shiny deposited gold film while the upper scattering layer is textured. The texturing comes from coating the surface with 400-nm diameter polystyrene beads. Exposure of the beaded surface to an oxygen plasma reduces bead diameter to about 300 nm. These shrunken beads act as a mask for the subsequent 200-nm-deep etch step. Best scattering efficiency comes when the resulting cylindrical pillars do not touch one another. Besides texturing, another key ingredient is an antireflective coating applied to the so-called mesa region.

With the special treatments, the devices sport a 31 per cent absolute external quantum efficiency at a 3-mA drive current. That translates to power efficiencies of 0.44 W per amp of current. Without texturing or coating, efficiency drops to 10 per cent.

The NRC LEDs also have a maximum wall-plug efficiency of 14 per cent which makes them a promising light source for short-range optical interconnects. (Source: *Machine Design*, 11 March 1999)

Nanocrystals will light up LED technology

Exotic compound semiconductors have been needed to produce LEDs ever since General Electric used gallium arsenide (GaAs) to make the first practical one in 1962. Since then, the materials and structures have become ever

more complex and today's LEDs often also include aluminium, nitrogen, indium and phosphorus, and owe more to laser manufacture than to older LED processes. All this complexity adds to cost and for some time researchers have been hunting for a way to make LEDs using silicon on standard silicon processes.

There have been some successes, although none come close to matching compound semiconductor devices for brightness or efficiency—and this situation is unlikely to change for a while yet.

Porous silicon, for instance, has been shown to emit light, but making it requires processes not compatible with chip manufacture.

Silicon nanocrystals can also be persuaded to emit light. However, according to LED maker Toshiba, they have, up to now, required between 10 and 25 V to operate—excessive for today's chips.

The latest announcement comes from the Advanced Research Laboratory of Toshiba in Japan, where it has pushed nanocrystal device operating voltage below 5 V while using formation methods broadly compatible with current integrated circuit production.

Making Toshiba's devices involves depositing a thin (around 2 nm) layer of amorphous silicon onto a silicon wafer, then heating it to between 700 and 850° C in an oxygen or nitrogen atmosphere for a few minutes.

During this heating, silicon nanocrystals grow on the wafer surface inside the amorphous silicon.

Once cool, the nanocrystals emit visible light at room temperature when reverse biased through a Schottky contact.

The crystals are hemispherical and, by altering the amorphous silicon layer thickness, processing temperature, atmosphere and heating duration, the researchers have made different sizes.

Orange emission came from samples processed at 700° C in nitrogen or oxygen.

Red came from 800° C processing in nitrogen (at 3.5-4 V), but an oxygen atmosphere at these high temperatures caused the nanocrystals to oxidize away. Similar destruction of the nanocrystals happened with nitrogen above 850° C where they were converted to polysilicon.

The experiments have narrowed down the source of the electroluninescence, but not identified it.

It is not due to defects in the amorphous silicon, or defects at either of its surfaces, or the amorphous silicon-nanocrystal boundary. However, it only happens in nanocrystals less than 2 nm across and 1.5 nm high, and wavelength is related to crystal size.

The team's best guess at the moment is that the light is coming from within the nanocrystals themselves and that emission is due to "the quantum confinement effect" within them—More specifically, "the recombination of confined electrons and trapped holes".

The team's report concludes that efficiency, at the moment very poor, can be improved by increasing the number of nanocrystals and strengthening the carrier confinement and that: "The LEDs that have been demonstrated are promising devices for realizing monolithic optoelectronic ICSs". (Source: *Electronics Weekly*, 31 March 1999)

Small but powerful lithium batteries on the horizon

Smaller, longer-lasting lithium-ion batteries may result from research at Sandia National Laboratories, Albuquerque, NM. A mixture of metals creates the cathode portion of the lithium-ion battery. Researchers there are combining lithium with manganese, cobalt, nickel, chromium, and aluminium to create better cathodes. The right combination could make lithium-ion rechargeable batteries economical and able to store enough power to drive electric cars or replace existing lead-acid batteries.

Today, lithium-ion batteries power only small electrical devices such as camcorders because of cost and safety concerns. The most frequently used cathode material, lithium cobalt oxide, is expensive. The drive to field bigger lithium-ion rechargeable batteries focuses first on making the batteries more environmentally friendly. Lithium manganate has almost no environmental impact, while lead batteries contain poisonous heavy metal. Also, a lithium battery can be recharged and used repeatedly.

Second, lithium batteries are light and provide more electricity than other batteries of equal size and weight. The challenge is to find the right combination of cathode elements.

Initial experiments show cobalt, nickel, manganese, and other transition metals may be the most effective combinations.

Introducing nickel to replace some of the cobalt reduces the cost of the final material while maintaining high charge capacity. Manganese produces a good charge distribution and costs less than the cobalt it replaces. It is also a benign material and environmentally less damaging than some other elements used in lithium batteries. (Source: *Machine Design*, 11 March 1999)

Process lays down electrical conductors on plastic

Scientists at the Fraunhofer Institute for Laser Technology in Aachen, Germany, have developed a process which allows them to apply electrical conductors to injection-moulded parts.

To lay down tracks, selected parts of the plastic component are exposed to short wavelength ultraviolet light from an excimer lamp or excimer laser altering the surface chemistry. After exposure, the plastic is dipped in an aqueous solution, where a metal compound binds to the exposed areas. After several different baths, over a few minutes, a complete copper or nickel layer forms.

The layer is under 1 μm using electroplating.

As thick layers do not adhere as well as thin layers, because of internal stresses in the metal, the Fraunhofer group has developed a pre-treatment roughening process for the plastic surface to improve adhesion.

This involves applying an excimer laser through a mask generating tiny depressions where the metal will later be deposited.

Fraunhofer is aiming the whole process at automotive and mobile phone sub-assemblies. (Source: *Electronics Weekly*, 21 April 1999)

IBM almost achieves 60 Gbit/cm² storage density

Data could be stored at a density of 60 Gbit/cm² (400 Gbit/in²) if work at IBM's Zurich Research Laboratory ever makes it to production. The best magnetic hard drives are now achieving around 2 Gbit/cm².

The storage medium is a sheet of polymethylmethacrylate (the same material in "Perspex" clear plastic sheets) and the storage technique involves melting tiny pits in it using an atomic force microscope (AFM) technique.

The tip of the AFM is sprung and in constant contact with the polymer surface. Springing is through a U-shaped cantilever which also acts as an electrical conductor to allow the tip to be resistance-heated.

To write, the tip is heated to 400° C so that the tip melts into the polymer under spring pressure, like a hot knife on butter.

To read, the tip is warmed to a temperature that will not melt the polymer (350° C) and dragged along the surface. When the tip drops into a pit, it is cooled by thermal conduction. The change in temperature can be read as a change of resistance. The whole assembly could be the size of a conventional chip.

The tips are on a 92 μm pitch grid and can produce 40 nm pits. By moving the whole array slightly, the pits can be made with a 40 nm spacing.

This means that each tip can be made to produce over 2,000 pits before it begins to overwrite pits from its neighbouring tip. As the array moves in two dimensions, each tip can actually access over 5 million pits.

1,024 tips in the array can therefore be used to service 5 billion pits. According to project leader Peter Vettiger, this estimate could be a little conservative. "I think the array could finally store around 10 Gbit on 3 x 3 mm of polymer", he said.

Although no way of erasing individual bits has yet been proposed, erasure of an area is possible by heating the polymer to melt it back to a flat surface.

Vettiger points out that the work is at a very early stage, but he sees small devices based on an array moving over a similarly sized area of polymer, "for consumer audio-visual and PDA applications", and bigger stores where the array can jump to a fresh area of polymer. (Source: *Electronics Weekly*, 21 April 1999)

IBM's copper SOI ready

IBM Microelectronics has a copper interconnect on silicon on insulator (SOI) process available for prototyping which can draw gate lengths on silicon down to 0.11 μm.

Before volume production is available, an ASIC library for the process has to be readied. According to IBM, this is currently being prepared.

IBM has used the process internally to make PowerPCs and ASICs. It expects customers to use it for the IBM BlueLogic system-level chip offering and for ASICs used in high-end servers.

Using copper interconnects speed up chips by 10 to 20 per cent compared to aluminium, says IBM, while using SOI wafers improves transistor performance by up to 35 per cent and offers up to a threefold reduction in power.

Although SOI wafers cost three times the price of silicon wafers, according to André Auberton-Hervé, president of SOI wafer suppliers SOITEC, the extra cost for finished silicon is only 10 per cent. IBM calls its copper/SOI process SA27E. (Source: *Electronics Weekly*, 28 April 1999)

Brainwave reads mind via sensor

US medical researchers are reporting a 95 per cent success rate in detecting a person's thoughts to yes-no questions. The research is part of work to advance the man-machine interface and aid individuals who are severely handicapped.

The US team, from the New York State Department of Health, has trained people to modify their brainwaves in response to verbal questions with yes-no answers. These waves are picked up using an array of sensors on the subject's scalp and are processed to identify the changes.

Two types of brainwave—mu and beta waves—are produced and cause voltage changes of "tens of microvolts" on the scalp. In the team's standard protocol, people with or without motor disabilities learn to control mu or beta rhythm amplitude.

Other researchers have shown that patients who are totally paralysed can operate a simple word processing program. In these experiments, slowly changing potentials over the brain's central cortex were used. A joint effort is under way to combine these slow time-domain signals with the mu and beta frequency-domain signals to improve performance.

Future work will attempt to identify which waves are most easily controlled, improving the way the signals are sensed and processed, as well as to understand the way the mind and the electronic system interact. (Source: *Electronics Weekly*, 28 April 1999)

It is logical to be physical

A US start-up has unveiled a chip design tool that aims to ease the transition from logical to physical domains when designing deep sub-micron ICs.

The tool from Silicon Perspective Corp. (SPC) carries out placement of logic gates following synthesis. It separates the job of placement from the routing tool with the aim of reducing overall layout time.

Called First Encounter, the tool is able to partition the chip design, place blocks and cells and perform trial routing. It also carries out parasitic extraction, timing delay calculations and timing analysis.

The typical design flow would be to take a netlist and timing files from a synthesis tool and use SPC's tool to produce an IC layout that only requires routing.

By separating the placement from the routing, the designer can decide earlier on whether a layout is going to work. Because designs normally need a number of

iterations back to synthesis, overall design time is reduced, the firm said.

The company claims to have tested its tool on three projects. One of these, from Trident Microsystems, is a 0.25 µm device using over a million gates of logic. (Source: *Electronics Weekly*, 28 April 1999)

Disk density breakthrough

Seagate Technology has claimed a breakthrough in hard-disk-drive technology that dramatically increases data density. The company says it has managed to record 16 billion bits per square inch—three times the capacity of current hard drives.

Seagate has developed disk drive read heads made of giant magneto-resistive (GMR) heads combined with a new type of ultra smooth cobalt alloy for the disk platter. The heads fly just 15 nanometres above the magnetic media.

The achievement caps IBM's competitive efforts to increase recorded bits per square inch, which stand at 11.6 billion bits per square inch.

Seagate hard disk drives using the advanced GMR heads are expected to be available later this year. (Source: *Electronics World*, April 1999)

New architecture promises smaller, faster ICs

A US start-up has come up with a novel design for embedded microprocessors that promises smaller, faster integrated circuits (ICs).

TeraGen has invented an architecture it calls thread processor technology. Several simple processing units called microthread engines are placed on a chip. In parallel, these can replicate the functions of existing processor architectures.

On-chip software or microcode, held in a read-only memory, converts conventional processor instructions into primitive operations for the microthread engine. This means that it is conceivable that any existing processor instruction set could be emulated by the microthread engines. This could cover 8- to 32-bit processors, and because each engine and its set of primitive operations are very simple, they will run very fast—easily over 200 MHz in a 0.5 µm process.

The first platform TeraGen is targeting is an 8-bit microprocessor. More specifically, it is the 8051, still used in vast numbers today. At the speeds needed by 8051 designs, the chip will draw little current. The devices are also small. Because of the characteristics of the design, it is heavily read-only memory (ROM), datapath and random access memory (RAM) oriented. These are very dense, which leads to small, high-performance die.

As the microthread engines can emulate pretty much anything, they will also be used to emulate peripherals.

The only thing that changes the engine from emulating a processor or a peripheral is the microcode in the ROM. This allows for a simple chip layout.

Development times, cost and chip size could all be reduced by up to 40 per cent, the company claims.

TeraGen chips could replace older processors in existing designs and reuse the existing code without changes.

Applications such as mobile phones, where the chip includes a central processing unit, digital signed processor and peripherals could also be targeted.

In the future, microcode could also be implemented in RAM, making the engines reconfigurable.

TeraGen will be licensing the technology to semiconductor companies as well as designing its own chips. The first 8051-compatible product is due sometime this year. (Source: *Electronics World*, April 1999)

World's first multi-purpose TFT-LCD monitor

A Korean venture company has developed an integrated thin film transistor-liquid crystal display (TFT-LCD) computer monitor which can receive television (TV) and video cassette recorder (VCR) signals without aid from an auxillary device, the first of its kind in the world.

At first glance, the 15-inch flat-screen computer monitor, dubbed "Magic Box", looks like an ordinary flat LCD-type PC monitor.

However, it does not take long to realize that Magic Box, otherwise called "Monitor with TV", is quite different.

What sets Magic Box, developed by 3B Technology, apart from existing analog cathode ray tube (CRT) monitors is its built-in stand-alone receivers, which allow it to be used as a TV and VCR monitor.

It is the first time that a PC monitor capable of receiving television and VCR signals without a TV reception card has been developed. To watch TV through a PC, computer users have to insert a special board into their computers, but with Magic Box, such a board is unnecessary. It not only receives signals in both the NTSC format used in the United States and PAL standard used in Europe, but also delivers a high resolution of 1,024 by 768 pixels on its 15-inch model and 800 by 600 pixels on its 12-inch model.

Another feature of Magic Box is that it can be mounted, offering users a home theater environment.

The centrepiece of Magic Box technology, for which 3B Technology has also applied for a patent, is an integrated circuit, which transforms analogue signals from television sets into digital signals, which are projected onto the monitor screen.

Suh Soon-kyo, a sales manager at 3B Technology, said the prospects for the combination of TV, computer monitor and VCR monitor, are bright as it can replace the CRT monitors now dominating the world monitor market.

Currently, the Republic of Korea is the world's second largest supplier of CRT monitors.

Suh said that Magic Box technology is so useful it can be applied to a variety of purposes, including areas such as industry and education.

Company president Park Young-ho said that the popularity of Magic Box is so great that orders from foreign countries—including the US, Germany, Denmark, Spain and the UK—have been flooding in.

In particular, Suh said, some European and US buyers are interested in Magic Box because it can be mounted in the car without taking up much space. A 12-inch Magic Box monitor is only 4.8 cm thick and requires

one fourth the power needed to operate a CRT monitor. (Source: *Newsreview*, 29 May 1999)

High-speed transistor produced with low-resistance polymetal gate technology

NEC Corp. has succeeded in establishing a gate electrode low-resistance technology for 0.1 μm CMOS devices that are indispensable for the development of future high-performance system-on-chip (SOC) assemblies.

The newly developed low-resistance gate electrode represents a new gate electrode structure consisting of a polymetal structure that laminates tungsten/amorphous silicon/titanium nitride/polycrystalline silicon in the transistor structure used as the logic LSIs with embedded memory. Due to the development of this low-resistance gate electrode, resistance of 1 ohm in the gate electrode in logic LSIs with embedded memory has been reduced to one fifth. The memory unit and gate electrode of the logic unit, which required separate structures due to their different fabrication processes, can now be coordinated into a single polymetal structure. As a result, the manufacturing process is simplified substantially for the realization of SOC with sub-0.1 μm CMOS devices.

The fabrication of logic devices and memory devices in a single chip (co-mounting) is proceeding for the attainment of ever higher performance and higher added value. Among these logic LSIs with embedded memory, the logic LSIs with embedded DRAM enabling increase of memory capacity is a particular focus of intensive research. However, the transistors for advanced DRAM and advanced logic transistor use widely different structures and processes, so it will be necessary to use separate gate electrodes matched to these components. As a result, even if it were possible to lower the resistance with the conventional type of structure, there is the problem of reduced yield. Also, the W/TiN/poly-Si polymetal gate electrode had been available for coordinating the electrode structures, but the resistance of the W film increases with this gate electrode, therefore resistance can be reduced only to about 5 ohm, making the attainment of high performance rather difficult. To cope with this problem, there is a need to develop a new type of low-resistance gate electrode that coordinates the gate electrodes of the memory and logic circuit for performance improvement. Further information from: NEC Corp., 5-7-1, Shiba, Minato-ku, Tokyo 108-8001. Tel.: +81-3-3798-6511; Fax: +81-3-3457-7249 (Source: *JETRO*, March 1999)

IBM device restores world density record

IBM is reclaiming the world record in data storage after achieving a density level of 20 billion bits per square inch.

Researchers at IBM's Almaden Research laboratories in Silicon Valley said they have demonstrated a device that can store 2.5 Gbytes per square inch. This is three times the density of commercial disk drives, and the storage equivalent of two hours of MPEG-2 digital video.

IBM says that a key goal of the research is the development of new data storage materials.

The latest achievement was made possible using an advanced version of the giant magneto-resistive read head, a narrow-track thin-film inductive write head and ultra-low-noise cobalt-alloy magnetic media. (Source: *Electronics Weekly*, 19 May 1999)

One-wire chips go packageless

The demand for smaller and smarter electronic devices seems to be insatiable. To keep up, IC maker Dallas Semiconductor, Dallas, TX, has scaled down some of its one-wire, chip-scale packages (CSPs).

"Until now, the chip was sealed from outside contaminants with a package many times larger than the chip itself", says Product-Development Vice President Michael Bolan. But the new pin-head-sized CSPs have shed the traditional bulky, plastic packages and are instead wrapped in thin protective films.

The tiny ICs attach directly to PC boards using two on-chip solder-bump connections. This type of attachment is said to be the most efficient way for individual circuits to communicate. Besides having good connectivity, bumps are tough as well. Tests show that solder-bump attachments have shear and pull strengths equal to traditional attachments. And the circuits can be mounted using existing pick-and-place equipment.

One-wire circuits merge bidirectional, digital communications and power into just one signal plus a ground return. Typical circuit functions include silicon serial numbers, memory and temperature sensors. The new, packageless versions consume zero standby power and have minimal capacitance, making them ideal for battery powered equipment such as cellular phones. To learn more about packageless ICs, call Hal Kurkowski at Dallas Semiconductor. Tel.: (972) 371-4448; Web site: www.dalsemi.com (Source: *Machine Design*, 11 March 1999.

Apple networks for science

Some scientists are moving away from supercomputers and turning their attention to Apple Macs. Physicists at the University of California, Los Angeles, CA, US, have made a parallel cluster from eight G3 Power Macintosh computers. They have found that it can out-perform some supercomputers for executing plasma-simulation programs. The use of the MacMPI distributed operating system means that calculations can be carried out in Linux, Mac or even super-computer environments without changing the code.

Scientific interest in Apple may increase as the company collaborates more with other hardware and software providers. The next release of Apple's operating system MacOS 8 will deliver the 3-D graphics performance of Silicon Graphics' (SGI's) OpenGL standard to the new G3 Mac. In another link, SGI's Flat Panel monitor has been adapted for use with Apple Macs. (Source: *Scientific Computing World*, February/ March 1999)

Plastic pixels

Bell labs is close to revealing details of a smarter all-"plastic" active semi-conductor display pixel, a potential route to big-screen printed displays.

"The new smart pixel design includes the circuitry to allow for variations in the pixel and drive components to be compensated for", said Ananth Dodabalapur, an emissive device physicist at Lucent's Bell Labs.

Bell Labs has already demonstrated active all-plastic pixels which combine a drive transistor and a photo-emissive structure.

The new pixel-driver combination enables parameters that drift during operation to be brought back into line. "If a transistor needs more voltage, it gets more voltage", said Dodabalapur.

The circuit, developed by Dodabalapur's colleagues, is analogue and has six transistors, but according to Dodabalapur needs little space in the pixel.

The other disclosed detail is that the pixel does not work totally alone. It sends information back to the drive circuitry which modifies drive signals accordingly.

The smart pixel is destined for future large area displays, larger than those currently made using LCD technology. (Source: *Electronics Weekly*, 14 April 1999)

Synthesis of ceramics-system quasi-crystal

The National Institute for Research in Inorganic Materials (NIRIM) of the Science and Technology Agency (STA) succeeded in synthesising a ceramics-system quasi-crystal for the first time. In a crystal regular units of atoms are arranged repeatedly, but a quasi-crystal has only regularity with no periodicity in the arrangement of atoms. Its property differs from that of a crystal or an amorphous substance. A quasi-crystal of aluminium-manganese alloy was discovered in 1984, and since then many researchers all over the world have been challenging to the synthesis and structural analysis of quasi-crystals.

NIRIM employed the "local reaction method", which causes reactions at the interface between starting solid substances, and synthesized a tantalum-tellurium-system quasi-crystal. Such a synthesis was tried in Germany in the past, but the reproduction of the synthesis was successful in NIRIM for the first time. A plate of metallic tantalum was covered with the powder of a tantalum-tellurium compound, heated in a vacuum silica tube at about 1,100° C for 3 hours and quenched in ice water. Two layers of different compositions were formed on the surface of the tantalum plate and were confirmed to be quasi-crystals by their composition and structural analyses. NIRIM will synthesize a large amount of quasi-crystals and establish the synthetic method of various ceramic-system quasi-crystals.

(For further information, contact the Planning Section, Administration Division, NIRIM, STA. Tel.: 0298-58-5623) (Source: *STA Today*, No. 3, March 1999)

Real-time observation of fluxoid quantum motions in high-temperature superconductor

The Japan Science and Technology Corporation (JST) has succeeded in the real-time observation of motions of fluxoid quantum in a high-temperature superconductor for the first time as part of the research on the micro-space image dissection of phase and amplitude of electron waves, a research project of JST's programme of core research for evolutional science and technology (CREST).

This is a joint research of a group led by Akira Tonomura of the Advanced Research Laboratory, Hitachi, Ltd. and a group under Professor Koichi Kitazawa of Applied Chemistry, Faculty of Engineering, the University of Tokyo. The results were published in *Nature* issued on 28 January 1999.

The groups investigated the thin film of a bismuth-system high-temperature superconductor by using a 350 kV holography electron microscope capable of observing microscopic phenomena by utilizing wave motions of electrons, and succeeded in filming the behaviour of "fluxoid quantum", a flux of very narrow lines of magnetic force, moving with the temperature changes.

It has become a significant problem in the research of high-temperature superconductors to stop the motions of fluxoid quantum (pinning) for increasing the upper limit value of current (critical current) which can flow under a superconductive condition.

The present research result is expected to give a clue to the clarification of the pinning mechanism and contribute to the practical use of high-temperature superconductors. (For further information, contact the Department of CREST, JST. Tel.: 048-226-5635) (Source: *STA Today*, No. 3, March 1999)

Single photon source to regularly produce one photon at a time

A single photon source that can produce photons regularly one by one was created by the Yamamoto *Quantum Fluctuation* Project (head investigator, Professor Yoshihisa Yamamoto of Stanford University, USA and NTT Basic Research Laboratories) one of the projects of the Creative Science and Technology Promotion Program by the Japan Science and Technology Corporation (JSTC).

The light source (element) is called a turnstile element because it generates one photon at a time like a revolving door allowing people through one by one. Its structure is composed of three quantum wells, produced by piling up gallium arsenide semiconductor substrates, arranged in parallel. One photon is generated by entrapping one electron and one hole entrapped in the left and right wells into a middle well utilizing Coulomb repulsion. The experiment was conducted in the environment at 50 mK.

Though the realization of a single photon source was theoretically predicted, it is the first time that it has been confirmed by an experiment. It is expected to contribute to next-generation technology such as quantum computers and quantum communications on the basis of the basic principles of quantum mechanics.

(For further information, contact Susumu Machida, Ph.D. Research Manager, Yamamoto Quantum Fluctuation Project. Tel.: 0422-36-1894) (Source: *STA Today*, March 1999)

Chips to get new models

Materials researchers meeting in San Franciso have detailed semiconductor material developments that could lead to new types of devices.

Researchers at the University of Delaware were at the Materials Research Society conference to detail the use of silicon carbide alloys. Silicon carbide's greater heat resistance promises chips operating at much higher frequencies than current silicon devices.

Silicon carbide ICs can withstand temperatures above 600° C compared with 250° C for silicon chips.

Researchers from the US government's Defense Advanced Projects Agency revealed research into spin transport electronics which promise enhanced field effect transistors. (Source: *Electronics Weekly*, 14 April 1999)

Sensors like elastoplasts

Biomedical sensors with the look and feel of an adhesive plaster are to be developed by Irvine Sensors.

Skin contact electrodes will be combined with batteries and non-volatile memory. The whole assembly will be no thicker than a plaster, the US firm said.

The sensors will use Irvine's method of thinning semiconductors. In other research, the US firm is approaching thicknesses of just 10 µm by shaving the back off the silicon die.

The first application is studying sleep disorders by measuring electromyogram (EMG) signals of muscles controlling the eyelids.

"Since the sensor will have its own memory and therefore would not have to be wired to anything, it would free the patient from having to stay in a confined area," said Dr. Volkan Ozguz, Irvine's technology development manager.

Because the patient can stay at home while under observation, the tests will be more representative of normal activity patterns. (Source: *Electronics Weekly*, 14 April 1999)

Researchers turn hot water into electricity

Recovering waste heat using thermocouples could become practicable through work at the University of Cardiff.

"We have developed materials specifically for taking energy from hot temperature water", said project research associate Dr. Simon Williams.

The Cardiff Project is supported by NEDO, the Japanese government organisation that searches for new energy sources. It is aimed at extracting power from waste hot water, in steel mills for instance, that is too cool for steam generation.

"One of our devices has a generation density of 50 kW per cubic metre of machine volume from a 80 to 90° C temperature difference in water", said Williams. One of the materials Cardiff uses extracts three times more power than bismuth telluride. Bismuth telluride is the material used in most Peltier-effect coolers and is also employed in thermoelectric (Seebeck-effect) generators.

Thermoelectric generators operating from waste hot water need minimal maintenance, said Williams, so any electricity they generate is essentially free once the initial pay-back period of "a few years" is completed.

A future aim is to extract useful amounts of electricity from domestic waste water. (Source: *Electronics Weekly*, 14 April 1999)

Stamp cuts cost of ICs

Researchers at Bell Labs have developed a cheap way of manufacturing integrated circuits using a special rubber stamp.

The technique can place the circuits on a variety of substrates including glass, plastic and metals, and could enable such products as flexible displays.

The Bell Labs researchers make the reusable rubber stamps by pouring liquid rubber into a silicon mould containing the desired chip pattern. Once the rubber solidifies, it is peeled away to reveal the microscopic silicon relief pattern.

"Techniques that use these rubber stamps and moulds provide simple, low cost alternatives to conventional lithography", said Bell Labs chemist John Rogers. "The techniques also may lead to novel applications because we can now print features on rough or curved surfaces, such as optical fibre, and on materials that are incompatible with standard lithographic techniques."

To make the chips, the rubber stamps use an organic ink stamped onto gold-coated plastic and the part not covered by the ink is etched away until the chip pattern remains.

After stripping away the remaining ink, semiconductor material is deposited on the gold pattern that is left. This technique has produced 0.2 µm features. (Source: *Electronics Weekly*, 31 March 1999)

Chips chill out

Imagine a computer that can work at full speed while using half as much power. American researchers have produced an experimental system, built round a battery-powered laptop computer, that uses clever software to analyse the task in hand and handle different stages of it at different speeds. They hope their system will one day allow computers to run much faster without overheating.

The higher the frequency at which computer chips do calculations—the clock speed—the faster the chip processes data. But faster clock speeds usually require higher voltages. This increases power consumption, which produces more heat and makes the batteries of laptops go flat faster. Simply reducing the clock speed to save power makes processing sluggish.

Researchers led by Vijaykrishnan Narayanan, assistant professor of computer science and engineering at Pennsylvania State University, and colleagues at the University of Texas and the University of South Florida, are pioneering "dynamic frequency clocking", a technique in which the processing speed is varied on the fly according to the operation in hand. An experimental system uses voltages of between 5.0 volts and 2.4 volts, and corresponding clock speeds of between 28 megahertz and 7 megahertz. Graphic images are processed as quickly as possible, while simple calculations can be handled slowly, with no overall loss of speed. The overall

energy saving is more than 50 per cent. (Source: *New Scientist*, 20 March 1999)

Chips that evolve and adapt to an environment

Pioneering work in "evolving" microchips may bring us not only supercomputers but gadgets from watches to space craft that repair themselves, and even digital cells and, one day, digital organisms.

The processor inside your PC is good for nothing. While it might do a passable job at lots of tasks, there is precious little that it absolutely excels at. It was designed that way, because people like to do many different things with their PCs. Far better to have one machine that is OK for playing games, paying invoices and parsing sentences than it is to buy a different computer for each job. The downside of this is that your PC is a jack of all trades and a master of none, so every piece of software written for it is a bit of a kludge because programmers have to use the same standard parts to create wildly different applications.

But what if the processor was not set in silicon and could adapt to the software you were running like a living organism adapts to its habitat? Then it could turn into a specialist chip dedicated to turning out graphics for games or to number-crunching for spreadsheets.

Researchers around the world are pursuing just this goal. They are creating "evolvable hardware"—computer chips that can adapt, reproduce and heal themselves. Instead of being programmed, they learn as needed. It is likely that these chips will be used first in esoteric fields to create supercomputers more powerful than those we have today, or to help satellites cope with the harsh conditions in space. Eventually, though, they will be used to make the next generation of everyday computer chips that, if they are to keep on getting more powerful, will have to use components so small established techniques cannot fabricate them.

Before all this happens, the basics of designing chips using evolution must be mastered. Curiously, even this early work is revealing that evolution is much more creative than people.

A pioneer of evolutionary hardware is Adrian Thompson of the University of Sussex. Thompson has been trying to evolve a simple circuit that can distinguish between two sounds such as "stop" and "go". He says a human designing a circuit to do this would call it "trivial" if he could use any components he wanted. The restrictions Thompson is placing on the design, however—making it as small as possible and using few standard components—make it anything but trivial.

To speed up the testing, Thompson is using a special kind of processor known as a Field-Programmable Gate Array. These are "blank" chips made up of lots of unconfigured blocks of transistors. Different configuration programs customize the chip so it performs different tasks.

Evolution is helping Thompson design the configuration program for the sound-sensor. Every attempt at a design is downloaded into the chip to see how well it works. While the first configuration program was pretty useless at distinguishing between two sounds, by randomly mutating the program over a few thousand generations it is possible to make a program that turns the chip into a working sensor.

The final program, generation 4,100, uses far fewer than the 100 logic blocks Thompson gave it to play with. When Thompson had a look at the circuit, he was amazed by what he found. A small island of logic blocks were completely unconnected to the main ones, yet the chip stopped working if they were removed. Thompson says evolution has proved very "innovative"—which is really shorthand for doing something he cannot explain. "[Evolution] is exploiting properties of the chip I can't even measure", he says, "I really have no idea how it works".

Thompson still has a lot of work to do. For a start, the early circuits being generated are intimately tied to the properties of the chip they are grown on—so much so that they rarely work when used to configure another chip. They resemble a fragile species such as the panda which refuses to eat anything but bamboo from a particular grove. He is tackling this problem by evolving several configuration programs in parallel on chips being subjected to changing temperatures. He is doing the same thing Nature does to animals every day: it forces them to evolve by throwing ice ages and droughts at them. Thompson does it on a lab bench using tiny heaters and thermoelectric coolers. The result is a circuit happy to work on any chip, at both high and low temperatures.

Thompson's work has attracted NASA's attention. The space agency is eager to exploit any technology that can help its satellites survive for longer in space. Chips designed with the aid of evolution are likely to degrade far more gracefully than existing chips would if they were hit by high-energy radiation or the extremes of temperature found off-planet. Their ability to work out for themselves the most efficient way to carry out a task is something else that NASA finds attractive. Thompson's work may even help researchers trying to make nano-scale components for computer processors. Intel and Motorola may be etching ever smaller components on to chips, but they are fast approaching the limit of today's technology. Thompson's discovery of a technique that produces working components using properties and parts no one can measure might help to break the barrier.

Other researchers have even more ambitious plans. Gianluca Tempesti and colleagues at the Swiss Federal Institute of Technology in Lausanne want to create an entire organism using customizable chips. So far the team have created something called a biodule—the digital equivalent of a cell. The small RAM memory, microprocessor and connectors that make up these biodules correspond to a cell's nucleus, ribosomes and membrane. At the moment, the biodules are plastic boxes like big Lego bricks that can be stuck together to create sheets of cells. The team calls its work "embryonics"—embryonic electronics.

With some clever programming, the Swiss researchers have worked out how to make the cells reproduce and heal themselves. They can even work out what job they are supposed to do, given their location—just like real cells which take on the job of the organ they find themselves in. A collection of biodules starts off with

no idea what they are supposed to do. But once a "mother" cell is given the configuration progam—a basic genome—and starts to reproduce, the cells swiftly self-organize into a coordinated unit. If a biodule is damaged, the organism isolates it and all the cells around it work out what their new task should be. This is in stark contrast to existing chips, which stop working if they suffer the slightest damage. Part of the reason chip making is so expensive is that it takes so long to make error-free processors.

So far the most complex device the group has made is a biowatch. The counting program it uses was designed by humans, but its lifelike properties means it can suffer a great deal of damage and yet get itself back in working order. Says Tempesti: "Biology is a great example of something that works very well and is really robust."

Tempesti is now working on ways to move from biodules to large arrays of FPGAs to create a supercomputer. "The big problem with supercomputing and parallel processing is that programming them is a nightmare", says Tempesti. Humans are very bad at splitting problems up so individual chips can work on bits of the task at the same time. Using customizable chips that work out what they are supposed to do solves the problem. "If you manage to have very large arrays of processors, even if each one is not very powerful, they could still do a lot of computing", he says. The Swiss team want to go even further. Once they master FPGAs, they want to make cells from clumps of these customizable processors. These sub-units will represent molecules in the cells. Then they want to add neural networks to configure the system so it can adapt. Whatever they create, though, will be a tool rather than a toy. "Something that works and does whatever it wants to is not our aim", says Tempesti. "Our aim is to make something that has a task to accomplish and will learn and evolve to do it better." (From: Virtual Organisms (Macmillan) by Mark Ward. Source: *Electronic Telegraph*, 8 April 1991)

Computers that run without electricity

Powerful computers that run without electric power could be possible in the future. Research shows that computer circuits can be built to work without electricity. A tiny initial charge is all that is needed.

The new "logic gates", developed by scientists at the University of Notre Dame in Indiana, USA, exploit the charge of captured electrons to set off a domino-like cascade of charge in stored information.

Most experts believe that standard computer processors can only be miniaturized so far, before classical physics fails and strange quantum effects take over. This new technology could be a replacement as it can in theory be shrunk to the molecular scale.

The key to the new technology is a cell with four tiny dots of material arranged as a square, which can capture electrons. When two electrons are put into the cell, they repel one another and end up positioned across one diagonal or the other. These two positions correspond to the binary "0" and "1" used in computing. Today's computers use on and off transistors for zeroes and ones. By placing another quantum-dot cell next to the first, the repulsive electrical charge of the electrons allows the information to be passed on without needing an electrical current.

Chains of the cells would be the "wires" in the new computers and could be arranged to make logic gates. The researchers at Notre Dame built a simple type of gate to show that the principle of this kind of computing is sound. At the moment, the circuits only work at -272.9° C, just above absolute zero. (Source: *BBC News Online*, 8 April 1999)

NIST physicists demonstrate highly directional atom laser from Bose-Einstein condensate

Atoms in a Bose-Einstein condensate can be manipulated with light to form a highly directional atom laser, report physicists at the Commerce Department's National Institute of Standards and Technology.

The NIST atom laser represents a significant step forward from the first atom laser demonstrated in 1997 at the Massachusetts Institute of Technology in that its atoms stream forward in a chosen direction as a very narrow beam. The direction of the earlier MIT atom laser beam was determined by gravity and had a big spread due to the tendency of the atoms to repel each other.

"The atom laser is as different from an ordinary atom beam as an optical laser is from a flashlight. It now gives you for atom beams what you have had with laser light", says William D. Phillips, leader of the Laser Cooling and Trapping Group in the NIST Physics Laboratory.

The NIST atom laser was made from a gaseous Bose-Einstein condensate, an exotic form of matter first achieved in Boulder, CO, in 1995 by NIST physicist Eric Cornell and University of Colorado physicist Carl Wieman. In the atom laser experiment at NIST in Gaithersburg, Md., scientists trapped sodium atoms in a magnetic field and cooled them to a millionth of a degree above absolute zero at which point they began to Bose condense.

They further cooled the gas to about 50 billionths of a degree above absolute zero, so that nearly all the atoms became part of the condensate. In a Bose-Einstein condensate, a state that Albert Einstein predicted more than 70 years ago, all atoms behave as a single entity in which individual atoms are indistinguishable from one another.

Although practical uses of the atom laser could be years away, scientists are excited about the NIST invention and its potential. "As when the optical laser was invented 40 years ago, the potential applications of the atom laser may not yet be apparent", says Phillips, a Nobel laureate for his work on cooling and trapping atoms with laser light.

Nevertheless, scientists anticipate being able to create holographic images producing any picture or pattern desired on a flat surface. This eventually may lead to improvements in lithography, the manufacturing technique for making exquisitely small features on computer chips. The atom laser may lead to improvements in instruments that currently use an atom beam, such as novel gyroscopes and atom interferometers

used in research. Such instruments may one day be used in navigation or in prospecting for oil.

To make their atom laser, NIST scientists aim two optical lasers at the supercold Bose-Einstein condensate, one from the left side and one from the right. The atoms absorb photons from one laser beam and emit photons into the other laser beam. This process transfers momentum to the atoms and gives them a kick in the direction of one of the laser beams.

In order to select the direction of the atom laser beam, NIST scientists tune the optical lasers to slightly different frequencies. The atoms preferentially absorb photons from the higher frequency laser and emit them into the lower frequency one. Therefore, they move in a single direction, toward one laser and away from the other.

Although the atoms gain momentum from the laser beams, they are still held in the trap by the magnetic field. In order to free the atoms, which are like tiny magnets all pointing in the same direction, NIST scientists have to change the atoms' orientation so they no longer feel the attraction of the magnetic field used to confine them. Reorienting the atoms requires energy, which scientists provide by increasing the difference between the frequencies of the optical lasers.

By pulsing the lasers very quickly, the scientists are able to overlap the small clumps of atoms that get kicked out of the trap with each pulse, effectively making a continuous beam of atoms. By varying the intensity of the laser light, the scientists are able to create atomic laser beams of varying intensities at the chosen direction and speed.

The NIST work represents a significant step toward making a truly continuous atom laser. Since the NIST atom laser removes atoms from a Bose-Einstein condensate containing a finite number of atoms, it eventually runs out of atoms. For a truly continuous atom laser, scientists would have to find a way to replenish the atoms in the Bose-Einstein condensate while removing the atoms that make up the atom laser beam.

The NIST atom laser is very well collimated, that is the atoms streaming out of the Bose-Einstein condensate remain as a very narrow beam, much as light in a laser pointer spreads very little even across a large auditorium. The atom laser is about 60 millionths of a metre wide, about the diameter of a human hair, and travels at about 6 centimetres per second.

For more information and to see images of the atom laser, go to the NIST Physics Laboratory's news page on the World Wide Web at http://physics.nist.gov/atomoptics. (Source: *NIST*, 11 March 1999)

Successor to Verilog and VHDL

A successor to Verilog and VHDL, the hardware description languages (HDLs), has been unveiled by Co-Design, a design automation start-up.

Called SuperLog, the language is aimed at both hardware and software engineers, allowing a complete system to be described by one language.

"It's a design language targeted at system-on-chip design", said David Kelf, of Co-Design's marketing.

SuperLog will allow chip designers to explore architectural trade-offs, choosing which parts of the design go into hardware, and which are software.

Other EDA firms are trying to use C, Java or extended versions of Verilog to move to the next level of chip design.

"None of these can meet all the requirements of a new language", said Kelf. Any new approach must unify the multiplicity of tools that currently exist, be much faster than today's solutions and must be able to use existing blocks specified in Verilog, he said.

"That's why you can't use C—you need to throw away all your old designs", said Kelf.

Co-Design will make SuperLog an open language and will develop its own products to support the HDL. (Source: *Electronics Weekly*, 2 June 1999)

The new wave

A simple way of guiding matter waves—analogous to the way optical fibres guide light waves—has been demonstrated by Austrian physicists. The trick is a vital step towards building devices based upon "matter optics" such as atom beam splitters, tiny highly sensitive motion detectors and switches for quantum computers.

The technique's appeal is its simplicity: all it requires is a wire. When a current flows through the wire, it generates a magnetic field. Electrically neutral atoms are affected by magnetic fields because their nuclei have spin.

If the field is strong enough, and the atoms are moving slowly enough, the magnetic field around a wire can trap atoms into circling the wire, just as the Sun can trap passing asteroids. Johannes Denschlag and his colleagues at the University of Innsbruck have done just that with super-cold lithium atoms, chilled to within 200 millionths of a degree of absolute zero.

They also applied an external magnetic field at right angles to the wire, producing a region parallel to the wire where the magnetic fields cancel. Atoms prefer to reside in that region.

Atom streams moving along a wire could be steered in different directions by manipulating the wire, in much the same way as a fibre-optic cable steers light beams.

Denschlag also predicts that a quantum computer could be made using this technology. Quantum computers aim to use the quantum states of objects such as photons, electrons or atoms to store more states than the mere 0s and 1s of today's computers.

No one is yet sure whether the wire-guided atoms produced by Denschlag's technique maintain their coherence—that is, if the matter waves all stay in the same phase.

However, the simplicity of the arrangement raises hope that it will be easier to build matter-wave switches with the wire-guided method than with a rival hollow-tube method.

If the wire guides do produce coherent matter waves, they could represent a breakthrough as significant as that of fibre optics. And since matter waves have much smaller wavelengths than light waves, they can be used for much more precise measurements, just as microscopes

that use electrons instead of photons get much more detailed pictures.

The fairly weak magnetic fields used in the Innsbruck experiments were able to trap lithium atoms for tens of milliseconds. It should be easy to apply stronger magnetic fields, and thus increase the confinement times significantly. (Source: *New Scientist*, 13 March 1999)

Falling into place

Future micromachines will build themselves, say Harvard scientists who have managed to assemble millimetre-sized objects by copying the way biological molecules put themselves together.

Molecules such as DNA and proteins tend to interact by molecular recognition, where two molecules—or segments within one molecule—are attracted to each other because their shapes are complementary, or through surface properties like hydrophobicity or hydrogen bonding. These forces are what make proteins spontaneously fold into complex structures, or single strands of DNA zip up to form a double helix. For years, chemists have used these principles to design molecules.

The way proteins interact with smaller molecules, known as "ligands", inspired them to see if the same principles would work on a much larger scale. At Harvard, George Whitesides and graduate students Insung Choi and Ned Bowden made hexagons 2.7 millimetres across and 1 millimetre high out of a hydrophobic polymer called poly(dimethylsiloxane). To make parts hydrophilic, they covered one face and several edges with tape and oxidized the exposed surface.

To model a protein, the chemists glued several hexagons together to make various shapes. For the ligands they used just one or two hexagons. Since poly(dimethylsiloxane) is slightly denser than water, they could suspend their hexagons in the interface between water and a denser, hydrophobic organic solvent.

After swirling the suspended models about, the researchers discovered that smaller "ligands" did indeed nestle into the pockets of larger "proteins" if the hydrophobic edges matched. The researchers could mimic a real protein's inherent preference for either left-handed or right-handed ligands. When they made two-hexagon ligands with hydrophobic edges either on the upper left or on the upper right, they found that each ligand would join only with a "protein" with the same "handedness".

Whitesides says the attraction between the hexagons is driven by a reduction in the overall energy of the interface between the liquids. The work will be reported in the *Journal of the American Chemical Society.*

The technique may allow for very precise assembly of materials, the researchers suggest. (Source: *New Scientist*, 6 March 1999)

Sensor sensibility

A team at MIT's Media Lab have created a "sensory tabletop" that keeps track of your hand as you move it around. But rather than being limited to two dimensions, the table can accurately detect the motion of your hand in three dimensions.

Physicists Neil Gershenfeld and Josh Smith want computer users to enjoy their technology built into attractive furniture.

Electrodes built into the surface of the table induce tiny currents of the order of nanoamps in your hand. Your hand in turn, induces detectable currents in the coils embedded in the table top.

From the distribution of current in coils across the table, mathematical algorithms calculate where your hand must be in 3D space to create such currents. In this way, the technology could be used to control 3D special effects or computer-aided design software.

The technique mirrors one used by geophysicists, who face a similar problem—but the other way up. By sending electric or acoustic pulses into the ground, they can then measure the pulses that return and attempt to use these to describe the matter beneath the surface.

The MIT team have refined their algorithms so the table sensor works on low cost computers. Their next step is to develop the system so that the sensor table can generate a 3D computer image of the hand above it. (Source: *New Scientist*, 6 March 1999)

Laser triplet

Semiconductor lasers are usually monochromatic, so multi-wavelength versions had to incorporate several materials emitting at different wavelengths, and required complicated multiple resonators.

Now, scientists at Bell Laboratories in New Jersey have developed a new semiconductor material that emits up to three distinct wavelengths in the mid-infrared spectrum. The new device could be useful for differential spectroscopy and analysing trace gases. (Source: *Technology Ireland*, March 1999)

Micromachined RF

Micromachining is coming to RF chips. The only important question remaining is when.

Silicon semiconductors, so useful in digital and low-speed analogue circuits, are more limited in RF applications.

There are silicon processes that will work at 2 GHz, but any tuning components or signal path switches have to be off-chip, and the tuning problem extends all the way down the RF spectrum.

Only semiconductors with high bulk impedances, such as expensive GaAs, can be used to make filters with any appreciable selectivity.

Making micro-electromechanical systems (MEMs) by micromachining looks set to side-step the switching and tuning problems by allowing the construction of low-loss relays, mechanically resonant filters, high-Q inductors and variable high-Q capacitors.

All of these have been constructed on-chip using modifications of standard semiconductor processes and are small enough to lay alongside other circuitry. The University of Michigan, for instance, has constructed a 92 Mgz hand-pass filter with a Q of 8,000 which is only 13.1 μm long.

Soon claimed Professor Elliot Brown, a micromachine specialist at the University of California, Los Angeles, RF MEMS will be commonplace on chips.

First will come on-chip RF switches in the form of electrostatically deflected relays.

The standard solution to implementing a compact gigahertz-range RF switch is to use a PIN diode where more than 1 dB switching loss is inevitable. A 3-6 GHz PIN diode 8 x 8 crossbar switch has an insertion loss of around 21 dB. Individual MEMS switches have already been constructed with losses of under 0.1 dB and isolation over 35 dB.

And they are fast, bounce-free switching in 4 µs has been recorded 20 µs is more typical. Although 5 V is the target, it takes 40 V to operate a MEMS switch this quickly at the moment. Other drawbacks are low manufacturing yield and limited life.

MEMS frequency control components, for filters and oscillators, fall into two types. One uses micromachining to make conventional capacitors and inductors without the limited Q of traditional on-chip reactive components. These components require special packaging, but operate at atmospheric pressure.

The other approach is to micromachine mechanically resonant structures that are capacitively coupled to the signal path and profoundly affect the signal. These are being made at the University of Michigan by professor Clarke Nguyen. So far his devices, which use combinations of inter-linked masses and cantilevers, have all operated at VHF frequencies. His work has shown that not only can filtering devices be made, but that they can be as time-stable as quartz if they are fabricated from monocrystalline silicon.

There are several factors holding back the introduction of RF MEMS.

Technology stability is one. Micromachined devices are made using many types of wafer processing. What is needed is standard process, even if it does have some limitations, so that fabs can offer it for production and IP developers can start making libraries.

Designers are another problem, few of them think in terms of MEMS solutions yet.

Lastly, design tools are needed to develop micromachined products. These have to be able to handle the physics of the mass-spring structures used as well as the fluidics of surrounding atmospheres. (Source: *Electronics Weekly*, 3 March 1999)

Micromachined RF has "Q" of 10,000

Researchers at the University of Michigan have reported they have turned to micromachining to improve one-chip radio receivers.

Radio reception is all about selecting wanted signals from a sea of unwanted RF and noise.

There are two main ways of performing this selection: the "analogue" (superheterodyne) approach, using a narrowband tuned receiver; or the "digital" way, with a wider less critical receiver followed by digital signal processing to pick out the wheat from the chaff.

The analogue approach is difficult to integrate because the maximum Q of an on-chip LC filter is around 10, nowhere near enough for a radio. Instead, the filters have to be made off-chip, wasting space, money, and worst of all, power.

The digital approach removes most of the off-chip components, but requires expensive and power hungry high dynamic range on-chip front-end A/D converters to maintain system signal to noise ratio.

The Michigan team presented an on-chip micromachined resonant structure with a Q of around 10,000 at VHF frequencies.

These devices are polysilicon cantilever beams, capacitively coupled into surrounding circuitry and consuming minuscule amounts of power.

Two cantilevers, mechanically coupled by a flexible beam, can be used to form a two-pole filter with characteristics sharp enough to cut out adjacent channels and out-of-band interferers.

At 34.5 MHz, 1.3 per cent filter bandwidth has been demonstrated. At HF, the situation gets even better, with 0.2 per cent possible. No problems can be foreseen extending the technique up into the gigahertz range.

For multi-channel and frequency-hopping applications, banks of filters are envisaged, with electronic switching between the individual filters. (Source: *Electronics Weekly*, 17 February 1999)

AMD's K7 stands out among the x86 crowd

Soon to be released to the public, K7 is the latest generation x86 processor from AMD. A couple of important things make this device stand out from the crowd: Firstly, it could mark the first time AMD takes a performance lead over Intel; and second, attention has been paid to the processor's floating point performance, often poor in x86 clone devices.

With 2.4 million transistors, occupying about 15 per cent of the die area, the FPU is no small part of the chip. It is responsible for executing all x86 floating point, MMX and 3DNow! Instructions. The latter are AMD's version of MMX for floating point numbers.

The front end takes up to three x86 FP instructions per cycle and decodes them into internal execution op-codes. When the operands (data) are available these are sent to the 36 entry scheduler.

The scheduler sends the operands to the relevant execution units when they become available. A retire block keeps the state of the core up to date, freeing up registers when their associated op-code is completed.

Three execution pipelines are available in the core; an add, a multiply and a store pipeline. The first carries out all FP addition, substraction and compare operations.

The multiply pipe computes FP multiply, remainder, division, square roots, MMX operations and 3DNow! Multiplications. A 76 x 76-bit multiplier takes four cycles to compute a multiply, and 16 to 24 cycles for a division.

Multiplys can fill in unused cycles during a division to maximize use of the pipeline. (Source: *Electronics Weekly*, 17 February 1999)

Clock dithering technique tackles chip interference

The tendency for high speed equipment such as handheld PCs to emit more electromagnetic interference (EMI) has been addressed by researchers at Korea's Seoul National University, who have shown a clock dithering technique that spreads the frequency spectra of clock and data signals, and hence reduces their peaks.

The work is aimed at devices such as notebook computers which have high clock and data speeds, but cannot afford the weight and cost of too much shielding material.

Seoul University's method is called spread spectrum phase modulation (SSPM). The clock signal is dithered such that its phase varies over a number of clock cycles.

A fast Fourier transform analysis showed that different phase changes gave a variety of reductions in EMI. EMI peaks should be reduced by 5, 13, 6 and 3 dB as phase is changed by 90°, 180°, 270° and 360° respectively.

Therefore, for best results, the system was designed to vary the phase of the clock between 0 and -180°. Each consecutive edge changes the phase of the clock by 3.3 per cent of a clock period. A phase of -180° is reached in about 16 clock cycles. Then the process reverses and the phase is brought back to 0°.

Thus periods when the clock is either at 0° or -180° are interspersed with periods when the clock is running faster or slower.

The researchers fabricated a delay locked loop (DLL) using 0.35 μm CMOS. The core size is 0.6 x 0.4 mm and it consumes 45 mW at 3 V.

Current driven by clock and data drivers was passed through a metre of unshielded ribbon cable.

Measurements were based on CISPR16-1, an international standard for measuring radio interference. The reduction in EMI is around 13 dB at the fundamental and third harmonic.

Measurements of conducted spectra showed a similar result; spectral energies are spread and peaks of the fundamental and harmonics were reduced by 13 dB. (Source: *Electronics Weekly*, 17 February 1999)

10 bn Flops using logs

Motorola has unveiled a 32-bit logarithmic co-processor aimed at 3D graphics and video processing applications.

The attraction of using logarithms as the internal number format of the Beta device is that multiplies and divisions become single cycle additions and subtractions. As a comparison, Motorola cites a 32-bit divide using the PowerPC 603 processor which takes between 18 and 33 cycles. If it is a square root operation, the 603 can take over 100 cycles.

This, claims Shao Wei Pan, one of the Beta's designers, provides the device with significant processing performance/power consumption advantages compared to conventional processors.

The Formatter is used to convert almost any data format into the 32-bit internal logarithm domain. The absolute error using a logarithmic operation is less than one least significant bit in IEEE 32-bit floating point format, claims Motorola. The data is then passed to any number of the 64 on-chip compute units, each having 128 x 32-bit of local store.

The units are also linked via a local data bus. This enables data to be passed between the units during such operations as digital filtering and correlations.

According to Motorola, with one instruction Beta can implement a 64 by 64 filter bank or a 4096-tap finite impulse response filter, a 256-point or greater fast Fourier transform, or large matrix computations. The average sustained processing performance is of the order of 10 billion floating point operation/s.

The results from the compute units are converted back into real values using one of the 32 anti-logarithm (Alog) units. If required, the results from the Alog units are accumulated using an adder-chain structure and passed to the reformatter which converts the data into the required format.

Motorola claims that the Beta chip is ideal as a DSP co-processor for PC or embedded environments. It has already been implemented on a board containing an MPC823 processor. For certain wireless communication applications the overall design achieved a speed-up times greater than using the MPC823 alone.

The Beta chip is clocked at 120 MHz, as are the input and output buses. The sustained data processing rate of the Beta can be as high as 480 Mbyte/s. Power consumption reaches 3 W when all 64 compute units are being exercised. (Source: *Electronics Weekly*, 17 February 1999)

Large-sized PolySiC wafers

Though previously thought to be unachievable, polycrystalline silicon carbide (SiC) wafers have demonstrated electrical characteristics comparable to single-crystal SiC. Using a unique version of chemical vapour deposition (CVD) developed by Sullivan & Company (Indianapolis), silicon carbide can be rapidly deposited at atomospheric pressure without porosity or "micropipes". The result is that large size wafers measuring up to 150 mm have been grown. It is expected that economies of scale in the material making process will produce prices competitive with volume production silicon wafers up to 400 mm in diameter.

Silicon carbide has demonstrated significant advantages over silicon as a wafer material. Researchers at Purdue University in Lafayette, Indiana, for example, have used SiC to form a novel accumulation-channel MOSFET (ACCUFET) having an off-mode blocking voltage (V_B) of 1,400 V and an on-mode resistance (R_{ON}) of 15.7 mΩ/cm^2. For this SiC device, the figure-of-merit, V_B^2/R_{ON} is 125 MW/cm^2, 25 times higher than the theoretical limit for silicon power MOSFETs.

Silicon carbide is typically classified according to crystal orientation, single crystal alpha-phase (4H and 6H) and beta-phase (3C), which can be either single or polycrystalline. The material grown at Sullivan is 3C polycrystalline SiC. PolySiC unlike other semiconductor materials, has the same carrier mobility as single-crystal, 370 cm^2/Vsec at 7 x 10^{13}/cc doping. The reason may be

that SiC is a covalently bonded material with high surface energy due to the availability of d orbitals in the valence shell and the distance of valence electrons from the nucleus. Valence electrons being weakly held by the Si nucleus are available when a field is applied. A close bonding of individual crystals in the polycrystalline silicone carbide structure also facilitates electron mobility. With these advantages and the potential for larger wafers, silicon carbide is anticipated to make inroads into the semiconductor industry. (Source: *Semiconductor International*, January 1999)

Manufacturing-worthy processes merge DRAM and logic circuitry

The merging of logic and memory components on a single chip poses special requirements in high performance technologies. At the IEDM Conference in December, NEC, IBM and other companies presented system-on-a-chip process flows designed to minimize the number of process steps. Engineers from NEC's ULSI Device Development Laboratories (Sagamihara, Kanagawa, Japan) reported on use of Ar^+ and N^+ implantation into gate oxides with dual-gate polysilicon doping using self-aligned thermal oxidation to produce a 20 per cent gate oxide thickness difference between DRAM and logic regions without reducing reliability. Other engineers at NEC's Development Laboratories replaced conventional silicide and polysilicon-based structures of commodity DRAMs with shared tungsten structures. Tungsten acts as local interconnects and stacked contacts/vias in logic circuitry to realize a 40 to 65 per cent reduction in interconnect resistance, while reducing process steps, thermal budget and surface step height for high manufacturability. Finally, engineers from IBM's Microelectronic Division (Hopewell Junction, NY) merged a 0.617 μm^2 DRAM cell with a 4.2 μm^2 SRAM cell in a 0.18 μm dual-damascene copper metalization process. (Source: *Semiconductor International*, February 1999)

New etch gases could replace PFCs

An important mission in the semiconductor industry is to reduce emissions of perfluorocompounds (PFCs), presently used to clean PECVD chambers and for etching. PFCs such as CF_4, C_2F_6 and C_3F_8 are believed to contribute to global warming. Several approaches are being considered, including abatement, capture/recovery, process optimization and the development of alternative chemistries as substitutes.

Researchers at MIT and Motorola have addressed the latter approach and have come up with novel hydrofluorocarbon and iodofluorocarbon chemistries that they have shown to be suitable replacements to PFCs now used, or, at least, good enough to warrant further evaluation.

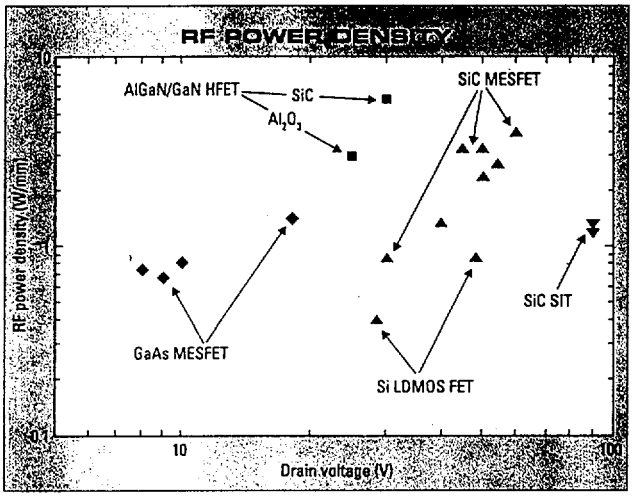
The most promising results came from two isomers of iodoheptafluoropropane: 1-iodoheptafluoropropane (CF_2I-CF_2-CF_3) and 2-iodoheptafluoropropane (CF_3-CFI-CF_3). "It is particularly encouraging that, in the case of 1-iodoheptafluoropropane, it was possible to simultaneously improve both emissions and process performance", noted the researchers in a recent paper in the *Journal of the Electrochemical Society* (December 1998). 2H-heptafluoropropane (CF_3-CFH-CF_3), another gas studied, was found to be capable of process performance that was roughly equivalent to that of C_3F_8, while yielding a reduction in global warming gas emission on the order of 60 per cent. (Source: *Semiconductor International*, February 1999)

Wide bandgap materials draw interest

The unique properties of wide bandgap semiconductor materials such as silicon carbide (SiC) and gallium nitride (GaN) are drawing greater interest as an alternative for enhancing device performance. The high breakdown voltage and saturated electron drift velocity make them attractive for a wide variety of high-frequency and switch-mode power devices. Silicon carbide's high thermal conductivity further adds to its appeal.

Both SiC and GaN are epitaxially grown. GaN is typically grown on SiC or sapphire (Al_2O_3) substrates, SiC on SiC substrates. Since SiC has a homoepitaxial layer, vertical as well as horizontal devices can be built. Therefore, Schottky and MOSFET vertical switch-mode power devices can be fabricated with SiC. GaN, having a heteroepitaxial process, is currently limited to horizontal devices, only RF power devices. However, because a quantum well forms at the AlGaN/GaN heterojunction, very high sheet carrier densities can result, yielding higher current densities than in SiC.

The numbers have been impressive: maximum frequencies of oscillation (f_{max}) exceeding 100 GHz and power densities of 5.3 W/mm at 10 GHz with AlGaN HFETs, power densities of 3.3 W/mm at 850 MHz (CW) and 10 GHz (pulsed) with 4H-SiC MESFET's and output power of 450 W (pulsed) at 600 MHz and 38 W (pulsed) at 3 GHz with 4H-SiC SITs. The RF power densities of SiC MESFETs and AlGaN HFETs are superior to those of Si MOSFETs and GaAs MESFETs (see Figure).



Comparison of RF power densities indicates better performance of GaN- and SiC-based devices.

Furthermore, the high breakdown voltage capability of SiC has been demonstrated in a number of switch-mode power devices such as Schottky diodes, PIN diodes,

MOSFETs and GTOs. For 4H-SiC PIN diodes, breakdown voltages as high as 5.5 KV have specific on-resistances two orders of magnitude lower than those of comparable Si devices.

Despite the promising performance of these devices and technologies, several major challenges must be overcome before commercialization is possible, said Charles E. Weitzel, member of technical staff at Motorola (Tempe, Ariz.). He targeted three areas of concern. Clearly, the availability of material takes precedence. Several viable material suppliers must be able to provide high quality, low defect density, large area, standardized starting material at a reasonable cost.

SiC epitaxial layers on SiC substrates are typically fraught with micropipes that appear as holes through the substrate. Since the SiC epitaxial layer does not fill the holes, device defects result, impacting yield. Currently, the best micropipe densities are $<1/cm^2$. Similarly, GaN epitaxial layers can have dislocation densities in excess of $1 \times 10^9/cm^2$. Surprisingly, they still make lasers. Since GaN is heteroepitaxial, good crystallographic matching to the substrate is essential. One method for reducing dislocations is lateral epitaxial overgrowth. Using a SiC substrate with stripes of SiO_2 or Si_3N_4, the GaN is grown from the substrate but not on the dielectric. However, lateral growth occurs over the dielectric and notably contains fewer dislocations. This process is repeated over the region grown from the substrate. The resulting film has a significantly lower dislocation density.

Once the material issues are resolved, fabrication alternatives must be developed. For example, SiC requires very high temperature processes such as implant anneals at 1,500° C. Finally, new packaging technology will have to be developed. In these as well as all semiconductor devices, heat accelerates device failures. While SiC has high thermal conductivity, operating temperatures for high-power applications will quickly offset this advantage. To realize the full potential of wide bandgap devices, packaging to accommodate higher power densities and temperatures will be necessary.

The greatest impact of wide bandgap materials, however, may be in photonics, in particular, blue GaN LEDs and lasers. With a wavelength more than a factor of two smaller than GaAs, data storage densities can be quadrupled. Clearly, whether in the realm of electronic or optical devices, wide bandgap materials show distinct advantages. Could manufacturable solutions for these unique materials be far behind? (Source: *Semiconductor International*, February 1998)

Nanotubes: Small but perfectly formed

For an industry where small is beautiful, single-wall carbon nanotubes fit the bill nicely.

The attraction of the single molecule nanotube is that it is "an inherently small structure that you can use for a whole host of things", according to Alan Johnson, Assistant Professor at the University of Pennsylvania.

The nanotube is made from a graphite plane of carbon atoms rolled up and sealed at the two edges. The result can exhibit either semiconductor or metal properties depending on how it is rolled.

Performance is another advantage promised by the nanotube structure. "Ballistic electron transport over nanometre distances promises terahertz (THz) switching speeds", said Johnson. Ballistic transport refers to fast travel (without scatter) of an electron when injected into the tube. "It is not a demonstrated fact but the time constant is about 100fs", said Johnson. This equates to a potential device switching speed of 10 THz.

What is exciting researchers such as Johnson is that the nanotube has moved beyond the theoretical stage. A 1.4 nm diameter, 10 μm long nanotube has already been shown to have FET-like behaviour at room temperature.

According to Johnson, the TUBEFET turns out to be slightly more complicated than a MOSFET but has similar behaviour. The nanotube—behaving as a semiconductor—acts as the channel connecting the source and the drain, while a gate is used to turn it on and off.

The nanotube can also be used to demonstrate quantum electronics effects such as single electron devices. "The structure is the same except that the nanotube is acting as a metal not a semiconductor", said Johnson. However, such effects have only been seen at temperatures of 10 K.

Two key challenges remain before the potential of nanotubes starts to be realized. Separating the nanotubes into metal and semiconductor categories when they are made is one major obstacle.

The other is tackling the issue of self-assembly, getting the single molecule nanotubes to assemble to form complicated circuit elements.

"It will probably be one to two decades before they are used in practical applications", said Johnson. (Source: *Electronics Weekly*, 17 February 1999)

Wearable Web server fits in pocket

A Stanford University professor has created a tiny Web server that fits into a shirt pocket.

The device is one of the smallest PC computer devices ever built and is part of Stanford's research focus into wearable computer systems that promises to be a lucrative market for electronics firms.

Using standard components, Vaughan Pratt, Professor of Computer Science at Stanford, built a Web server less than 4.5 cm high, 7 cm wide and 0.7 cm thick.

It consists of an Advanced Micro Devices 486-SX 66 MHz microprocessor, 16 Mbyte of DRAM and 16 Mbyte of flash ROM. It is connected to the Internet through a parallel port and runs a version of the Linux operating system.

The tiny server is one of the first projects of the Wearables Lab that Pratt has started. The lab is modelled on that of the Massachusetts Institute of Technology. Both labs are developing computer technology that can be fitted directly into clothing. (Source: *Electronics Weekly*, 17 February 1999)

Voice chip to enable mobile computing

IBM Microelectronics believes it can enable mobile computing by developing a voice control chip for hand-held equipment, and a wireless connectivity chip for pocket-sized equipment.

Currently IBM's Via Voice speech recognition technology, allowing you to dictate into your PC and command it by voice, is a software product requiring Pentium-type processing power and 32 Mbytes of DRAM.

The co-processor under development at IBM is a hardware solution which will allow Via Voice to operate on pocketable machines running off ARM-type processors.

The wireless chip combines RF and baseband processing. Although IBM has not decided finally on the technology it will use, one part of it will definitely be silicon germanium (SiGe) and that could be combined with silicon-on-insulator wafers.

IBM will use the intellectual property it obtained from its purchase of San Diego RF specialist CommQuest to implement the chip.

With its ARM licence, and shortly to be unveiled embedded DRAM technology, IBM believes it has all the technology needed to implement mobile computers/communicators.

For DRAM it is going down the double data rate (DDR) route which, IBM says, is popular with customers and could be used right across the PC range—not just for high end machines. IBM believes that PC133 DDR is the way the PC industry will go and is bringing out a 133 MHz 256 Mbit DDR DRAM in the second half of this year. (Source: *Electronics Weekly*, 17 February 1999)

Super cool lines

The Dept. of Energy in the US has given the go-ahead to a superconducting cable network. According to a report in Modern Power Systems this will be the world's first high temperature super conductor power cable system. The change is expected to triple the present capacity of copper cables. If the application works well, HTS cables will provide a solution for utilities which can produce power but lack delivery infrastructure. In the approved project Detroit Edison will begin using HTS cables in mid-2000. Lengths of up to 50 yards have already been tested, and in the first stage of development nine of the four-inch diameter copper power lines connecting the station to the grid will be replaced by three super-conducting lines chilled with liquid nitrogen. Four inch superconducting lines will carry 2400 A at 2400 V. Apart from the saving in space, only 250 lbs of HTS cable will be needed to replace over 18,000 lbs of copper. (Source: *Technology Ireland*, April 1999)

Fibres wake up to sensors

Optical fibres are affected by their environment.

This can be a problem if shipping data long distances, but exceedingly exceedingly useful if you are a sensor maker. Temperature, force and pressure can all now be measured by their effect on fibres.

By making use of force sensitivity, reports the IEE's *Electronic Letters* (vol. 34, No. 21, page 1991), fibres are now being used to measure physiological parameters.

The sensor concerned is the size and shape of a wristwatch and has been developed by a multi-discipline academic team from Lorient in France to indicate the phases of human sleep.

It measures the heartbeat, blood pressure variations, breathing frequency and breathing amplitude.

In the sensor, a fibre is trapped between two metal plates, one of which is ridged. Forcing the plates together causes the ridges to deform the fibre which changes its attenuation through variations in refractive index at the contact points.

A 1 mW laser diode and a photodiode allow the attenuation to be sensed.

An ordinary elastic wristwatch strap holds the assembly against the inner wrist and, being attached to the outer plate, sets a bias force on the fibre.

The signal from the photodiode is processed using a Texas Instruments MPS 430, transmitted over an RF link, then further processed to extract the required parameters.

Although the first application will be in sleep analysis, the developers see it finding use in other medical areas and industry. For instance, it could be the basis of a fatigue detector for workers operating dangerous machinery. (Source: *Electronics Weekly*, 3 February 1999)

New interface makes virtual world tangible

When you explore or manipulate an object in the real world, it helps to use your hands as well as your eyes. Handling a flexible plastic film, for example, requires sensing small pressure variations across the fingertip. Inserting a pin into a small hole can require real-time information about friction and vibration. In the virtual world of computer models and remote-control robots, users generally lack such tactile, or haptic, feedback, which makes delicate manipulative tasks even more difficult. Now physicist Ralph Hollis and graduate student Peter Berkelman, of Carnegie Mellon University's Robotics Institute in Pittsburgh, have developed a new way to bring the sense of touch to computer interfaces: a magnetically suspended joystick that allows a user to manipulate—and feel—objects in the virtual world.

It's not the first haptic interface ever constructed, but it is the first to rely on magnetic levitation instead of conventional bearings, which eliminates friction and allows the device to reproduce more subtle tactile feedbacks.

The device works by harnessing the Lorentz force, an effect discovered in the 19th century in which a wire carrying an electric current and immersed in a magnetic field experiences a force at right angles to both the current and the magnetic field. The force can be used to suspend a current-carrying object between two magnets—what Hollis calls Lorentz levitation. It can also cause the suspended object to move when the current flowing through it is changed.

Hollis reasoned that the right arrangement of magnets and current-carrying coils could generate force feedbacks that a user grasping the suspended object would sense, and he thought it could lead to a more realistic haptic interface than ones based on motors, wires, and pulleys.

To put theory into practice, the Carnegie Mellon group built a device consisting of a joystick handle

attached to a bowl-shaped non-magnetic surface that contains six wire coils. This assembly, called the flotor, is suspended in the air gap between six pairs of permanent magnets mounted inside and outside the flotor on bowl-shaped stationary surfaces. An arrangement of three light-emitting diodes (LEDs) and matching optical position sensors allows the device to sense motion in the flotor.

When an operator moves the joystick, each LED-sensor pair records movement in both the *x*- and *y*-axes around that sensor. Combining the output of the three pairs gives six independent measures of movement, corresponding to the six degrees of freedom—*x*, *y*, and *z*, plus pitch, roll, and yaw—needed to describe the motion of any object manipulated in space. Software, analogous to, but far more complicated than the device drivers used to translate the motion of a trackball to movement of the cursor on a computer screen, translates the sensors' electrical output into movement of an object in a three-dimensional computer simulation of, for example, a bolt being fitted into the correct hole on a jet engine or a drug docking with its receptor.

The interface transmits haptic feedback to the user when output from the computer simulation alters the currents flowing to the six coils, generating forces and torques on the joystick. Crash a virtual object into a virtual wall, for example, and you would feel the impact and recoil through the joystick.

The technology allows only a limited range of motion: 15 to 20 degrees—about 2.5 centimeters—in all directions for the current device.

The next challenge is to improve the software so that the device can interact with a wide range of computer simulation programs. (Source: *Science*, vol. 283, 19 February 1999)

Extracting electron beams with superior monochromacity from a superconductor

The research group headed by Professor Chuhei Ohshima at Kagami Memorial Laboratory for Materials Science and Technology, Waseda University, has successfully used a tunnel phenomenon to extract electron beams with superior monochromacity from a niobium superconductor.

Experiments of this sort have previously been carried out but were never successful due to the difficulties with the experimental technique. The present achievement is part of research on analysis and control of self-organizing mechanisms of substances and materials, one of the comprehensive research programmes that have been funded by the special coordination funds for promoting science and technology.

When electron beams are used for an electron microscope indispensable for research and development on physical properties of materials, the narrower the energy width of the electron beams used, the higher becomes the performance. The Ohshima group's present research has reduced that energy width to one-tenth (20 meV) of the traditional value, and theoretically its reduction to less than 0.1 meV is anticipated.

The present experiment used a niobium needle as the source of electron beam generation. A strong electrical field was applied to the needle under superconductive conditions of -268° C that caused a tunnel effect in which the electrons in the needle passed through the electric barrier on the needle surface and jumped out as electron beams.

Although experiments of this kind have been technically difficult in the past, the research group combined the technologies of very-low temperatures, ultra-high-vacuum and high-resolution electron spectroscopy to develop new equipment that enabled them to carry out the experiment. (For further information, contact the Materials Development Promotion Office, General Research Divisions, Research and Development Bureau, STA. Tel.: 03-3581, 5271, ext. 434.) (Source: *STA Today*, January 1999)

Amulet3 to bloom in June

Amulet3, the asynchronous ARM processor designed at Manchester University, will be taped-out in June. Meanwhile, versions with more general purpose applications are being planned.

The first version of Amulet3 is a customized telecoms IC based on the asynchronous core surrounded by peripherals from other sources. It is being developed under an EU collaborative project with commercial partners so its specific application is secret.

Professor Steve Furber, head of the Amulet design team at Manchester University describes Amulet as an "asynchronous processing subsystem" rather than as a core. It is low power compared with conventional clocked chips and has low electromagnetic emission. This makes it ideal for portable applications combining processing power with radio circuitry. (Source: *Electronics Weekly*, 10 February 1999)

Problems with evolution and the CBM

One of the big problems with using genetic techniques to train large neural networks is the sheer amount of time it takes.

For every generation, each of a population of possible neural patterns has to be tested against training data. Then the most successful patterns have to be bred and mutated to spawn the next generation of patterns, which are tested—and so on.

"It normally takes about 100 generations for activity to settle down in one of the brain modules. This takes a whole day on my IBM laptop", said Dr. Hugo de Garis, who is developing an artificial cat's brain in Japan.

Once activity has settled and the module has been trained, a 90 kbit "chromosome" describing the interconnections within the module is stored for future use.

To speed evolution de Garis and Michael Korkin, president and CEO of Genobyte, have developed the concept of the CAM brain machine (CBM).

"The CBM can do in one second what it takes my laptop a day to do", said de Garis.

Genobyte, lead by Korkin, is responsible for the detailed design of the CBM.

When it is finished, it will consist of 72 Xilinx XC6264 FPGA, and be capable of updating 150 billion

CAN connections per second. But the CBM is not only the evolutionary force behind the brain, it is the brain.

After completing its task of evolving functional modules and module clusters, the CBM goes on to run the brain in normal operation.

The brain consists of 32,000 modules, but at any one time only one module is active and over 99.9 per cent of the brain is stored in a 1.22 Gbyte block of RAM.

The active module is within the CBM, which reconstructs its neural pattern from a 90 kbit stored "chromosome", initializes the state of each CA from a data stored last time the module was active, then "runs" the module to propagate data from its inputs to its outputs.

The CBM then restores the modules current state and moves on to running the next module.

In this way, the brain is run in a "module-serial" form. "The CBM is so fast that the brain can be run in real time", said de Garis.

Genobyte has licensed the right to build and sell CBMs and so far has contracts to supply three, complete with RAM blocks. The first will go to de Garis' Kyoto team; the second to Flanders Language Valley in Belgium, where it will be used for speech processing research at Lernout & Hauspie Speech Products; while the third will go to a Japanese corporation. (Source: *Electronics Weekly*, 10 February 1999)

Polymer beads in taste sensor

A taste sensor is being developed at the University of Texas, Austin.

Like smell sensors, it is based around chemical reactions. In this case, the chemical reactions occur on the surface, or in the body, of tiny polymer beads and result in them changing colour.

An array of the beads, all different (there are 59,049 types to choose from) and selected to match the range of chemicals to be detected, is immersed in the solution to be analysed, then the transmissive properties of the beads is assessed using a light source and a colour photo detector.

The university's chemistry department has developed the beads, which are typically between 10 and 100 μm in diameter. At this stage, they have the appropriate colour response, but are not dimensionally stable, and can double in linear size during operation. This exacerbates one of the problems of having dozens of tiny spheres in water, that they get washed away.

To counter this, the electronics department has developed a holder. This consists of tiny pyramidal pits etched into the surface of a silicon wafer.

One ball is positioned in each pit, then a thin glass cover is placed over the top. This cover is spaced just above the surface, leaving a gap that is narrower than the diameter of the beads. Alternatively, the glass can contact the silicon, and etched grooves can link the pits.

To detect the chemical reactions, the micromachined silicon slice can be mounted directly on a CCD photodetector array with a light on the far side of the beads.

Response time of the tongue is between 10 and 30 seconds.

Future developments may include integrating the system electronics into the silicon alongside the pits and adding photodetectors to the pit bottoms. Additional micromachining could add pumps and valves between the pits to control flow. (Source: *Electronics Weekly*, 20 January 1999)

Lightning may strike, but this cable will not break

A cable resistant to lightning strikes has been developed by a US inventor.

Known as lightning retardant cable, it was developed by Samuel Gasque working in conjunction with engineers at the Kennedy Space Center and Marshall Space Flight Center.

The cable uses the magnetic field generated by the lightning to ensure it follows a proper path to ground, rather than along the cable and destroying electronic equipment.

Gasque discovered that by placing opposing windings along the length of the cable, magnetic fields are produced when lightning strikes.

These fields are equal and opposite in magnitude and so cancel out. Cancelling the magnetic field stops current flow along the wire, preventing damage.

Gasque claims independent testing has shown the cable to be over 15 times more efficient at dissipating the effects of a lightning strike.

The cable is being marketed by Consumer Lightning Products, a NASA spin-off. Its first product will be a replacement kit for digital satellite dishes. Licences will also be sold to cable manufacturers.

Applications include cable TV, security cameras, electric gates and any other outdoor use of power or signal cables. (Source: *Electronics Weekly*, 20 January 1999)

"Individual" DSP claim

A US research firm has developed a digital signal processing (DSP) architecture that can be tailored to individual algorithms.

Infinite Technology Corporation (ITC) has named its system the reconfigurable arithmetic datapath (RAD).

Different blocks, such as arithmetic and logic units, RAMs and multiply accumulate units, are taken from a library and linked together on chip.

Each so-called "RADcore" is designed specifically for the task and algorithm in hand.

"The targeted end applications suited to RADcore are areas where high speed data throughout are required", said Robert Veal, ITC's vice-president of sales and marketing. These include videoconferencing and xDSL modems, he said.

The approach falls between that of programmable DSPs and field programmable gate arrays. The former is easier to programme, while FPGAs often produce faster signal processing circuits. Multiple RADcores can be placed on a single chip, each containing several of the blocks.

ITC is now developing an assembler for programming the cores. (Source: *Electronics Weekly*, 20 January 1999)

LAN transmits at 150 Mbit/s

Europe looks set to steal a march on the US and Japan with the development of a wireless local area network (LAN) capable of transmitting at 150 Mbit/s.

The prototype system is the result of the Median European ACTS research project. Comprising a basestation and two portable units, the system is expected to be fully operational in June, transmitting ATM (asynchronous transfer mode) cells at 150 Mbit/s across a 60 GHz radio interface.

According to Dr. Peter Smulders, a staff researcher at Eindhoven University of Technology who is involved in the project, the attraction of using 60 GHz is the massive amount of spectrum it offers.

At 60 GHz the frequency re-use distance is much shorter than that of GSM due to the air's attenuation. In an indoor environment this can result in an extremely short frequency re-use distance, confining the cell "to a room or a corridor".

Having a wireless broadband LAN promises a range of novel applications. "Office desktop PCs can be replaced by notebooks. People can go wherever they want and be automatically connected to the network", said Smulders. Moreover, the services will be broadband, the sort currently only available via cable.

Smulders stresses that it will be several years before such high-speed wireless notebooks become available. Before then he expects 60 GHz systems to be confined to niche applications: stockbrokers viewing multiple video channels simultaneously and medical staff viewing X-rays where staff do not have minutes to spare before viewing multiple images each 16 Mbit in size.

There are also significant technical challenges to be overcome before the technology becomes mainstream.

RF technology needs to mature to produce the necessary transmit power at 60 GHz. "At the moment only 10 mW is possible", said Smulders. The limited transmit power also results in a very limited link budget (the scope available to ensure sufficient signal strength to successfully receive data), and hence coverage. "This requires the use of smart, adaptive antennas to focus the beam on the weak signal." This is hard enough to do at GSM frequencies, said Smulders, never mind 60 GHz.

Yet another challenge is the amount of processing required at baseband: the Median prototype system requires a processing performance of 9 giga instruction/s.

All of which accounts for the project members' sense of achievement that a working system could be available as early as June. A follow-on project to Median is being planned. (Source: *Electronics Weekly*, 27 January 1999)

The ultimate weapon in the telemedicine armoury

Oak Ridge National Laboratory (ORNL) in Tennessee has been working on "medical telesensors", chips that attach to the body and measure vital signs. Signals are processed and transmitted as radio signals to a remote receiver.

The aim of this military funded project is to develop an array of chips which monitor body functions collectively. These telesensors will send the physiological data back to an intelligent monitor on a medic's helmet. When the data indicates that the soldier is in trauma the monitor will alert the medic who can take appropriate action.

The telesensors are application-specific integrated circuits operating at a low duty cycle from a thin-film Liion battery. Each chip has a sensor, processing electronics, modulation electronics, a transmitter and an antenna. The batteries are recharged by an externally-applied source.

To data a temperature sensor IC has been developed which can be attached to a finger or placed in an ear. Next in line is a pulse oximetry sensor in the form of a finger ring. This measures pulse rate and blood oxygen level by measuring the amounts of red and infra-red light absorbed from light-emitting diodes placed on the inner surface of the ring. Using two of the oximeters at different locations, the times of pulse arrival can be compared and used to estimate blood pressure.

Other developments envisaged include measuring the skin's electrical conductivity as a measure of stress and using accelerometers to measure pulse and respiration.

It is expected that the chips will also find applications in the civilian arena, for which ORNL is seeking funding. At the moment though funding generally is a problem. "The project has moved slowly due to a crunch on research funds", said Thomas Ferrell, researcher at ORNL. "We hope to obtain new funds in March." (Source: *Electronics Weekly*, 13 January 1999)

Sun belt: German firms plan solar power plant on Crete

Crete could soon have a new tourist attraction: German companies plan to build Europe's largest solar power plant in the south of the Greek island. Fifty megawatts of electricity are to be generated from 2002; that is one seventh of Crete's peak consumption. The sun's rays will be collected by enormous parabolic mirrors, not solar cells. A special thermo-oil flows through a tube at the focus of the mirrors and then heats water in a heat exchanger. The water vapour then drives a turbine. "Theseus" is the name of the project, with which the European Union aims to launch this form of solar energy. There are already plans for further plants. (Source: *Deutschland*, No. 3/1999)

Laser technology

It sticks well, is invisible, holds notices in place—and could soon play an important role in the world of computers: transparent adhesive tape could well be the data storage medium of the future. Computer scientist Steffen Noehte and colleagues at Mannheim University discovered by chance that the 90 layers of crystal clear adhesive tape wound onto a roll are exceptionally well-suited for laser processing. A laser beam burns digitally readable dots into the adhesive layer and scans them again when required. Rolls of tape can store three-dimensional images, texts, and music; they are also small enough to make them suitable for use in handheld computers and digital video cameras. The scientists want to develop a tape-based storage device with a capacity of three gigabytes. This corresponds to the contents of 2,300 conventional diskettes. (Source: *Deutschland*, No. 3/1999)

D. MARKET TRENDS AND COMPANY NEWS

Market trends

Six million GPS target

The worldwide market for global positioning system devices (GPS) is set to reach six million units in 2005, according to US market research firm Computer Economics.

This compares with 1.6 million units sold this year. Some GPS devices may experience problems later this year as the GPS satellite system resets its clocks, causing navigation errors in older systems. (Source: *Electronics Weekly*, 26 May 1999

Chip crisis soars as prices plunge

Further semiconductor casualties are expected in the memory market as DRAM prices once again plummet.

This follows industry standard 64 Mbit devices falling to $6 from a February high of $10. At one point the $10 price was forecast to remain constant all year.

At this pricing level it is difficult for all but a few manufacturers to make a profit. Companies with small die sizes and lower costs, such as Micron, Samsung and NEC can better weather the storm. But other firms, perhaps a Japanese DRAM manufacturer, might decide to throw in the towel and exit the DRAM market.

The short-term future looks grim. Only the pre-Christmas rush for PCs is expected to bring any respite. (Source: *Electronics Weekly*, 26 May 1999)

Flash shortage looms with move to 32 Mbit

A flash memory shortage is looming as mobile phone manufacturers move from 8 Mbit to 32 Mbit chips and the semiconductor manufacturers have constraints on their ability to ramp production.

Almost all flash capacity is coming out of a joint venture between AMD/Fujitsu (called FASL).

At the moment, FASL's expansion is coming from a move to more advanced processes. That means techniques like phase shift mask and optical proximity correction which squeeze finer geometries out of current equipment. (Source: *Electronics Weekly*, 16 June 1999)

Chip future puzzle

Confusion reigns in the semiconductor industry with the publication of widely varying market forecasts by the World Semiconductor Trade Statistics (WSTS) and Dataquest.

Both were published before the recent collapse in DRAM prices which may impact their prognoses.

WSTS expects a $141.4 billion world semiconductor market this year, Dataquest expects a $153 billion market.

WSTS is expecting 14.2 per cent annual growth rate from 1999 to 2002, while the much more bullish Dataquest is expecting a world chip market worth $244 billion by 2003.

By 2003, Dataquest reckons the American market will reach $83 billion, the Asia/Pacific market will grow to $58 billion, the European market will top $52 billion and the Japanese market will get to $51 billion.

"A key assumption to the forecast is a DRAM shortage starting in late 2000, which will cause DRAM revenue to peak in 2001. After that, the DRAM cycle of oversupply will repeat itself", said Dataquest analyst Ron Bohn.

A DRAM shortage could drive up DRAM revenues by as much as 22 per cent in 2001, says Bohn. According to UK analysts Future Horizons, the jump could be as much as 30 per cent.

But both assumptions were made before the May slump in DRAM prices which saw prices slashed to $6, while Micron, NEC and the Koreans are still adding to worldwide overcapacity.

Dataquest says that the key drivers for chip demand are PCs, consumer electronics and communications equipment, collectively accounting for about two thirds of all chips. Automotive electronics is shaping up into a fourth major category. (Source: *Electronics Weekly*, 2 June 1999)

Flat screens, fat profits

Liquid-crystal display (LCD) screens of the sort found in flat-panel personal-computer monitors, television sets, and notebook computers, is the fastest-growing bit of the semiconductor business; the market, worth $5.5 billion last year, will be $10 billion in 1999. And it is dominated by the Republic of Korea and Japan. Moreover, LCD prices and profits—unlike those of memory chips, the other big Asian semiconductor industry—are rising fast.

It is no surprise then that LCDs should be central to the biggest deal in the Republic of Korea since the Asian crisis broke in 1997. Philips Electronics agreed to buy half of LG LCD, an arm of LG Electronics, for $1.6 billion.

Fewer than a dozen companies around the world make the sort of big, "active matrix" LCDs that LG specializes in. These screens, which range in size from 12 to 15 in., cost between $300 and $600 each, and can account for up to a third of the price of a notebook computer. Demand is driven not only by growth in notebook PCs, but also by the rise in flat-screen monitors to replace bulky cathode-ray tubes. Today, flat screens can cost two or three times as much as a conventional monitor, which is why only 1 m flat-screen monitors were sold last year. But that number is expected to triple this year and, as the technology improves and costs drop, flat screens should eventually displace cathode-ray tubes almost entirely.

Memory chips were once a boom market too, but are in the midst of the longest slump in their history. Companies can enter the market relatively easily. That has led to a chronic oversupply in recent years, and pushed most of the industry into the red. LCDs, on the other hand, are inherently less cyclical. They are much harder to make—LCDs are basically one big semiconductor, so that whereas a single fault on a wafer would ruin just one of several dozen memory chips cut from the wafer, it could render an entire LCD screen useless. And the usual technique for increasing capacity in the memory business quickly by squeezing more, smaller chips on to a wafer does not work with LCDs: the demand is for larger screens, not smaller ones.

By next year the LCD market will be as big as the memory market and should overtake it next time the memory market turns down. Prices are up by 20 per cent or so and the growth of the overall market this year will add some $5 billion to the revenues of LCD makers. LG, which is the market leader, stands to do particularly well. Philips says it expects LG LCD's sales to rise more than threefold this year, to $1.8 billion. (Source: *The Economist*, 22 May 1999)

Wireless market

In a LAN market moving rapidly to 100 Mbit/s fast Ethernet and switched 10 Mbit/s Ethernet systems the 2 Mbit/s data rate offered by 802.11 systems has not proved much of an incentive to switch to the wireless office.

However, suppliers have been addressing the bandwidth issue with the result that 1999 should see the first systems conforming to a new higher speed version of 802.11 that operates at 11 Mbit/s. The expectation is that this is the data rate which would start to get the LAN equipment suppliers interested in 802.11 wireless LAN systems.

Prime movers behind the new high speed standard are LAN chip set suppliers Lucent Technologies and Harris Semiconductor.

The 11 Mbit/s version of 802.11 will use a variant of the direct sequence spread-spectrum radio scheme already specified in the original 802.11 standard. As well as increasing LAN data rate from 2 Mbit/s to 11 Mbit/s, the complementary coding scheme has been designed with silicon cost and power consumption very much in mind.

Lucent and Harris will both have new silicon this year. The Harris part will be based on its existing 802.11 chipset, known as Prism, but component count and power consumption will be reduced and the four devices will be manufactured on IBM's silicon germanium process.

Cost is not the only issue needed to be addressed with the new standard. The slow uptake of 802.11 systems to date has prompted a number of PC and telecoms firms to put forward their own ideas on wireless connectivity. One such proposal, the Bluetooth initiative from Ericsson, Nokia, Intel, Toshiba and IBM, has gained enough ground in the past two years to be taken seriously.

Bluetooth is not a direct alternative to 802.11 wireless LANs, as it principally supports short-range wireless interconnection between PCs and mobile phones. The issue for the 802.11 standard is to ensure that it is immune to interference from other wireless protocols, such as Bluetooth, which may be operating in the same 2.4 GHz frequency band.

With data rates rising and costs possibly about to fall, the last thing the LAN market needs is another reason why going wireless is a bad move. (Source: *Electronics Weekly*, 27 January 1999)

Chip makers at risk

A sharp rise in the costs of chip manufacturing may soon see several companies having to drop out because they can not afford it.

According to *The McLean Report* published by Bill McLean, president of IC Insights of Arizona, the cost of cleanrooms will go up three times in the first decade of the new Millennium, the cost of steppers will go up almost three times while the cost of unprocessed wafers will go up between 9 and 17 times.

Constructing a cleanroom capable of fabricating 0.18 μm linewidths on 8 in. wafers in the year 2000 is expected to cost from $5,000 per sq. ft to $15,000 per sq. ft for fabricated 0.10 μm linewidths on 12 in. wafers in 2010.

Stepper costs are on a similarly escalating trend. For 0.35 μm processing a stepper costs only $5 million, by the time 0.20 μm steppers became available the cost was $9.5 million, but, in 2010, when manufacturers will need to be processing 0.10 μm linewidths on 12 in. wafers, steppers will cost $24 million each, said McLean.

Currently 12 in. wafers cost $900 but once in full production the cost figure is expected to be $400. This is still a substantial increase on today's cost of a raw 8 in. wafer of $55.

These and a thousand other costs are expected to see the price of a fab increasing by 15 per cent a year through the next decade. McLean reckons that today's fab costing $1.5 billion will rise to $2.5 billion in the early 2000s and $6 billion by 2010.

One solution to escalating costs is to cut ramp-up time. Whereas 0.8 μm fabs took 36 months to ramp from first silicon to full production, quarter micron fabs took only 15 months, and 0.18 μm fabs should take 12 months.

Another problem facing chip makers is that biological viruses may start knocking out chips. That is because a defect in a wafer larger than half the minimum processed feature size will kill it. With the 0.10 μm processes of 2010, viruses at 0.05 μm and greater diameter will be chip killers. (Source: *Electronics Weekly*, 24 February 1999)

Chemical producers form alliances to serve semiconductor manufacturers

In two separate deals, companies launched alliances to improve their offerings to the semiconductor industry. The moves indicate an acceleration of a partnering trend that has been building in the electronic chemicals industry during the past year.

One of the deals struck was a global marketing alliance between Arch Chemicals and Air Liquide. The agreement calls for the two to mutually promote each other's complementary services to the chip makers they serve. The companies say the alliance includes all the gases and chemical products and services that semiconductor manufacturers require, providing a complete solution which simplifies operations and optimizes costs.

In a similar move, Praxair Inc. and Merck KGaA Electronic Chemicals announced a global partnership to provide high-purity process gases and chemicals, related equipment and site services to the semiconductor industry. The deal combines the companies' sales, product lines and organizations.

The two deals build upon a partnering trend among suppliers of electronic chemicals and gases. In 1998, semiconductor offering partnerships were formed between Arch Chemicals (then part of Olin Corporation) and Wacker Silicones Corporation, as well as between Mallinckrodt-Baker and Samsung America, and between Ashland Chemical Company and Taiwan's Union Petrochemical Company.

Air Products also announced it will extend its business downstream by manufacturing semiconductors in a partnership with a subsidiary of US Filter Corporation. (Source: *Chemical Market Reporter*, 19 April 199)

Voice over the Internet

Voice-over-the-Internet will have a significant effect on the telecommunications industry, according to Motorola. It predicts that over 30 per cent of all voice traffic will be sent over data networks by 2003.

"One of the things we should realize in terms of the trends of the market is that voice-over-Internet-protocol (VoIP) is a reality, it is going to happen", said Gabriel Dusil, marketing director at Motorola's Internet and networking group.

"The industry has identified that data over the voice network is no longer a viable solution", said Dusil. The maximum data speed possible over analogue lines is 64 kbit/s, whereas data network already reach speeds of up to 2.5 Gbit/s.

The technology has yet to reach the general consumer but Dusil is convinced it will. US market research firm IDC believes the VoIP market will exceed $1.8 billion by 2003. However, it notes that VoIP is still very much a trial balloon and that interoperability and standards development remain a key issue. (Source: *Electronics Weekly*, 17 March 1999)

Fuzzy logic gains interest

Interest in fuzzy logic control is growing among European domestic appliance makers, claims STMicroelectronics.

Far Eastern manufacturers have been incorporating fuzzy logic control for a considerable time, using it as a marketing tool. This has not happened in Europe.

STM is launching a range of microcontrollers which have native fuzzy logic instructions. (Source: *Electronics Weekly*, 17 March 1999)

The year of the home network?

The idea of linking home computers in an office-style network has been around about as long as the computers themselves, but despite the steady growth of multi-computer households, few consumers were interested. The technology was too hard for people to use, and the benefits did not justify the considerable expense of installing special wiring.

1999 will be the year that home networks start to make sense. Computers are cheap enough that Dataquest estimates that 15 million US households own at least two. Soon, inexpensive high-speed Internet service will become available to millions of homes through cable systems or new fast phone links. But these connections will come one to a house. So for computers to share them, they will have to be networked.

Equally important, you will be able to link computers at low cost, without networking expertise and without installing any new cabling. The method that will make the biggest initial splash, at least in North America, will use existing phone wiring to transmit data. A consortium of companies called the Home Phoneline Networking Alliance jump-started the market by agreeing that every one would build their first products using a technology called HomeRun from Tut Systems, so that equipment from different companies will work together.

Although Internet sharing is the best reason for a home network, computers can also exchange files and share accessories such as printers or Zip drives—or run multiplayer games.

The set-up is a lot easier with the built-in networking from PC makers such as Compaq Computer and add-on kits from companies such as Diamond Multimedia Systems and Boca Research. These packages include software that configures the network automatically, allowing all PCs to share files and printers and setting up one computer as an Internet gateway.

HomeRun networks run at one megabit per second, and because they use standard Ethernet technology, HomeRun systems can be cheap; Compaq expects that phone-wire networking should add less than $50 to the price of a desktop system.

The limitation on phone-wire systems is that you can only put a PC where there is a phone jack. This will be a problem in some older homes and especially outside North America, where most homes have only one or two jacks. Here, a wireless solution is a better answer. In operation and set-up, it is much like phone-wire networking except that it uses radio waves.

Wireless networking companies have agreed on a draft standard, but current products from different vendors will not work together. Wireless is a bit faster than phone wire, but also more expensive. Diamond sells its Home-Free wireless networking in starter kits consisting of two plug-in boards for desktops or one plug-in board plus a PC card for a laptop for about $200. Prices for Proxim's more versatile Symphony system start at $149 for a desk-top card. Proxim eliminates the need for a gateway PC that must be powered up all the time with simple stand-alone gateways that give any networked computer access to the Net. A gateway, including a standard v.90 modem, costs $299, while a device that works with a cable modem or fast phone link is $399. (Source: *Business Week*, 18 January 1999)

Japan de-emphasizes DRAM production

The reduction in capital spending by the Japanese semiconductor companies suggests that all the main players, except NEC, are de-emphasizing their DRAM plans.

Matsushita is the latest company to exit the DRAM business after it announced that it will stop making and marketing DRAMs for PCs as from this month. It joins Nippon Steel Semiconductor which was sold to UMC of Taiwan, and Oki Electric which pulled out of the business.

The giants are expected to be Samsung, Micron Technology, LG/Hyundai and NEC, although Toshiba points out it has enough capacity to supply between 12 and 13 per cent of the world market.

However, Toshiba, Hitachi and Fujitsu are phasing out commodity product to concentrate on the high-performance, high-density, differentiated end of the business (Rambus, Double Data Rate, Virtual Channel, etc.). Toshiba expects to reduce 64 Mbit production by 90 per cent to one million pieces a month by December as it brings up 128 Mbit instead.

Matsushita's exit was not unexpected because it had closed down an old DRAM fab in Puyallup, WA, USA, last year, had postponed upgrading its Tonami DRAM fab, and had put back construction of a fab at Niigata. The company said it will continue to make some DRAM for its consumer electronics division.

Mitsubishi Electric is another company de-emphasizing DRAM with the establishment of Taiwanese production at Powerchip Semiconductor.

The Japanese capacity to produce advanced DRAM will be well down in 2000/2001 and, without a product to replace it, companies are going to find it hard to make the capital investment which is essential for future competitiveness in semiconductors. (Source: *Electronics Weekly*, 7 April 1999)

EDA market rises

The electronic design automation (EDA) industry grew 21 per cent in 1998 with sales revenues of $3.26 billion.

The figures, from the EDA Consortium, show that Europe overtook Japan for the first time, posting revenues of $642 million, a growth of 22 per cent. In contrast, sales in Japan grew just one per cent.

Of the different categories of tools, IC layout was again the fastest growing.

Last year companies bought $560 million worth of layout tools, a 30 per cent increase over 1997.

Other quick growing areas include analogue and mixed signal simulation, analysis and VHDL simulation.

Consulting services sales were $370 million, a growth of 50 per cent in 1998. (Source: *Electronics Weekly*, 7 April 1999)

Sematech members hit by chip recession

The chip recession has had a bearing on Sematech, the semiconductor industry R&D consortium which rescued the US chip industry after the Japanese took the DRAM market away from it in the mid-80s.

Sematech's annual report says it will spend $25 million less in 1999 than its $160 million 1998 budget.

National Semiconductor has said it will leave the consortium at the year end "for financial reasons". National's former president, chip industry pioneer

Charlie Sporck, was the prime mover in the setting up of Sematech.

Another member pulling out this year is Digital following its takeover by Compaq. This leaves Sematech with eight members: Advanced Micro Devices, Conexant (formerly Rockwell Semiconductor), Hewlett-Packard, IBM, Intel, Lucent Technologies, Motorola and Texas Instruments.

The members of International Sematech are Philips, Siemens, STMicroelectronics, Hyundai, and Taiwan Semiconductor Manufacturing Co.

Sematech has been asking for more full members and is waiving the rule that they must be American. (Source: *Electronics Weekly*, 5 May 1999)

Graphics IC sales "astound" analysts

Sales of graphics chips are booming with almost a 40 per cent increase in 1998, says US market research firm Jon Peddie Associates (JPA).

Graphics chip sales rose by 39 per cent to $2.4 billion, a rate of growth that JPA calls "astounding". In terms of unit growth, shipments grew over 20 per cent in 1998 to reach 113.7 million units.

ATI was the leader in unit shipments of chips with a 30 per cent market share, followed by S3 with 21 per cent. Matrox came in third and Nvidia showed strong growth to finish in fourth place. Intel held just one per cent of the market but 1998 was its first year as a merchant supplier of graphics chips. (Source: *Electronics Weekly*, 21 April 1999)

Chip price falls again

Memory makers cannot agree on the cause of the latest drop in DRAM prices. Some claim that "maybe" chip vendors are pre-shipping April requirements to their customers at low prices in order to make their March budget figures.

The market situation, according to James Hone at DRAM price trackers ICIS-LOR, is that the price on the PC100 64 Mbit synchronous DRAM has now slipped to $7 in the US and $7.10 in Asia from $7.50 and $7.80 respectively at the beginning of the month. This comes on top of a severe reduction from $10 at the beginning of the year.

"Demand is poor and there's oversupply", said Hone.

However, there are a number of rumours in the market that may have affected pricing sentiment. One example is that Compaq has decommitted to Micron Technology—one of the top three suppliers—which could free up a lot of products in the spot market.

Another explanation is that top tier PC makers have decided to go with PC133 DRAM rather than wait for Rambus and are buying up as much PC133 as they can from the more advanced DRAM manufacturers at the expense of PC100.

There are also reports that the reseller channel is clogged with PCs while the PC makers still churn out machines at full tilt.

Japanese companies have been cutting back production, but the Koreans are reported to have upped production in Q1 in the wake of the 64 Mbit reaching $10 at which price it was profitable. (Source: *Electronics Weekly*, 21 April 1999)

Get on down

The audio format known as MP3 has shaken up the music industry with an explosion of content and electronics companies are hoping it will lead to new mass market electronics products.

MP3 is the popular term for the audio format technically known as Motion Picture Experts Group (MPEG), Audio Layer 3, a way to compress audio files. With MP3 digital audio files can be compressed with a 12:1 ratio (MiniDisc uses 5:1) and yet still retain almost CD-like audio quality.

This open standard has been embraced by hundreds of thousands of Internet users as a way to turn their PC systems into jukeboxes with thousands of MP3 converted CDs on their hard drives, and easily download MP3 encoded music over the Internet without having to wait hours to download the original music file.

Hundreds of on-line music sites have sprung up show-casing free MP3 content with the most popular one, MP3.com, hosting more than 4,000 artists and adding almost 100 new artists every day.

With millions of downloads of MP3 music, electronics companies worldwide have spotted a potentially large market for electronics products that can decode and play MP3 music without necessarily requiring a computer. Diamond Multimedia was the first to enter the market late last year with its Rio player, a small, portable solid-state device that plays MP3 music downloaded from a PC.

The recording industry, seeing the potential for MP3 as an on-line distribution medium decided to launch a similar initiative but focused on an audio compression technology that is secure and would not allow free distribution in the same way MP3 does. Major record companies formed the Secure Digital Music Initiative (SDMI) last December, with plans to introduce a secure audio compression technology by the end of this year.

But the SDMI initiative is far too late to make much impact on the huge momentum that has emerged behind MP3, a momentum that has not gone unnoticed by Silicon Valley's venture capital firms which recently invested $11 million in MP3.com. This momentum is best illustrated by a simple fact: the term "MP3" is the second most requested search term according to company Searchterms.com.

For electronics companies, the potential business opportunities are in MP3 decoding chips, flash memory data storage modules, and various types of MP3 players whether portable, designed for the living room, cars, and add-in boards for PCs. There are now more than 30 MP3 related electronics products either already launched or planned for launch later this year including European efforts such as the German firm Pontis Electronic with its Mplayer3.

While many electronics firms hope to carve out profitable businesses thanks to the popularity of MP3, the actual business model for selling MP3 music has not yet developed, threatening its future prospects. With Internet users accustomed to large amounts of free content whether it is text or in the case of MP3, CD-quality audio, it is difficult for MP3 supporters to create a profitable business model. (Source: *Electronics Weekly*, 17 February 1999)

OECD communications outlook 1999

The latest edition of the biennial OECD *Communications Outlook* shows total revenues of the communications sector, including telecommunication services, broadcasting services and communications equipment, to have surpassed one trillion dollars for the first time.

At the end of 1997, the total telecommunication services market in OECD countries had grown to more than US$ 617 billion. This compares to US$ 584 billion in 1996 and US$ 539 billion in 1995. The main driver of growth was mobile communication with one in every five dollars being spent going towards mobile services. For telecommunication providers, the Internet is providing a tremendous new market for products ranging from leased lines to second residential lines and in call traffic.

In 1988, monopoly structures were the norm for telecommunication service provision and competitive markets the exception. By 1998, this situation had been reversed. At the end of 1998, six OECD countries (Czech Republic, Greece, Hungary, Poland, Portugal and Turkey) still maintained monopolies in some market areas but they have made commitments to open their markets by specified dates.

There has been a large growth in the number of telecommunication operators, due to liberalization allowing new players to enter fixed and mobile communication markets. The OECD's telecommunication database draws on financial data of around 150 companies and more than 90 of these companies operate in the mobile communication services market. In 1997, there were 64 telecommunication operators with revenues greater than US$ 1 billion up from 42 in 1992. In 1997, there were 25 telecommunication companies with mobile revenues greater than US$ 1 billion. New entrants have clearly made the biggest impact in mobile communication having captured 44 per cent of the mobile services market. In the overall telecommunication market, new entrants now account for 19 per cent of market share.

In 1997, investment in telecommunication networks in the OECD area reached a record US$ 151 billion, with mobile investment of US$ 40 billion. The Internet was also having a considerable impact on investment by telecommunication companies as they race to upgrade networks in the face of competitive markets. The Internet is also having a huge influence on the use of communication networks. For example, in 1975, there were around one million interactive bibliographic searches performed in the United States for the entire year. By September 1998, Internet users viewed an average of 144 million web pages per day alone from "Yahoo!", a major search engine.

The patterns of communication developing in OECD countries with mobile communication and the Internet would have been affordable to only a few prior to market liberalization. Monopolies kept prices high and rationed services. In 1980, an international telex, sent within Europe, with 1,000 characters cost an average of US$ 1.17 (expressed in 1998 dollars) and accessing a teletext page of the same size could cost US$ 0.08. The charge for placing content on one teletext page was around US$ 8 per annum. By way of contrast, for residential users, the price of sending electronic mail, browsing web pages and creating personal home pages is now available for the price of Internet access. The *Communications Outlook* provides a comparison of the cost of Internet access and a range of other telecommunication services in all OECD countries.

The data provided by the OECD *Communications Outlook* covers the last decade up to 1997/1998. The indicators are provided in a harmonized format and mainly on a country-by-country basis making it possible to analyse developments and highlight future trends. In order to complement the national figures, an extensive range of additional firm-level data are also provided for leading service suppliers. Further information on this publication is available on the OECD Web site: http://www.oecd.org/dsti/sti/it/cm/prod/com-out99.htm (Source: *News Release*, 16 March 1999)

1999 will be year for open platforms

Schlumberger believes that this year will see the first significant deployment of open platform smartcards. This will help in the development of applications that will coexist on the one smartcard.

The company also believes that the PC application sector for smartcards is set for growth following Microsoft's endorsement of smartcards. In particular, smartcards will be used for network security and enable e-commerce applications.

"Once Microsoft's marketing power is behind it that will drive the market," said a Schlumberger spokeswoman.

According to Schlumberger's figures, the overall smartcard market grew 30 per cent last year and is predicted to grow the same amount again this year.

Contactless cards will show the greatest change by doubling in number, although the volumes involved are comparatively small. Payphone cards are still the biggest market accounting for 70 per cent of smartcards but this share is predicted to drop to 50 per cent by 2002. (Source: *Electronics Weekly*, 3 March 1999)

Hot prods to "triple in value"

The world market for high temperature electronics products is expected to triple in value in the next six years.

So claims AEA Technology Products & Systems team leader, Richard Sharp, who said that the global market will be $400 million next year and reach $1 billion by 2005.

Research at AEA shows that while semiconductor devices typically meet their electronic specifications at temperatures up to 250° C, the intrinsic limit is 400° C due to the packaging materials.

For aerospace and automotive the temperatures can be up to 300° C.

AEA's Sharp said that silicon-on-insulator devices operate reliably at higher temperatures than straightforward silicon. For temperatures greater than 350° C, wide-band gap semiconductors are needed. Here, silicon carbide is the main contender, being the most technologically advanced; gallium nitride being still at the research stage. (Source: *Electronics Weekly*, 3 February 1999)

The bizarre new world of chips

The semiconductor market is undergoing a dramatic change. For the last three years, the growth in the use of chips used for handling communications—data transmission, Internet access, wireless and land-based phone calls—has exceeded that for chips designed for PCs. At present, chips incorporated into computers still account for about half of total industry revenues, compared with about a fifth for communications chips. According to the market research firm Integrated Circuit Engineering, however, revenues derived from communication chips will grow at 15 per cent a year over the next five years, compared with 10 per cent a year for computer chips.

Intel has dominated the computer chip market for the past decade. Now firms such as Texas Instruments, Motorola and Lucent Technologies—joined by newcomers such as ARM Holdings, Broadcom and PMC-Sierra—are jostling for a share of the new opportunities opening up in the marketplace.

As more and more services become available on the Net, non-PC devices such as cell phones and set-top boxes are expected to become ubiquitous. Increasingly, we are witnessing the merger of computing and consumer electronics. Merging the functions of multiple chips within a single one (a "system-on-a-chip") makes possible a whole series of new digital devices. Next year, for instance, Lucent will be able to offer a cellphone-on-a-chip device which previously would have required eleven chips.

Intel has reacted quickly to this emerging information-appliance market by moving away from its previous Pentium-only stance. It sells a low-end chip originally based on an ARM design, and is working with Mattel to develop toys which are extensions of a PC. (Source: *Fortune*, 1 March 1999)

Notebook PCs

The market for notebook computers continues to grow at a rate twice that for desktop machines, despite the fact that prices for the former have not declined as dramatically as those for the bigger units. This popularity reflects changing working patterns: according to the Gartner Group, more than 108 million employees will regularly work outside the conventional office environment by 2002.

In January, Intel introduced new 333 and 366 MHz Pentium processors, as well as two Celeron processors, all aimed at the mobile computing market. Notebook manufacturers will also be looking to introduce the Pentium III at the top end as soon as possible.

The fourteen-inch screen is starting to become standard, with a fifteen-inch display available. Integrated CD drives are now commonplace. Despite this, the size and weight of devices continues to decline: Dell, Toshiba and IBM are now offering machines weighing less than 2.5 kg and measuring less than a couple of centimetres thick. Another key area of improvement is that of standardization, such as the new mini-PCI standard.

The remaining major constraint on weight reduction is battery technology: increased power means more demands placed on the battery, so much so that some manufacturers have been forced to include two battery bays. Lithium ion will remain the primary battery technology for the present, as lithium polymer is still relatively expensive and requires longer charge times. (Source: *Information Week*, 17 February 1999)

Changing roles for the PC

The future of the PC could change this year. Instead of racing up the Hz and bytes trail it could become a cheap tool to be bought for under £100 as a stand-alone, or incorporated as an extra feature into loads of other products such as TVs, telephones, set-top boxes, remote controls and VCRs.

The moves to commoditizing the PC look irresistible, and the strongest of them is the move to cheap microprocessors.

New Celerons at 400 MHz are being offered for £50 and AMD and Cyrix are selling equivalents cheaper. The most expensive component in a PC is almost a commodity.

But what would happen if we get the universal microprocessor that is promised by the Silicon Valley start-up Transmeta backed by Microsoft co-founder, Paul Allen.

If a universal micro capable of running any application whether written for Unix, the MacOS or Windows—were licensed freely, it could be produced like bottle tops for next to nothing.

With the hardware costing a few tens of dollars and the Linux OS available free, and with Java and Netscape navigator available free—the nearly-free PC is almost with us. In a subsidized form it already is.

Commodification might mean that PCs will be tailored to the needs of consumers, easy to use, performing simple functions like e-mail, word processing and Web browsing efficiently and reliably, sending error messages in clear comprehensible English, and crash-proof.

Commodification might mean that these machines will get cheaper to produce by 30 per cent every year like other electronics goods, and that manufacturers will pass on these costs reductions to consumers.

Commodification might mean the end of the creeping obsolescence of PCs as new, more powerful models running new software make last year's machine old hat.

If PCs are just going to provide e-mail, word processing and Web browsing, then they can be made on a single chip and sold as cheap consumer items called "information appliances" or can be incorporated into TVs, set-top boxes, or even telephones. At last, simple PC/IT technology may get into the majority of homes.

It has taken a long time. Back in the 1970s the French Government tried to kick-start the process with the "Minitel" data terminal, and the UK tried to do the same with Teletext.

Like many government schemes of that era, people liked them, but no one could find a way to make money from them.

Then came the runaway success of the mobile phone and everyone was carrying around sophisticated technology. But would mobile phones have succeeded if they had been sold at cost?

Will the commoditized PC be the vehicle which finally turns on the non-techie majority to IT? Has the PC's future already been overtaken by events? (Source: *Electronics Weekly*, 17 March 1999)

Electronic commerce

Get ready for an entirely new Internet in 1999

In this summary, Frank Gens, IDC's Senior Vice-President, Internet Research, predicts key Internet trends, strategies and events that will reshape business and society in 1999. Mr. Gens' predictions, which have been more than 70 per cent accurate over the last three years, rest solidly on IDC's in-depth research.

Major predictions for 1999

- Mergers and acquisitions: Yahoo! Partnering with TimeWarner or CBS;
- Web access will become available in many retail stores, while live sales people can be reached through retail Web sites;
- Personal computer (PC) prices will drop to the US$ 400 price range and finally penetrate more than half of US homes;
- Men will become the new minority on the Web, as will the US as a whole;
- Internet usage will rocket to 147 million users, larger than the population of Japan;
- On-line spending will total nearly US$ 1 trillion by 2002;
- Disruptions from Y2K will be as low as 0.2 per cent for business-critical applications.

Just as everyone thinks they know where the Internet is going in 1999, we are going to shift into a decidedly new phase in the Internet revolution. The Internet is going to closely mirror reality in who the Internet shoppers are and where they live, how businesses succeed on the Net and how Internet stocks are valued in the market. These Internet marker shifts will create new opportunities and risks, resulting in new winners and losers.

Three years ago, IDC shocked the market by predicting US$ 800 to 1,000 for PCs and in 1998, predicted major strategy shifts by Microsoft, Intel, Compaq and other key players. The success of its predictions has been not to focus on what suppliers say they will do. Instead, IDC focuses on what the market will require suppliers to do.

Certain trends will emerge:

- 50 per cent of US households who are on-line will buy on-line;
- Virtual sites will become voice-enabled to give customers live sales assistance and customer support;
- "Bricks-and-mortar" retailers will introduce Internet kiosks into their stores to give customers the information resources of the Internet;
- Personalization will be the ante for successful commerce sites;
- There will be a growing demand to measure the value of on-line sites in terms of "lifetime value of customers";
- Reaching international customers will become a critical success factor. (Source: *ITU News*, April 1999)

Company news

Firms force DRAM pace

The end-game in the long DRAM debacle is under way with US supplier Micron Technology apparently

intent on forcing the pace which may push the weaker players out of the market.

After three years in which the value of the DRAM market has declined from $40 billion to $14 billion, prices are still falling like a stone. Dataquest's memory analyst Richard Gordon says that the contract price for 64 Mbits has now hit $5, and Henry Warren of ICIS-LOR's DRAM pricing tracking service says that the spot market has seen some Taiwanese 64 Mbits selling for $3.90.

These are disastrous prices for the industry with everyone making a loss. Analysts say the prices may cover die cost but the package is getting chucked in for free.

The industry has split between "bit-pushers" and "technology-pushers".

With the leading players already down to 0.20, the ability of their current tool-sets to keep shrinking die is running out, reckons Gordon. With every e-vendor making large losses the question is: which will run out first—the technology or the money? Either way the crunch should come this year. (Source: *Electronics Weekly*, 7 July 1999)

Panasonic creates a nursery for fresh ideas

Panasonic plans to open a 20,000-square-foot incubator in Cupertino, CA, that will house some 15 to 20 start-ups. To go along with its Panasonic Digital Concepts Center, the company will also set up a $50 million venture capital fund to support the firms.

The incubator is the result of a decision made two years ago, when Panasonic, the consumer electronics arm of Japan's Matsushita Electric, decided it needed to get a grip on the much-heralded "convergence" of TVs, personal computers and telephones—all of which Panasonic manufactures.

Appliances such as TVs, PCs and DVD (digital versatile disk) players, now all have the same basic technology inside. Namely, microprocessors. The question for Panasonic is what happens when all these devices start talking to one another.

The incubator's first prospective tenant, InterActual, is developing software that adds an interface to DVD movies that allows a consumer to "play with" the movie on a computer DVD-ROM optical disk drive (a new generation optical disk drive). (Extracted from *Technology Review*, May/June 1999)

Intel/HP come clean on Merced processor

Intel and development partner Hewlett-Packard have revealed the first major disclosure on the forthcoming Intel IA-64-64-bit microprocessor, codenamed Merced.

The companies have posted on their Web sites an *Application Instruction Set Architecture Guide* for the IA-64 which describes the application instruction set, architecture features and programming model for IA-64 processors.

The disclosure sheds more light on a controversial new technology called EPIC (Explicitly Parallel Instruction Computing), based on a combination of advanced computer architecture concepts such as speculation, predication and parallelism processing.

IA-64 processors will have 128 integer registers, 128 floating-point registers, and 64 predicate registers along with a number of special-purpose registers. Instructions will be bundled in groups for parallel execution by the various functional units.

But EPIC still has to be proved to work and some industry analysts point out that EPIC will do little to boost current applications and will require special compilers to unlock the potential of IA-64 microprocessors. (Source: *Electronics Weekly*, 2 June 1999)

Matsushita in 0.25 μm move

Actel has announced that its foundry partner Matsushita has developed a 0.25 μm manufacturing process for antifuse FPGAs.

Moving to a smaller process means faster, cheaper devices. Actel is predicting a 32,000 gate chip capable of running a 66 MHz PCI-core. The use of a 0.25 μm process means that FPGAs based on antifuse and SRAM technologies are now using the same process geometry.

The reason antifuse has caught up with SRAM is simple, said Actel. Technologies such as multi-voltage transistors and chemical/mechanical polishing, once unique to antifuse, are now commonplace. (Source: *Electronics Weekly*, 7 April 1999)

US firms secure China CDMA deal

Motorola and Lucent Technologies have secured a $500 million contract to provide a Chinese telecommunications company with CDMA equipment.

The contract raises the prospect that China will embrace CDMA 2000, the US-based third generation proposal for the International Telecommunications Union's IMT-2000 standard, rather than the rival European UMTS standard.

However, the deal is complicated by the telecoms company, Great Wall, being half-owned by the Chinese military.

China's sanctioning of CDMA technology opens up a huge potential market for US and European wireless communications companies. The Chinese Government expects to introduce CDMA services to as many as 40 million users by the end of 2000.

US telecommunications firms, however, want China to change the rules on foreign investment in local telecommunications companies. (Source: *Electronics Weekly*, 7 April 1999)

BT and Microsoft to develop and deploy Internet and Intranet services for mobile users around the world

BT and Microsoft have announced an agreement to develop a new range of Internet, Intranet and corporate data services for mobile customers.

For the first time, these services will allow mobile users outside North America to access securely Microsoft's broad range of Internet and corporate applications which they rely on in the office and at home. Customers could, for example, access applications such as e-mail, calendaring, personalized Web content and on-line information services using their digital mobile phone, pager, handheld or laptop computers.

Trials will begin in the UK in the spring of 1999, with services expected to become available in several countries by early 2000. Under the agreement, the new services will be developed and marketed worldwide by BT and Microsoft, and offered by Concert, BT's global communications company. (Source: *ITU News*, April 1999)

Merced ready by autumn

Intel has promised to have samples of its Merced microprocessor ready by this autumn.

Merced is late, however, with Intel originally promising the chip in volume production by the end of this year. The company has also hedged its bets with plans to produce further generations of its 32-bit chips because of the delay in producing Microsoft Windows NT 64-bit operating systems which are necessary to unlock the performance of its IA-64 line.

Intel's Geyserville technology will be out by the end of this year which allows mobile versions of Pentium III to run at higher speeds when plugged into a power outlet. (Source: *Electronics Weekly*, 21 April 1999)

Microsoft gives CE real-time capability

Microsoft will release a version of its Windows CE operating system with real-time capabilities by the year end.

Microsoft president Steve Ballmer promised a Windows CE version with real-time operating system capabilities in the fourth quarter. He also outlined the company's market push to get Windows CE into a range of consumer electronics devices. "Windows CE does not require a hard disk which makes it great for low-end machines."

Microsoft is late in adding real-time features to Windows CE. Last year it promised to deliver these features by the middle of this year. This has limited Windows CE's use in many embedded applications, to the benefit of real-time operating system providers such as Wind River, ISI and Microware. (Source: *Electronics Weekly*, 14 April 1999)

Lucent teams up on big optical storage

Lucent Technologies and Siros Technologies have teamed up to produce optical data systems which promise a storage capacity ten times that of magnetic systems.

Siros will use a very-small-aperture laser head developed by Lucent's Bell Labs to read and write data. The 50 nm aperture laser allowing it to potentially store data at densities of 200 gigabit per sq. in., higher than the density limit of magnetic disks and even higher than using small wavelength blue lasers. (Source: *Electronics Weekly*, 14 April 1999)

Intel will fight for Rambus

Intel is squaring up to the rest of the semiconductor industry over the Direct Rambus memory interface standard.

While DRAM makers are finding Rambus difficult and expensive to make, test and qualify, Intel is pressing for an autumn introduction.

Memory companies complain that testing direct Rambus DRAM is expensive because "you cannot write to a location and read it back, you have to read a string and then do the error checking"—a practice which involves using more testers than usual.

Other manufacturers have identified a bug in the interface which would require a redesign on every masking level. This could result in half a year's delay. (Source: *Electronics Weekly*, 14 April 1999)

Siemens announces 400 Mb/s Gbit DDR SDRAM

Siemens Semiconductor (Munich, Germany) recently announced production of its first double date rate (DDR) 1 Gbit SDRAM. It was developed with IBM at the company's Advanced Semiconductor Technology Center (ASTC) in East Fishkill, NY. Samples packaged in 16 mm-wide TSOP 88 will be available in the second quarter.

The 1 Gbit SDRAM will be available in x16 and x32 configurations and can achieve a 400 Mb per second per pin data rate. In its 32 bit-wide configuration, the device allows system data rates of 1.6 GB/sec. Main applications for the 1 Gbit SDRAM are high-end servers, workstations, networking devices and portable computing devices.

The chip uses 180 nm (0.18 μm) CMOS technology with four level metalization. The 2.5 V device is based on the trench cell concept from Siemens' previous DRAM generations, and it takes up an area of 390 mm^2. (Source: *Semiconductor International*, January 1999)
www.semiconductor.net

Samsung simplifies gigabit DRAM design

Researchers from Samsung (Kyungki-Do, Republic of Korea) developed a new DRAM cell technology that merges storage node and memory cell contact processes

to provide a simple, manufacturable process for 4 Gb DRAMs. The new cell scheme combines photolithography steps for the storage node and storage node contact, removing the shrinking alignment tolerance between the memory cell contact and storage poly. The new process eliminates the polysilicon etching step in addition to the buried contact lithography step, two "bottlenecks of sub-150 nm DRAM cell processes", according to Samsung. (Source: *Semiconductor International*, January 1999) www.semiconductor.net

Where no chip has gone before

Motorola has become the first major chip maker to commit itself to making biochips. The company plans to start by building a blood analyser based on a biochip, and it says that it will eventually produce hand-held machines that can perform genetic tests or detect disease.

Motorola is one of the leading producers of semiconductor devices. Its processors power Apple Macintosh computers, and it is the world's largest manufacturer of silicon micromachines, such as airbag sensors. Now it aims to develop biochips in which all functions, whether they are electronic or biological, are integrated on a single sliver of silicon.

The company will make improved versions of the DNA "microarrays" that can rapidly spot mutations or reveal which genes are active. Such devices are already available, but they are relatively large, test for only a few thousand genes and must be read using bulky laser scanners. Motorola plans to merge detection and readout on a single chip. Later, a chip that purifies DNA from a tissue sample—one of the most cumbersome parts of any genetic test—will be developed. (Source: *New Scientist*, 20 March 1999)

Philips develops fastest silicon BiCMOS process

Philips Semiconductors (Eindhoven, The Netherlands) has announced a silicon BiCMOS process technology that can be used to produce devices with f_{max} values of ~70 GHz. This is roughly twice the typical values previously achieved for silicon production devices and is comparable with those of SiGe and GaAs ICs. Philips estimates the new process can be used to fabricate devices at about two thirds the cost of SiGe and GaAs products.

This new QUBiC3 process can integrate high-frequency RF bipolar circuits with high-speed CMOS logic blocks onto a single chip. Philips plans to use it to produce a new range of high-speed, high-reliability RF front-end ICs that are scheduled for release in 1999. The company claims these products will enable it to maintain a leading position in the aggressive mobile telecommunications market.

The CMOS part of the QUBiC3 process currently employs a mature 0.5 µm process with 0.42 µm effective gate lengths. It is supported by a comprehensive set of design libraries and tools. An improved double polysilicon technology is used in the bipolar section of the circuit, which has an effective emitter geometry of <0.3 µm. It uses a self-aligned silicide and a low-capacitance interconnect system.

Hydrogen silesquioxane (HSQ), which has a low dielectric constant of 3.0, is used as the insulating material between metal layers formed in the QUBiC3 process. The use of HSQ insulation results in a 45 per cent reduction in stray capacitance relative to use of conventional insulating materials that have a dielectric constant of ~4.0. The reduction in parasitic capacitance is vital for achieving optimum high-frequency performance. Philips claims this unique feature, combined with the ability to achieve extremely high-speed switching and a very low noise figure of only 0.6 dB means that QUBiC3 is the ideal process to make ICs for low noise amplifier designs and mobile telecommunications applications. Its low noise and distortion are claimed to match the best offered by SiGe and GaAs.

Philips claims complex SiGe technologies, which may be limited to just two metal interconnect layers, can require up to 30 masking layers for fabrication. However, the same performance with twice as many layers of interconnect can be obtained using QUBiC3 and just 26 masking stages in silicon. Work has now started on a 0.25 µm QUBiC4 process that aims to achieve an F_{max} of 90 MHz. (Source: *Semiconductor International*, January 1999) www.semiconductor.net

Nokia dials networking

Mobile phone firm Nokia has surprised the networking industry by saying it will introduce wireless LAN systems for laptop computers later this year.

Nokia is the latest firm to show renewed interest in the wireless LAN market following the adoption of a higher-speed version of the long-standing wireless interface standard known as IEEE 802.11. Extensions to that standard will increase the wireless LAN data rate from 2 Mbit/s to 11 Mbit/s.

Nokia will join wireless LAN adapter card suppliers like Nortel Networks in bringing out products supporting 10 Mbit/s data rates. (Source: *Electronics Weekly*, 3 March 1999)

Siemens in wireless link-up

Siemens' information and communications division is close to forming a partnership to develop its next generation wireless information appliances.

The company also announced its strategy to expand its share of the mobile phone market. Siemens plans to increase its market share with the introduction of a low-cost mobile phone. Last year the company had made the mistake of concentrating on high-end, expensive mobiles. (Source: *Electronics Weekly*, 17 February 1999)

Intel goes giga

Intel is ramping up a 0.13 µm volume production process expected to produce gigahertz microprocessors by the end of the year.

It also expects it to be its workhorse process until 2002 and sees no need to move to copper technology until after then.

Intel's Fab20 in Oregon, where the process was developed, is now being turned over to full production with the process which delivers etched polysilicon gates with a width of 0.13 μm.

Within one year two more production fabs will have the process installed. It has already delivered a 900 MHz 16 Mbit SRAM. According to Pierre Mirjolet, Intel's architecture marketing manager, "before year's end it is very likely it will demonstrate gigahertz microprocessors".

Intel is using 245 nm wavelength steppers to produce the 130 nm feature sizes.

Intel does not expect to use copper interconnect until 2002. Mirjolet said that aluminium interconnects could be made larger than copper interconnects which outweighed much of the resistance advantage of copper.

With half a logic chip's area taken up with interconnect, Intel has given a higher priority to improving the performance of the interconnect than to improving the performance of the transistors or memory cells.

By using fluorine doping in the 0.13 μm process, capacitance had been reduced by 15 per cent and interconnect performance increased by 15 per cent.

At the end of 2001, Intel will move to 193 nm wavelength steppers and, after that, to 157 nm machines until, it hopes its "extreme UV" technology becomes available—probably in 2005—which delivers 13 nm wavelengths. (Source: *Electronics Weekly*, 17 February 1999)

One2One and Orange to trial UMTS

Mobile phone operators One2One and Orange have announced trials in the UK for third generation services based on UMTS, the universal mobile telecommunications system.

One2One has signed up with Ericsson to use its UMTS trial facility being set up in Guildford.

Meanwhile, Orange is working with Ascend, Cisco and Fujitsu to set up a multimillion pound trial in the Bristol area.

Both trials will offer users a range of services, such as multimedia phones that include video and high-speed Internet access.

UMTS promises to increase bandwidth to between 384 kbit/s and 2 Mbit/s, depending on the distance to basestations and whether the mobile user is travelling or not.

The technology is based on wideband code division multiple access (W-CDMA) technology. However, the International Telecommunications Union (ITU) has yet to decide upon its official standard for third-generation networks. UMTS could end up as a Europe only network, with no worldwide roaming capabilities.

However, with the UK Government delaying the licensing of spectrum for third generation mobiles, this should ensure the eventual ITU standard is used within the UK. (Source: *Electronics Weekly*, 17 February 1999)

Micromachined light projecting pixel

Just when it was thought it could not be done, someone has developed another way to make a micromachined light projecting pixel.

Texas Instruments has its Digital Micromirror Device, Daewoo has its Thin-firm Micromirror Array, now Sunnyvale, California-based Silicon Light Machines has its Digital Light Machine (DLM).

DLM is significantly different from either the Texas or Daewoo devices in that it does not use a conventional mirror, however small. Instead, it uses light-wave interference techniques to turn pixels on and off.

The technology behind DLM was originally developed and patented by Professor David Bloom and his students at Stanford University where its was called a grating light valve.

Each DLM pixel consists of a number of parallel reflective strips held above a flat surface. When the strips are all relaxed, they form a flat mirror, reflecting light that impinges upon them.

However, if every second strip is pulled down towards the surface by a quarter of a wavelength, destructive interference occurs above the strips and the pixel does not reflect.

The surrounding optics can actually be arranged to treat either of these states as "on" and a grey-scale can be developed by deflecting the moving strips less than a quarter wavelength.

Switching speed is fast: "It has been demonstrated at 20ns", said company CEO Dave Corbin. This gives an alternative route to a grey-scale using temporal modulation.

As the pixel action depends on wavelength, it is colour-sensitive. For a full colour projector, "you would use three devices for red green blue. They would be identical, but operated at different deflections by the driver circuitry. Alternatively, one device could be operated with the colours in a time sequence", said Corbin.

Several devices have been prepared. A typical pixel consists of three pairs of strips each 100 μm long and 4 μm wide. Claimed reflection efficiency of the complete pixel, including diffraction and inter-strip gaps, is around 70 per cent says the company. This can be raised somewhat by the use of more complex optics which collect more of the diffracted light.

The first demonstration of a digital light machine was a 1,920 x 1,080 pixel HDTV projector. This was generated using a 1 x 1,080 pixel array and optically scanning the image to get the second dimension.

This technique, says Corbin, is easy to implement and gets the company away from the problems of yield

when producing reflective devices on silicon. (Source: *Electronics Weekly*, 3 February 1999)

Summer launch planned for 0.1 μm chip-making process

Motorola has a 0.1 μm chip-making process which will be ready for production this year, claims the company.

According to the Semiconductor Industry Association's (SIA) roadmap, a 0.10 μm feature-size manufacturing process is only expected in 2006. Motorola has said that the technology, based on phaseshift masks, will be used in production this summer. It has not explicitly stated that the products will have 0.10 μm features. The company has only said that a microprocessor, almost certainly a PowerPC, with 0.1 μm features has been successfully made on a production process. Applying the known phase-shift mask makes Motorola the first to embrace the technology, however.

Conventional masks are diffraction-limited as feature sizes approach the wavelength of light used in the stepper. Phase-shift masks actively use diffraction to produce crisp sub-wavelength features. (Source: *Electronics Weekly*, 10 February 1999)

BP Amoco takes pole position

BP Amoco has stepped up its commitment to sustainable energy by taking full control of Solarex, its 50/50 solar power joint venture with US group Enron. The deal makes BP Amoco the world's largest solar energy company.

Once the $45 million deal is completed, Solarex will be merged with BP Solar to create a new company, BP Solarex. This is expected to control roughly a fifth of the global solar market with an annual turnover in the region of $150 million.

BP Amoco's chief executive described the acquisition as a "significant step" towards building a $1 billlion solar business by 2010, a target set in 1997 as part of the company's pioneering interest in sustainable development.

Although the current market for solar products is less than $1 billion per year, analysts expect this to reach around $6 billion per year by the end of the next decade. Renewable energy sources will probably account for half of global energy consumption by 2050.

Solarex has manufacturing sites in Virginia and Australia producing solar modules with an annual power-generating capacity of 16.8 MW. Adding BP Solar's operations in California, Spain, Australia and India will increase output to around 30 MW, more than either of the current market leaders, Kyocera of Japan and Siemens Solar.

The merged company is expected to have a leading position in thin film manufacturing, a new process using vapour deposition to build up solar cells on sheets of glass. The new company will also be strong in polycrystallines, an older but more expensive manufacturing process for solar cells based on silicon wafers. (Source: *Chemisty & Industry*, 19 April 1999)

Intel debuts 3D PC chipset

Intel has introduced its first PC chipset to integrate a 3D graphics controller in an assault on the low-end PC market.

The 810 chipset, formerly code-named Whitney, integrates the company's latest i752 graphics controller.

Other companies already have products in the market with embedded graphics, but these alternative chipsets work with clone x86 devices from AMD and Cyrix.

Along with its Celeron processors, Intel now has a route to cheaper PCs.

Cost for the 810 varies from $25.50 to $32 in 1,000-unit quantities, depending on the version.

Intel has also released a stand-alone version of the i752 3D graphics core, but its performance is not enough for a stand-alone chip.

However, the move confirms Intel's intention to stay in the graphics chip market. Much more powerful products will be announced in a year or two. (Source: *Electronics Weekly*, 5 May 1999)

Hitachi hits high at 1,000 Mips/W

An embedded processor that hits the elusive performance/power figure of 1,000 Mips per Watt has been announced by Hitachi.

Running at 133 MHz from a 1.5 V supply, Hitachi claims the SH7751 processor manages 240 Mips while using 240 mW of power.

Versions running at 167 MHz will also be available. They, however, require a slightly higher operating voltage of 1.8 V and hence power is 400 mW at 300 Mips.

In addition to the improved performance/power ratio, Hitachi has added an on-chip controller for the PCI-bus.

The bus conforms to revision 2.1 of the PCI specification. It can connect with four PCI devices at 33 MHz and one at 66 MHz. Maximum bandwidth is 264 Mbyte/s across the 32-bit bus.

The SH-4 was designed for video applications so it integrated a powerful floating point unit. A maximum of seven floating point operations can be executed each clock cycle, leading to 930 Mflops or 1.2 Gflops at 133 or 167 MHz.

The SH7751 has separate direct mapped instruction and data caches and a memory management unit. An on-board memory interface works with DRAM, SRAM, ROM and PC Cards.

Hitachi will start manufacturing the SH7751 in August using a 0.18 μm, five layer metal process. This should allow the device to reach 200 MHz. (Source: *Electronics Weekly*, 12 May 1999)

Now it's World Wireless Web

With the Cellular Telecommunications Industry Association (CTIA) Wireless '99 trade show in New Orleans as the backdrop, several major alliances and products were announced that will bring the World Wide Web to millions of users of cellular phones and handheld computer devices.

Motorola announced an alliance with leading network equipment firm Cisco Systems to invest more than $1 billion over the next four to five years to build a wireless Internet. The two firms will develop hardware and software standards to simplify the connection of wireless devices to the Internet.

Motorola also joined Netscape Communications and Unwired Planet to support Nextel Communications' Nextel On-line family of wireless Internet services. Netscape will produce an on-line portal called Nextel On-line to help deliver Internet-based services to wireless device users.

Most significant of all for the UK market was Microsoft's alliance with BT. The two companies aim to create wireless Internet services based on devices using Microsoft's Windows CE operating system. The intention is to start first trials of such a system in the UK on BT devices using a small Web browser developed by Microsoft called a "microbrowser".

Canadian communications equipment firm Nortel Networks announced what it calls its "Webtone" service, an IP-based communications network providing wireless communications devices users with access to the Internet.

The CTIA notes that traffic on traditional wireline telecommunications networks is more than 50 per cent data-based, with most of that being Internet data. But while wireless communications networks attract large numbers of users, less than two per cent of that traffic is computer data.

Wireless communications firms realize that by adding connections to the Internet they can attract new classes of users to which they can sell Internet services. Voice-based wireless communications is growing but prices are falling due to competition.

With Internet-based data services, companies will be able to build potentially lucrative new revenues, and electronics firms will in turn benefit from new types of mass market wireless communications products. For example, it will be simple for wireless-based devices to allow users to check their bank balances and download other Internet-based information, and also engage in e-commerce.

The next issue will be, which operating system will become the standard for mobile Web browsing and the like? The recent US initiatives, especially the Microsoft alliance with BT, could challenge the potential success of the European Symbian mobile operating system joint venture. Backed by UK firm Psion, Nokia, Ericsson and Motorola, Symbian's EPOC32 operating system is being proposed as a competitor to Microsoft's Windows CE, which along with the support of wireless firm Qualcomm is being pushed heavily in the wireless Internet arena.

Perversely, some industry observers say that Symbian may now have a better chance of success because many communications companies do not want to see Microsoft dominating the wireless communications market in the same way that it dominates desktop computer markets. (Source: *Electronics Weekly*, 17 February 1999)

E. APPLICATIONS

Smart solar energy system headed for the public

A novel system that uses the power of the sun to directly heat water is about to become commercially available after years of development and testing at the National Institute of Science and Technology (NIST).

An exclusive licence has been granted to Four Seasons Solar Products Corp. of Holbrook, NY, to use the NIST-patented technology. The solar water heating system is the first to use photovoltaic cells and computer chips to harness and direct the sun's energy. PV cells convert energy from sunlight into electricity. The NIST system uses an array of these cells to transfer solar power to specially designed heating elements inside a hot water tank.

The system can use as many as six heating elements. A microprocessor monitors the energy produced by the photovoltaic cells, and then determines which heating element or combination of elements to use in the tank. This process enables the system to work very efficiently, taking advantage of the varying amounts of solar energy harvested throughout the day and optimizing the output from the solar cells.

The system eliminates durability and reliability issues associated with previous solar thermal hot water systems. Solar thermal systems heat water by pumping water or an antifreeze solution through solar collector panels. These systems require the use of pipes and circulating pumps to transport the fluid from the storage tank through the solar collectors. The PV solar water heating system does not require a circulating pump or pipes to transport the collected energy to the storage tank; it uses conventional house wiring.

Engineers developed and tested the system at NIST's Gaithersburg campus. Several other successful pilot projects have shown that the system works well in different climates. For example, one system supplies hot water in the rest rooms at the Sugarlands Visitor's Center within the Great Smoky Mountains National Park. The system is also in use at the Florida Solar Energy Center and at two US military housing units in Okinawa.

Further information from: Philip Bulman. Tel.: (301) 975-5661; e-mail: philip.bulman@nist.gov (Source: *NIST Update*, 2 August 1999)

Textures could make the Web a lot more fun

A motorized computer mouse can give Web surfers the sensation of texture—or other physical attributes—of items pictured on the Net.

Running the cursor over a picture of a tennis racket lets a user feel the tautness of the strings, the texture of a pair of corduroy jeans or test-drive a car, and the "Feel It" mouse even simulates an attempt to move through a heavy wind.

Until now, the technology to create such a mouse was only available in consoles and joysticks for computer games. Originally developed by Stanford University and NASA, force-feedback technology was first used for flight simulation. Recently, Immersion Corporation in San Jose, CA, managed to achieve the fast data exchange rates needed to provide realistic tactile sensations when someone is shopping on the Web.

The mouse is attached to a pad which contains two motors in a small housing at the top, one to move the mouse right to left, and the other to move it up and down. As you move your cursor over an image on a Web page, embedded motion commands are sent to a microprocessor in the mouse, telling it how to move to produce the desired sensation.

Internet shopping sprees aside, one of the best applications for this technology is in schools, says Robert Tinker, a physicist who runs a non-profit-making company dedicated to using emerging technologies in education. Tinker plans to use the force-feedback mouse to teach children about the forces of nature, especially the atomic level forces they cannot see.

The $99 mouse goes on sale in the US in the autumn. For the technology to proliferate, Web designers need only download free software from www.FEELtheWEB.com to embed the relevant Feel It commands in images. (Source: *New Scientist*, 10 July 1999).

Japan's latest micromachines can hunt in packs

A tenacious micromachine that can hunt for flaws in pipes in confined spaces has been developed by a consortium of three of Japan's largest industrial companies. Measuring less than a centimetre in length, the

"experimental chain-type micromachine" (ECTM)—so named because several can be chained together—incorporates miniature gearing and one of the world's smallest electric motors. The device was developed with government funding by Sumitomo Electric, Matsushita and Mitsubishi Electric, under the auspices of the Micromachine Center in Tokyo. It is designed to inspect the exterior surfaces of inaccessible pipes in power stations for cracks and flaws.

Even with a prototype, the ECTM is not ready for commercial exploitation. First, the researchers will have to develop an on-board power source, since the wires supplying the ECTM limit its range. There is scope for battery power—the ECTM weighs 0.4 grams but has the capacity to carry loads up to twice its own weight.

Japanese companies are trying to gain a lead in micromachine technology, which they believe will be a crucial market in the next century. (Extracted from *New Scientist*, 3 July 1999)

Smart baggage

Most air travellers would agree, airline baggage-handling systems could stand some improvement. Part of the problem are the bar-coded ID tags required for routing. To extract tag data, reader and tag must be in close proximity and properly aligned. The process is slow because bar-code readers can scan only one tag at a time. Moreover, tag data is fixed, so bags need new labels when itineraries change. Such limitations force nearly half of all baggage today to be routed manually.

Speeding to the rescue is a new smart luggage tag based on radio-frequency identification (RFID) from Philips Semiconductors Inc., Sunnyvale, CA. What looks like an ordinary paper label actually contains sophisticated antenna circuitry and programmable memory. These throw-away transponder tags receive power and data from a 900-MHz, RF antenna. Unlike optical bar codes, RFID tags may communicate up to 1.2 m away, even when the path is obscured by other bags. Best of all, the antenna can simultaneously read multiple tags and change stored data.

British Airways is now conducting shake-down tests of the RFID system at several European airports. If all goes as planned, the next stop may be the US. Such systems could help airlines comply with FAA regulations that require each luggage piece to be paired with a passenger before a flight departs. For more about smart tags, click on Philip's Web site: www.semiconductors.com (Source: *Machine Design*, 3 June 1999)

Signal change

Researchers at the University of Surrey's centre for communication systems research have developed and patented the "intelligent quadrifilar helix antenna". This continually adjusts its characteristics to ensure that the power transmitted and received by phones is directed to the best possible location. Four antennas are twisted around each other to form a helix, which, together with some smart circuitry, senses the signals received and combines them for best results. The same combining method is used when transmitting, so the transmitted power can be considerably reduced. (Source: *Engineering*, May 1999)

Bypassing nervous system damage with electronics

Although the effort to marry neurons and microelectronics into hybrid circuits is still in its infancy, neural prostheses that artificially stimulate the nervous system to partially restore lost vision, hearing, or movement are, paradoxically, much further along. In part, that is because they need only stimulate groups of cells rather than contact individual neurons. Heading the list of successes are cochlear implants, which use implanted electrodes to stimulate auditory nerves and provide rudimentary hearing to the deaf and have already been received by over 20,000 people. The US Food and Drug Administration recently approved related implants to improve bladder control and restore hand grasping abilities to quadriplegics. However, the obvious problem is communicating with the body's complex set of neurons. In just the eye, for example, 1 million nerves carry stimuli from light receptors in the retina to the brain. Stimulating all those nerves independently remains, for now, an impossibility,

Surprisingly, however, much has been accomplished with relatively crude electrical inputs. Cochlear implants, for example, connect at most 22 electrodes to auditory nerves in the cochlea that respond to different sound frequencies. When a tiny microphone outside the ear picks up sound, it passes the sound to a signal processor behind the ear that analyses it and signals an implanted electrical pulse generator to stimulate the appropriate electrodes in the cochlea. Although this does not provide perfect hearing, people with the implants typically pick up enough sound to carry on a conversation.

Other researchers are now trying to forge related technology to restore sight by stimulating cells in the retina, the optic nerve, or the brain's visual cortex. At Johns Hopkins University School of Medicine in Baltimore, MD, for example, Mark Humayun and his team have temporarily implanted a 3-millimetre-wide array of 25 electrodes atop the retina of one eye in each of two elderly patients with retinitis pigmentosa. (This hereditary condition slowly degrades the eye's light sensors, known as rods and cones, eventually leaving patients totally blind.) An external unit sends electrical signals to the electrodes via wires passing through a tiny slit in the eye.

In an upcoming issue of *Vision Research*, Humayun and his colleagues describe how the retinal stimulation allowed both patients to perceive complex shapes, such as squares and letters. The team is already working to create more complex arrays and control circuitry that would transmit signals through the skin via radio waves so that the arrays could be permanently implanted in the eye. "There's fundamentally no reason why you can't take a blind person and get them to see coarse features consistent with mobility", says Humayun.

Devices that provide rudimentary muscle control have also made strides. P. Hunter Peckham and his colleagues at Case Western Reserve University in Cleveland, OH, for example, have shown that a series of eight implanted electrodes that directly excite different muscle groups in the forearm and hand can restore hand gripping movement to quadriplegics.

Peckham says that he and his colleagues are currently working on adding electrodes so as to restore fine motor control of the hands and arms. The team is also making steady progress with a variety of other neural prostheses, such as one that helps paralysed patients stand and even walk, as well as an advanced version of a bladder-control device now on the market. (Source: *SCIENCE*, vol. 284, 23 April 1999)

Raring to go

Electric cars that crawl up hills could get a power boost from a new capacitor that stores charge at a hundred times the density possible in standard devices. The ultracapacitor could also help reduce battery bulk in devices like cellphones.

Conventional batteries release energy slowly, which is fine for devices such as transistor radios that need a steady source of low power, but not for those that require high power for brief intervals. To meet those peak requirements, engineers have had to use much larger batteries than would otherwise be needed. So researchers at the Los Alamos National Laboratory in New Mexico took a fresh look at capacitors, which store electrical charge on the surface of two parallel plates.

To increase the density of stored charge, the conducting carbon fibres that make up the paper-thin plates of their ultracapacitor were coated with conductive polymers, greatly increasing its surface area. Los Alamos developer Steven Shi says the ultracapacitor could give an accelerating burst to electric cars while providing weight savings by combining it with a conventional battery—though they do not say how many more visits to the charging station will be necessary. (Source: *New Scientist*, 24 April 1999)

Samsung mobile has Web access and Bible

A mobile phone capable of Internet access and containing a Bible, a Buddhist Canon and an English-Korean dictionary has been developed by Samsung Electronics. The phone has built-in Internet protocol software, enabling e-mail and Web access without connecting to a PC.

A 30 x 70 mm touch screen allows data such as addresses, memos and diary dates to be entered. Character recognition is claimed to be 95 per cent accurate in English and 98 per cent in Korean.

The phone's memory can store 2,000 addresses, a year's worth of schedules and 100 memos. The English-Korean dictionary contains 80,000 words, the Korean-English 50,000 words. An engineering calculator performs trigonometry, exponential functions and statistics.

Samsung said 110 researchers spent three years developing the phone. (Source: *Electronics Weekly*, 7 April 1999)

Novel power supply gets to the heart

Increasingly, electrical devices are being implanted into people. Some of the more ambitious in-body systems, including artificial hearts, are too power-hungry to be powered from batteries and have to be supplied from outside the body.

One option for getting the power in is to run a cable right through the skin. This is possible, but infection is a constant threat.

Transformers, with one coil outside the body and one coil inside, avoid the infection problem. Unfortunately, coupling efficiency is compromised because the skin is thick, between 5 and 15 mm.

In a paper submitted to the IEE's *Electronic Letters* (vol. 35, No. 2), a team from the Nanyang Technological University in Singapore has described a transcutaneous transformer which can transmit 20 W of power at 90 per cent efficiency.

The transformer employs an unusual geometry. The primary core is ferrite around which a 21-turn coil is wound. The secondary core is made from amorphous metal ribbon and has 27 turns.

Litz wire, made from many thin insulated strands, is used for both windings to reduce losses due to the skin effect.

An external 100 kHz oscillator provides power which is rectified inside the body. The coupling coefficient between the coils is 0.65 with a 5 mm skin thickness. (Source: *Electronics World*, May 1999)

Surgical tools from silicon wafers

A painless hypodermic needle could be one of the first surgical tools made using a technique borrowed from computer chip makers. The needle is one of several surgical devices built by Amit Lal of the University of Wisconsin in Madison. Lal predicts that by using extremely sharp instruments that vibrate at ultrasonic frequencies it will be possible to make incisions that cause hardly any pain.

With a normal cutting tool, pain is thought to arise because of tissue distress caused by chafing of the tool's edges. But Lal says that by vibrating the tool at an ultrasonic frequency reduces these forces and eliminates the pain.

Ultrasonic cutting tools like this have been used for cataract surgery for some years, but they are expensive and prone to overheating. Lal says his tools would be much cheaper and more robust. His idea is to etch surgical tools from silicon wafers, using the same kind of photolithography techniques that are used to make computer chips.

Lal says this proven technology allows him to create tools with microscopically fine detail, making them ten times as sharp as traditional scalpels. It is this sharpness,

and the fact that his devices are vibrated eight times as fast as conventional ultrasonic cutting tools, that is the secret of a painless cut. In the future, he says, another bonus of using silicon will be that sensors could easily be built into a tool, integrating it with a computer and exploiting the material's electronic properties. (Source: *New Scientist*, 17 April 1999)

Fibre sensors detect fatigue

Optical fibres are affected by their environment. This can be a problem in shipping data long distances, but exceedingly useful for a sensor maker. Temperature, force and pressure can all now be measured by their effect on fibres.

By making use of force sensitivity, reports the IEE's *Electronic Letters* (vol. 34, No. 21, page 1991), fibres are now being used to measure physiological parameters.

The sensor concerned is the size and shape of a wrist watch and has been developed by a multi-discipline academic team from Lorient in France to indicate the phases of human sleep.

It measures the heartbeat, blood pressure variations, breathing frequency and breathing amplitude.

In the sensor, a fibre is trapped between two metal plates, one of which is ridged. Forcing the plates together causes the ridges to deform the fibre which changes its attenuation through variations in refractive index at the contact points.

A 1 mW laser diode and a photodiode allow the attenuation to be sensed.

An ordinary elastic wrist watch strap holds the assembly against the inner wrist and, being attached to the outer plate, sets a bias force on the fibre.

The signal from the photodiode is processed using a Texas Instruments *MPS 430*, transmitted over an RF link, then further processed to extract the required parameters.

Although the first application will be in sleep analysis, the developers see it finding use in other medical areas and industry. For instance, it could be the basis of a fatigue detector for workers operating dangerous machinery. (Source: *Electronics Weekly*, April 1999)

Perfect scans

Compact hand-held scanners are usually simple to use, but suffer one big drawback: a wobbly hand produces a wobbly image. Now a system developed by the California-based computer giant Hewlett-Packard makes it possible for even the unsteadiest of hands to create clear images. The scan can be sent straight to a laser printer, without requiring a computer to process the image.

To get acceptable results from traditional hand-held scanners, you have to make sure that you move the scan head evenly across a document. This makes these devices slow and awkward to use. A slight slip of the hand is likely to leave an unsightly smudge across the image. And if the document is wider than the scanner, you have to make several scans and tape them together.

Hewlett-Packard's new device, which it calls CapShare, avoids all this by simultaneously performing two kinds of scan. While it scans text, photos and graphics, it also records magnified images of the grainy texture of the paper, and uses this information to work out exactly how the scanner is moving. So as the device is swept across the page it is able to compensate for any unevenness or wobbles in the movement.

The scanner uses two high-powered sensors on its underside, which Hewlett-Packard calls navigators. Each one contains an array of image sensors 47 pixels square, which can pick out detail in the texture of the paper just tenths of a millimetre in size. At this scale, the unique patterns of imperfections and indentations on the paper's surface stand out.

As the scanner moves across the page, it records a succession of images which it immediately correlates. To achieve this while scanning at 40 centimetres per second, the image processor has to correlate 200 million pixels per second.

Images captured by the scanner can be viewed on a built-in screen, or sent to a computer or directly to a printer via a wireless infrared link. When you point the scanner at a computer or a suitable printer it will figure out where the scanner is going, what format is most suitable for the printout and even what paper sizes are available. One of the biggest challenges in developing the new scanner was squeezing all the components into such a compact device. (Source: *New Scientist*, 27 March 1999)

Movie mail

A camera that squeezes video images into a compact new format will soon make it practical to send many minutes of video over the Net by e-mail. The technology, which will be launched in June by Sharp of Japan, will also make it much easier for websites to display moving pictures over low bandwidth connections.

Sharp's Vn-EZ1 Internet Viewcam is around the size of a mobile phone and weighs 150 grams. It shoots video, converts it to compressed digital data using the new MPEG-4 standard, and stores it in a 32-megabyte one-hour memory card like those used by digital cameras.

Digital TV needs bandwidths between 2 and 20 megabits per second, but MPEG-4 reduces this to just 10 to 100 kilobits per second. Originally conceived for sending video to mobile phones, its relatively low bandwidth makes it ideal for use over the Net.

MPEG-4 separates moving objects from their stationary backgrounds and compresses them in different data streams. It does this by breaking down each frame of a sequence into block areas, and only codes the difference between blocks in successive frames. The two streams are then combined to generate the image.

The camera's memory card is slotted into a PC adapter to allow editing, or transmission as an e-mail attachment or part of a Web page. The camcorder will cost around £600. (Source: *New Scientist*, 3 April 1999)

Optical fibres can pinpoint dangerous spills

A leaking pipeline carrying chemicals or oil can lead to catastrophe unless the hole is quickly detected and repaired. But when pipelines are thousands of kilometres

long, problems can be difficult to spot. Now a British engineer says he has the answer, in the form of a super-sensitive optical fibre that can detect and locate spills.

At present, petroleum and chemicals companies usually examine long pipelines visually, from a helicopter or a land vehicle. Chemicals companies are beginning to try out sensors based on electrochemical or semiconductor cells, which detect electrical or temperature changes associated with the presence of a particular substance and trigger an alarm.

But any network of sensors, no matter how extensive, always leaves gaps, and in windy conditions it can be hard to tell which alarm is nearest a gas leak. So Frank Kvasnik of the University of Manchester Institute of Science and Technology has designed a chemically sensitive optical fibre that can be laid alongside a pipeline, or throughout a chemical plant or ship. If a leak occurs, the fibre undergoes a chemical change which alters its optical properties. This allows the leak to be detected and pinpointed almost instantly.

In any optical fibre there is an inner glass core surrounded by a layer of transparent polymer "cladding". The key is the difference in refractive index between the two: if they are correctly matched, no light can escape from the fibre. To keep the cladding layer intact, and maintain the necessary difference in refractive indices, normal optical fibres are protected by a tough outer sheath.

The fibres Kvasnik proposes using as detectors turn this idea on its head. His fibre uses a permeable silicon-based cladding containing chemicals that react with the substance being monitored. This reaction changes the refractive index of the cladding, altering the optical properties of the fibre. In effect, the presence of the chemical causes a fault in the fibre, allowing light to leak out.

But merely detecting a fault in the fibre is not enough. So Kvasnik has borrowed a trick from the telecoms industry. Called optical time domain reflectometry, it works by regularly sending short pulses of light down the fibre. Any fault or break reflects a portion of this light back to the source. The time delay between the initial pulse and the arrival of the reflected light is a measure of how far the fault is along the fibre, with an accuracy of about half a metre.

Kvasnik has already built a 100-metre stretch of fibre capable of detecting ammonia leaks. Next, he hopes to develop a fibre sensitive to methane, for use with gas pipelines. He hopes the principle could be used to detect a range of environmentally damaging chemicals, including petroleum. (Source: *New Scientist*, 20 March 1999)

Massachusetts recycling programme turns computers into pothole filler

The State Department of Environmental Protection has joined forces with the American Plastics Council to promote the recycling and marketing of plastics from electronics.

A lightweight, asphalt-type mix can be made with the plastic portions of computers, along with such equipment as printers, paper trays and scanners.

A pothole filler has been developed by Conigliaro Industries Inc. of Framingham, which processes up to 12.5 tons of computer and other plastic housings every day.

Discarded electronics account for 75,000 tons per year of solid waste in Massachusetts alone, the Department said. By 2006, the volume of waste generated is expected to be 300,000 tons per year. (Source: *Nature*, 7 April 1999)

"Canary chip" to sniff the air at dangerous moments

A "canary chip" that can detect tiny traces of dangerous chemicals by using minute acoustic-wave chemical sensors should be in use as part of a hand-held chemical detection system within two years.

Using microsensors, each about the size of a grain of rice, to detect the presence of chemicals is part of a project at Sandia, an American government laboratory, to develop a hand-held "laboratory" the size of a palmtop computer. The acoustic wave sensor—called a "canary" chip after the old practice of taking a canary down the mines to provide advance warning of gas leaks—is one piece of equipment in that laboratory.

According to Steve Casalnuovo, a Sandia scientist who has been working on the integrated sensor for over three years, the breakthrough has been to integrate the chemical-sensing transducer and microelectronics on to a single substrate.

They can be so small that an array of as many as four or five miniature sensors, each about 2 x 0.5 x 0.5mm and sensitive to different chemicals, could be built on a chip the size of a shirt button.

Potential uses include mobile chemical-detectors on robotic vehicles sent to the site of a chemical spill and by soldiers in battle.

The base material of the sensor is gallium arsenide instead of the usual quartz. Traditionally, acoustic-wave chemical sensors are made from quartz. However, quartz cannot be integrated with microelectronics. Gallium arsenide is seen as particularly suitable because like quartz, it is piezoelectric—it can convert electric signals into acoustic pressure waves—and it is the best available semiconductor for making the high-frequency microelectronics needed to operate the sensors.

When specific chemicals are absorbed into the piezoelectric layer, the acoustic waves travel more slowly. This change can be detected when the wave is converted back to an electric signal.

Sandia researchers say the sensor electronics could be connected to an alarm that would activate when the slowdown in the acoustic movement on the polymer layer indicates that a certain chemical is in the vicinity.

Casalnuovo said a major milestone for the project was making the acoustic sensors alongside the microelectronics without degrading the performance of either. Often, combining technologies throws up incompatibilities. He added that the team was investigating new types of acoustic-wave device that could provide even

more sensitive chemical detection. (Source: *Electronic Telegraph*, 8 April 1999)

Laser sensors will help keep waterways clean

The murky depths of polluted rivers are being illuminated by lasers. Engineers say they have come up with ways of using ultraviolet laser light to monitor the polluting potential of discharges from factories and sewage works in real time.

"Until now, it has taken three to five days to get samples analysed in the laboratory", says Rafi Ahmad of the Centre for Applied Laser Spectroscopy at Cranfield University's site in Shrivenham, Wiltshire. Attempts to operate continuous monitors based on chemical analysis have been messed up by the pollution itself.

Now a collaborative project involving Ahmad's Cranfield team and the water engineering research group at the University of Hertfordshire has perfected a technique that uses ultraviolet lasers to provide an instant reading of key pollution figures.

By detecting how the polluted water scatters light, sensors above the surface can measure levels of key pollutants, including nitrates, chlorides, phosphates and organic waste from sewage and food processing. The concentration of organic waste can be used to calculate the water's biological oxygen demand (BOD)—the amount of oxygen that will be consumed by bacteria feeding on it. A high BOD will asphyxiate fish.

The two universities have now applied to Britain's Engineering and Physical Sciences Research Council for funding to turn their experimental system into a prototype pollution monitor.

With further development, mobile laser monitors could also be flown on planes to check for high levels of sewage in seawater off beaches and issue instant warnings to bathers. (Source: *New Scientist*, 13 March 1999)

NXT puts sound on screen through thin clear speaker

NXT, the flat-panel loudspeaker company, has developed a thin transparent speaker that can be fitted over a display and produce stereo sound.

In the first public demonstration, one was fitted to a slimline notebook computer, although the technology is said not to be limited to small screens. "It could be applied to a 60-in. television", said company spokesman John Watson.

The company claims that the technology, which it is calling SoundVu, is ready for use.

For NXT, it is too early to talk about licensees because the demonstration was the first time anyone outside the company had experienced SoundVu in action.

The display itself takes no part in the sound production, although Watson will not rule out using the display structure to make sound in the future. Instead the speaker sits in front of the display with an air gap. The speaker adds "a couple of millimetres, if that" to the display thickness, said Watson.

Driving the speaker from the top or bottom allows stereo sound to be produced, although Watson thinks that is would also be possible by driving from one side only "but you would need a DSP". (Source: *Electronics Weekly*, 3 March 1999)

Analog's sensor to save back from pain

Analog devices micromachined sensors are being used in a novel device designed to reduce back injuries.

Analog's ADXL202 iMEMS (integrated Micro Electro Mechanical Systems) sensor is being used by Texas-based Bio Kinetics in a pager-sized device designed to alert the user of movements that could cause back injuries.

Called Back Talk, the device detects the user's motions. Using the ADXL202's ability to measure motion in two axes, and also shock and tilt, the Back Talk device gives a warning if a bending or lifting motion is unduly stressing the back.

Bio Kinetics says that tests it has conducted with Back Talk showed an average 17 per cent decrease in the number of high-risk lifts during a one week period. (Source: *Electronics Weekly*, 3 March 1999)

Biometrics "ID" real applications

Biometric methods to prove an individual's identity are moving from the trial stage into real applications. That was the message at the Smart Card 99 show where biometrics had its own display area.

One example of this is face recognition software from Dectel Security Systems which is being used in US immigration control for workers who regularly cross the Mexican border.

Dectel's joint managing director John Ellis said that a retail scheme which identifies shoplifters is next on the list. The identification of prison visitors is another application that Dectel expects to move beyond the trial stage.

Other biometric technologies at the show included vein pattern recognition from Neu-sciences which uses infra-red to map the heat pattern of the veins in the back of the hand. (Source *Electronics Weekly*, 3 March 1999)

Smallest cellphone

Japanese telecoms company Nippon Telegraph and Telecommunications (NTT) has demonstrated a wristwatch cellular phone.

The device, shown at the Demo 99 conference in California, could earn NTT the title of owning the world's smallest cellular phone.

The NTT cellular phone is based on the Japanese Personal Handyphone System which operates over relatively short distances and with a low power consumption.

The wristwatch phone can also be used as wireless modems or walkie-talkies using NTT's AirWave system. NTT said that compared to cellular technology, AirWave provides better voice quality and higher data transmission rates and requires smaller, less powerful devices. In addition, there is no airtime charge when using AirWave com-

munications. (Source: *Electronics Weekly*, 17 February 1999)

High-power laser maps to help burns victims

Victims of serious burns could get help from an unusual source, a high-power laser.

One step on the way to healing deep burns is called debriding, the removal of dead skin to expose the live tissue below for treatment. This is normally done by a skilled surgeon.

A research programme at Oak Ridge National Laboratory in the US aims to automate this process using a pair of lasers, one to 3D map the burn and the other to burn away the dead tissue, all in one pass.

Although using a laser to remove tissue in this manner is not new, the mapping is.

The eventual aim is to produce a self-contained unit that will fit on a trolley. (Source; *Electronics Weekly*, 3 February 1999)

Time for a retread

A smart tyre that tells drivers when it needs replacing or inflating has been developed by engineers in the US.

Instruments that tell drivers the condition of their tyres are already available, but they are expensive and unreliable, says Wen Ko, an engineer at Case Western Reserve University in Cleveland, OH. Ko and a team at Goodyear led by William Dunn have designed and patented tiny temperature and pressure sensors using microscopic components known as microelectro-mechanical systems (MEMS).

Ko says sensors built with MEMS technology are reliable, cheap and remain stable over the life of the tyre—up to 10 or 12 years. The pressure sensor is a tiny capacitor made from two parallel silicon plates. The thinner top plate changes shape depending on the pressure of air in the tyre, which produces a measurable change in the capacitance of the device.

The temperature sensor is made from semiconductors that change their resistance to current flow as their temperature changes. These sensors, together with a transponder, are incorporated into the wall of the tyre during manufacture.

Each tyre also contains an ID chip that helps tyre makers keep track of their stock. To identify a tyre, or read its temperature or pressure, a radio signal is sent out by a transmitter built into a vehicle or a handheld scanner. The incoming signal provides enough power for the transponder to run the sensors and beam back the tyre's vital statistics. (Source: *New Scientist*, 13 February 1999)

New generation of silicon chauffeurs

An automatic back-seat driver is being tested by researchers in Germany that can take control of the car and manoeuvre it out of danger.

Having taken charge of the accelerator, brakes and steering, the intelligent car drives autonomously in urban traffic and will even indicate when it is about to change lanes. If the drivers want to regain control, they simply have to put their hands back on the wheel and start driving again.

Basic automatic "copilots", such as the Distronic system in the S-Class Mercedes, are already on the market, but these simply regulate the distance between cars and have no control over the steering. This sort of system is limited to motorway driving, where there is more room for manoeuvre and clearer road markings.

The new system, developed at the Fraunhofer Institute for Information and Data Processing in Karlsruhe, is meant to cope with busy urban conditions. Andrew Plummer, a mechanical engineer at Leeds University who was recently given a grant by BMW-owned Rover to build an intelligent car, says this type of driving is particularly challenging. "It is the most difficult environment because there is so much going on", he says.

What makes urban conditions so difficult, is that it is not always obvious what counts as a road lane. Other drivers frequently ignore lane markings, which can obscure them and can sometimes make them redundant.

The Fraunhofer car overcomes this problem by "going with the flow". To avoid complications it simply stays in line with the other cars, speeding up when they do and slowing or stopping when necessary. A result of this, is that the car will not automatically observe speed limits.

Two microprocessors figure out where the car is at any time, in relation to other cars and to the boundaries of the road. To do this the car uses stored three-dimensional models of what different types of road—such as intersections, two-lane and three-lane roads—should look like, as well as cars, trucks and pedestrians. By comparing images captured by two forward-facing cameras with models in its database, the computer works out where the car is and what vehicles and people are around.

The test system has its weaknesses, not least the fact that it depends on a database of ideal roads of specified widths. The system also works better at slow speeds.

However, it will be a long time before we see such vehicles on the road, because the electronics are still too big to fit in most of today's cars. Also, in many countries, the law would have to be changed. In Britain, for example, automatic control of steering and brakes is illegal—and drivers would still be liable for any accidents. (Source: *New Scientist*, 20 February 1999)

Portable navigation system

JATCO Corp. has started marketing a newly developed portable navigation terminal, DIGITAL BIRD. This product applies the company's control technology and sensor technology. Commercialization was advanced jointly with Japan Tourist Bureau and Shobunsha Co., Ltd. The system incorporates the global positioning system (GPS) that displays the present position on a geographical map. The screen showing the geographical map is scrolled automatically through a shift in position. In addition, by using a terrestrial magnetic compass, the bearing is displayed three-dimensionally.

When setting the target destination on the map, an arrow is displayed from the present position to the destination point. This permits the linear distance, direction

and speed of transfer to the destination point to be seen at a glance for guidance to the destination point. Functions for registering the destination point on the map or the locations of hotels beforehand by fingertip action are included, as well as a navigation function for searching based on the registered data.

Up to a maximum of 500 destination points can be registered beforehand to enable tourists to search for the nearest destination from the present position such as sightseeing spots, hotels and restaurants by using genre selection icons. An electronic compass is also incorporated that constantly coincides the map display and the actual geographical aspects even when the direction of the system facing is changed. There is also a north fixation function for constantly facing the display screen to the north. In addition, an ancillary communications cable links the system to a personal computer, to input necessary local map information with the Mapple Life PRO98 map information database. It is also possible to write in the names of desirable points or to paste icons on the Mapple Life PRO98 map display, or to use the route preparation function and prepare a map carrying the route and distance to a destination beforehand.

Sightseeing maps and guidebook information pages obtained from a scanner can also be input into DIGITAL BIRD for use as map information (applicable only to the northern hemisphere). The system also incorporates a computing function that calculates the volume of the data relating to the maps and ancillary information to be installed. There is also an optional function that permits position information to be acquired from a partner in transit and to display the partner's position on the navigation screen.

The navigation system measures 75 x 160 x 25 mm (excluding antenna) and weighs about 242 g (excluding the battery). The display consists of a reflective type monochromic liquid crystal and measures 3.8 in. (240 x 320 dots).

The company plans further research to commercialize a genuine handy navigational system. Further details from JATCO Corp., 700-1, Aza-kamoda, Imaizumi, Fuji City, Shizuoka Pref. 417-8585. Tel.: +81-545-51-2207; Fax: +81-545-51-5335. (Source: *JETRO*, April 1999)

System for remote automatic manipulation of personal computers

Eastech Online Co., Ltd. has developed an I Do System that can automatically manipulate personal computer operations by remote control. Mouse-clicking procedures of up to about 20 times are recorded, which can be retrieved through fingertip manipulation through interlinkage with the Internet system or display with a computing sheet.

The sequence of operations consists of first installing a special-purpose software on the personal computer. This connects a special-purpose signal readout and recording system to the personal computer, so pressing the remote control memory mode pushbutton enables selection of abbreviated numbers from 1-100 digits. This enables the clicked numbers to be memorized sequentially by mouse-clicking. By this, simply selecting the abbreviated numbers with the remote control unit and pressing the start button enables automatic manipulation of personal computers without having to use the mouse.

Up to now, for example, in floppy format, it had been necessary to double-click the microcomputer and select the 3.5-inch FD or file, but with the I Do System, simply recording these procedures enables the floppy disk to be set into the drive, whereupon selecting the abbreviated signal and pressing the start button provides the desired format. Further details from Eastech Online Co., Ltd. Brain-plaza, 1-2-16, Mita, Minato-ku, Tokyo 108-0073. Tel: +81-3-5427-6380; Fax: +81-3-5427-6747. (Source: *JETRO*, April 1999)

Special-purpose terminal for character telephone

Toshiba Corp. has developed a special-purpose character telephone terminal TEGACKY PM-T101 for the input and output of pen-written characters and handwritten illustrations. The character telephone service offered by the Specific Communications DDI Pocket Telephone Group of Enterprises is a specific communications service limited to the input and output text characters as well as handwritten characters and graphics, and the new product is designed to cope with this service.

This telephone terminal is compatible with the P-Mail DX Service enabling the transmission and receiving of messages containing up to about 1,000 characters, transceiving mail to and from P-Mail-compatible audio terminals, and utilizing the P-Mail service (short message function) of working with English, numerical, kana and specific symbols of up to 20 characters. In addition, it also permits transceiving through the Internet Service via the P-Mail DX Center, and features easy character readout and compactness for convenient portability using a large liquid crystal screen capable of displaying up to 48 characters.

The P-Mail service allows 200 received and 30 sent mail registered with terminals, and the P-Mail DX service allows 1,000 transceived mails, so these services have the largest capacities among conventional types of similar terminals. The radio frequency lies in the 1.9 GHz band, the transmission power is 10 mW, and the radio access system the TDMA-TDD system. The continuous chatting time is about 4 hours (when repeating the transceiving of messages of about 100 characters every three minutes, with background light ON and keytouch noise OFF), and the continuous standby time is about 400 hours (within the service area with light support and without characters). The system size is about 85 x 16 x 55 mm, and its weight about 81 g/75 cm^3.

The P-Mail function using mobile communications terminals is increasing at a rate surpassing that of audio communications, and the DDI Pocket Telephone Group of Enterprises accounts for about 40 per cent of the total number of calls placed from PHS terminals and systems. Meanwhile, there are requests for improvements to cope with inconveniences such as difficulty of message input,

difficulty in communications by e-mail, and the difficulty with large terminals for the transceiving of e-mail in mobile environments.

The newly developed product was commercialized to cope with these needs, and represents a new category of mail tool that enables input of handwritten messages, e-mail transceiving in conformance with the P-Mail DX service and via the P-Mail DX Center, and the use of a large display screen in a compact overall system. Further details: Toshiba Corporation, 1-1-1, Shibaura, Minato-ku, Tokyo 105-8001. Tel.: +81-3-3457-2105; Fax: +81-3-5444-9202 (Source: *JETRO*, April 1999)

Monitors, printers and scanners

Peripherals such as monitors, printers and digital cameras can transform an off-the-shelf, commodity PC into a tool which exactly matches the user's needs. Adding such devices has been much simplified since the industry's widespread adoption of the universal serial bus (USB) standard.

Investment in a quality monitor can be money well-spent for those spending long hours in front of one. The choice is between conventional CRTs and the more expensive flat-panel displays. In the US, a good quality, 17-inch CRT monitor costs between $300 and $500, while top of the range 21-inch models cost about $1,000. Alternatively, a user might opt for a liquid crystal display (LCD) of the same type used on notebook computers. They are more compact than a CRT and are flicker-free. On the other hand, although prices have fallen over the last year, they are still more expensive. Major suppliers such as Philips and NEC offer 15-inch models priced at under $1,000, but it is possible to spend more than $2,000 for high-quality 18-in. units.

In the mainstream business printer market, a new generation of lower-priced colour laser units is starting to appear. Examples include the Tektronix 740 and 740L models, which start at under $2,000, and the Hewlett-Packard 4500 and 8500 series. The printing speeds, however, tend to be lower than those offered by purely monochrome units. More advanced monochrome units such as the Lexmark Optra SE 3455 and Hewlett-Packard's LaserJet 8000 series offer high resolution (1,200 dots per inch) and up to thirty-four pages a minute.

The demand for electronic images—from e-mail greeting cards to Web auction sites with pictures of the goods for sale—has boosted sales of digital cameras and scanners. The major innovation this year has been the introduction of two-megapixel cameras, which offer twice the resolution available last year. The images produced by Nikon's Coolpix 950 and 700, or Fuji's MX-2700, for example, rival those offered by conventional film. Cameras such as this are priced at less than $1,000, which has driven that of one-megapixel devices down to $199-399. An alternative way of capturing images quickly and cheaply is to use a scanner. In the US, prices as low as $50 are not uncommon, although most—including those from Epson, Hewlett-Packard and UMAX—are in the $100 to $300 range.

Three products—one from each of these three categories—are worth a closer look. The Mitsubishi LSA810W display ($3,499) is an 18-inch LCD unit with sophisticated but easy-to-use controls. The Lexmark Photo Jetprinter 5770 ($349) combines elements of a specialized photo printer and a conventional inkjet. The Microtek ImageDeck ($499) is a fully functional scanner which does not need to be connected to a PC. (Source: *Fortune*, 29 March 1999)

Supercomputer does one Teraop at US lab

A supercomputer capable of a trillion operations per second—one Teraop—is being installed at the Oak Ridge National Laboratory (ORNL), part of the US Department of Energy.

Based on an IBM RS/6000 SP, the computer will start life at 100 Gops, but will be upgraded to a Teraop by the middle of next year.

This will make ORNL's machine seven times faster than its existing Intel powered computer, which was the fastest in the world four years ago.

"The latest generation of supercomputers are essential to make progress in solving some of the most challenging scientific and engineering problems", said Al Trivelpiece, director of ORNL.

ORNL has big plans for the supercomputer, aiming to use it for modelling climatic changes, reducing vehicle pollutants and assisting with the human genome project.

The Teraop machine will support the development of more comprehensive climate models that include interactions between atmosphere and oceans. (Source: *Electronics Weekly*, 21 April 1999)

F. SOFTWARE

Hack it if you can

An Australian company is so confident that its new SecurePage software can thwart attempts to change the content of Web sites that it is set to challenge hackers to crack it. Bahram Boutorabi, chief executive of Creative Digital Technology of Sydney, said that none of the company's skilled software developers had yet been able to alter sites that used the system.

The "cracking" of Web pages, in which pages are replaced by adulterated copies designed to embarrass or annoy the host, is an increasing problem. A number of prominent sites, including those of the US Army and Air Force, have recently fallen victim to electronic pranksters.

SecurePage works by encrypting a copy of every page on a site. This master version is continually compared with the pages available on the Internet. If any of the content changes without authorization, the software kicks in and restores the original using the master as the source. Because the master is encrypted using a triple-strength version of the US Government's DES algorithm, breaking the code would require an inordinate amount of time and computer power. (Source: *New Scientist*, 14 August 1999)

SANity check: Storage Area Networks emerge as viable solution to info glut

Storage area networks (SANs) are high-speed, back-end networks dedicated to storage. Most are being built around Fibre Channel, a high-speed transmission technology that facilitates the connection of multiple hosts to dedicated storage systems. SANs are growing in popularity in corporate enterprises because they offload traffic from critical data networks, which can increase the performance of corporate applications. SANs provide less obtrusive back-up of corporate data and improve disaster recovery scenarios. They also provide increased fault tolerance, higher availability of data, shorter data access time, more efficient storage resource utilization, and high scalability. Contributing writer Stephanie Wilkinson profiles four early adopters, who report high levels of satisfaction with their newly installed SANs. (Source: http://www.datamation.com/PlugIn/workbench/storage/stories/9909sanl.html)

Factory workers are becoming FAST workers

Researchers at Georgia Tech Research Institute (GTRI), US, have developed an electronic performance support system that delivers "just in time" training wherever it is needed.

The prototype system, known as Factory Automation Support Technology (FAST) is being field tested at a poultry plant in Claxton, GA, but could have applications in other industrial sectors.

FAST combines job performance support software, wireless communication and a wearable computer that operates hands-free. Development of FAST was thus a two-part process, involving the creation of an information database for each application as well as a hardware-based delivery system. Typical information databases include reference information about a job task or closely related set of tasks; just-in-time, task-specific training; expert advice about a job task and application help functions.

The hardware has four basic parts. A credit card-sized computer and wireless communication system is worn on a belt, which also holds flexible eight-hour battery packs. This allows both portability and transmission of data to other computer systems in real time. A visor, worn like safety glasses, displays computer information to the user via a miniaturized display. Earphones allow auditory information given by the computer to be heard, while a microphone enables voice-activated, hands-free operation of the computer.

Other optional equipment in the system includes a small, adjustable camera mounted on the visor. The user can point this at a broken piece of equipment and send video footage to an expert in a remote location. There is also a small, hand-held version of this camera that can be used to poke about in pieces of equipment, and a one-hand keyboard. (Source: *Engineering*, May 1999)

Electronic systems are being used to help spot forged signatures

Researchers at the University of Kent are looking at new ways of measuring the characteristics of a person's signature. "Static" information—from image analysis of

the signature itself—and "dynamic" information, gained from the movement of the pen above an electronic tablet, can be stored in magnetic strips or in chips on smart cards.

These could be used, with varying levels of accuracy according to the level of security needed, to verify identity for access to secure buildings or information. The work also has wider potential applications in processing handwritten documents.

The researchers are using volunteer "fraudsters" to forge signatures under a variety of circumstances in order to pinpoint the most effective counter-forgery strategies. (Source: *Engineering*, May 1999)

Intelligent, spoken multimedia electronic patient medical records

Berdy Medical Systems, Inc., Stony Brook, NY, has developed a data-input system for a computer-based patient record system that will allow computers to recognize natural speech in a medical setting. This three-year research effort, co-funded by NIST's Advanced Technology Program (ATP), has resulted in software that is speaker independent in 90 per cent of all cases, can understand complex spoken medical vocabulary with an accuracy of 95 per cent, and converts spoken language into discreet data elements so they can be stored in any database. In addition, it is able to understand speech at speeds approaching the pace of normal speaking. These innovations will promote better quality, more affordable health care by reducing barriers to the capture and storage of dictated medical records. The technology has broader applications than medical settings. Berdy has commercialized the technology in a product called SmartVoice, and has installed it in several medical practices. Several additional medical practices, including correctional facilities, have expressed strong interest. As a result, Berdy received $2 million in venture capital financing shortly before the completion of the project. (Source: *NIST*, February 1999)

Linux gets a desktop

The Free Software Foundation has released software that puts a friendly face on the Linux computer operating system, the flagship of the "open source" software movement. The new software, GNOME (pronounced guh-NOME), is the culmination of a two-year effort by volunteer programmers around the world to make Linux accessible to everyday computer users (see *Programs to the People*, *TR* January/February 1990).

Although hailed in some quarters as a Windows alternative that could end Microsoft's operating system monopoly, Linux has so far gained only a limited following. One reason: its demand that users learn arcane commands. GNOME could change that by providing Linux with a graphical, point-and-click interface that users can customize as they choose—giving it a Windows feel or a Mac feel, or something completely different.

Red Hat, the leading Linux distributor, will include GNOME in its next release of the system. GNOME is also available for free downloading at www.gnome.org (Source: *Technology Review*, May/June 1999)

Software saves the whales

Pattern-recognition techniques used to study particle physics at CERN are now being used to protect the hearing of sea mammals.

When oil companies survey for oil they send seismic pulses towards the seabed at volumes that are potentially damaging to a whale or dolphin's hearing. Software and instrumentation, developed by UK-based independent bioacoustic consultants Douglas Gillespie and Oliver Chappell, can detect whether sea mammals are nearby, and determine when they are distressed or when they are behaving abnormally.

The researchers have developed signal-processing techniques to detect and analyse marine mammal sounds. Pentium PCs are used to monitor the sounds. These are powerful enough to perform the pattern-recognition studies, but not so expensive to cause the researchers concern if they get damaged at sea. Using off-the-shelf computers is much easier than developing dedicated signal-processing chips that were previously used. The pattern recognition code is written in C++, and information from each detector is stored in a database that also records navigational data from a global positioning satellite.

Legislation in many countries forbids oil companies from using seismic waves when there are sea mammals in the vicinity. However, unless the sea is very calm it is almost impossible to use visual techniques to determine whether any whales or dolphins are nearby.

This bioacoustic research is less influenced by the weather and so is much more effective. The techniques can also be fully automated. (Source: *Scientific Computing World*, February/March 1999)

Virtual reality brings researchers together

Research collaborations around the world are benefiting from the networking capabilities of virtual reality. Groups from Australia, Singapore, Korea, Japan and the USA are using the facilities that have been developed at the Electronic Visualization Laboratory (EVL) at the University of Chicago, USA.

To interact with each other and with experiments around the world, the participants primarily use SGI computers and a wide variety of display devices, such as CAVEs, Idesks and Barco Baron. Most of the underlying software has been developed at EVL but extra functionality is added by most of the other members of the project. The researchers are connected using the Trans-Pacific Network, Asia-Pacific Advanced Network, STAR-TAP link in Chicago, and the USA's very high-speed backbone network. (Source: *Scientific Computing World*, February/March 1999)

Developers benefit from free software

Molecular Simulations (MSI), a subsidiary of the USA's Pharmacopeia, has recently announced that its

Cerius^2 Software Developer's Kit (C^2SDK) will be available free to researchers in pharmaceutical and academic laboratories.

C^2SDK is used to develop molecular simulation software and to integrate it with MSI's graphical modelling environment Cerius^2. The free availability of this product is expected to establish Cerius^2 as a standard for software development, and to provide an integrated platform for pharmaceutical research and development. It is also intended to enhance the facilities of Pharmacopeia's Center of Informatics and Drug Design.

Prior to the announcement, C^2 SDK already had between 80 and 100 users. The company now wishes to adopt a more aggressive strategy and provide a universal development platform. The initiative was greeted with enthusiasm by both industrial and academic customers. (Source: *Scientific Computing World*, February/March 1999)

The whole world in your hand

Pocket-sized gadgets such as palmtops and mobile phones that connect to the World Wide Web have to squeeze pages designed for desktop monitors onto a tiny monochrome screen. To make the results as legible as possible, Argo Interactive of Chichester, West Sussex, has developed a system that removes unnecessary clutter from complicated Web pages.

Argo's ActiGate system automatically analyses the HTML code embedded in each page and simplifies it. For example, where it finds a complex graphic that represents a link to another Web page it replaces it with a short text link or a simple, standardized icon. Font sizes are increased for improved legibility, and colour is replaced by shades of grey.

The ActiGate software is designed to run on an Internet service provider's "proxy server". When the proxy server receives a request from a palmtop, it calls the required page from the Web server where it is held and strips out the unnecessary graphics.

The simplified page is more compact than the original, so it downloads to the palmtop ten times more quickly. The only restriction on users is that they must access the Internet through a proxy server running the ActiGate software. (Source: *New Scientist*, 1 May 1999)

Creditcard and security

Hundreds of Internet businesses have made customers' credit card numbers easy for thieves to find. The trouble started when software that takes orders on the companies' Web sites was not installed properly.

Big sites such as Amazon.com seem to have dependable security, but some smaller companies which use third-party e-commerce programs have left credit card numbers lying around for thieves to find. A "shopping cart program" sets up an encrypted "conversation" with a customer who browses a shopping site, placing items in the virtual cart. This allows shoppers to safely transmit information over the Internet with their details encrypted in a private file.

However, it has been found that more than a hundred sites had not only failed to encrypt the information, but had also stored the files publicly. Since the files have standard names such as order.log, anyone can use a search engine to track them down. Two days after the revelations on Bugtraq, most of the sites with problems had fixed them, but other sites could make the same mistakes. (Source: *New Scientist*, 1 May 1999)

Crossword wizard

First computers learnt how to defeat people at chess and backgammon, and now, thanks to Duke University in Durham, NC, they can even take us on at solving crossword puzzles—and sometimes win.

Proverb, which runs on several PCs simultaneously, includes a complex array of databases and query algorithms, written in four different programming languages. It tackles puzzles in a way completely alien to human solvers. Faced with a typical quick newspaper puzzle, Proverb starts by sending all the clues and word lengths to each of its 30 modules, most of which are databases.

One database comprises 400,000 clues and associated answers from newspaper crosswords over the past 14 years.

Another module is what Michael Littman of Duke University's computer science department, calls a "degenerate" database which only looks for answers to clues based on direction: if words such as "point", "compass" or "direction" appear in clues for three-letter words, the database will return answers like NNW and NNE—favourites of some puzzle compilers. One of the largest modules Proverb taps into is the ever-expanding Internet Movie Database (www.imdb.com), which is so big that Littman's team wrote a dedicated search engine to prevent searches taking too long and slowing down the overall crossword puzzle solving process.

Proverb was written in four computer languages because each has its own benefits, depending upon the task at hand. Simple searches to match crossword clues were written in PERL, as it is good at scanning arbitrary text files and extracting information from them. The C language was used for number-crunching probabilities to decide on the best answer. Stringing the ensemble together were programs written in C++ and Java that coordinated the various modules.

Proverb takes the top-ranked trial answers—lists from each database module—and puts another program, "Merger", to work. Finally, a program called Solver takes Merger's output and plugs the highest-scoring words into the crossword grid, then repeats the process, looking for the best fit until it runs out of time. (Source: *New Scientist*, 1 May 1999)

Medical students get Clever

Medical students will benefit from spending more time with patients thanks to a virtual learning system.

The system from the UK company Clever Technology links ten remote London sites of Imperial College School of Medicine to its main Sir Alexander Fleming Building.

Students at the remote sites will be able to see and hear everything a lecturer presents on video screens. Questions can be asked using a request button at any stage of the lecture. Conversely, the lecturer can view any location and ask students questions.

The system saves time spent in travelling and means there is less disruption to the staff's clinical and research commitments. (Source: *Electronics Weekly*, 31 March 1999)

Melissa threat drives PC users mad

Users of the Microsoft Office application software have been hit by an e-mail-borne virus that crashes their PCs and brings down mail servers.

The Melissa macro virus has infected hundreds of thousands of PCs over the past week. Offshoot variants, called Papa and Mad Cow, has been detected and are potentially more troublesome than Melissa. The FBI says it is investigating Melissa and will prosecute the author.

Microsoft issued an alert to Microsoft Office users saying that the virus threat is a serious one. It recommends that Office users "should always disable macros when they are not certain of their purpose or functionality. By choosing to disable the macros, any macro viruses are prevented from running".

Melissa and Papa, once triggered, send out copies of themselves using the e-mail address book on the host PC.

Several companies, including Microsoft itself, have had to close down their e-mail servers temporarily to prevent infecting other companies. (Source: *Electronics Weekly*, 7 April 1999)

Melissa's mayhem

A new chapter in the history of computer viruses has opened. For the first time, a rogue program has taken full advantage of the Internet to infect tens of thousands of computers worldwide in just a few days.

The virus, called Melissa, has already spawned several "copycat" programs. Some experts fear that conventional countermeasures will not be able to blunt the threat posed by this new breed.

Melissa is a "macro" virus. These cause a disproportionate amount of havoc and exist as small programs, called macros, that can be added to documents created by software such as Word, Microsoft's word-processing package. As more than 100,000 computer users have already found to their cost, Melissa arrives by e-mail hidden within a Word file that contains a list of pornographic Web sites. If the recipient opens the document without disabling the macro function, the virus alters Word's security settings so that warnings about disabling macros will not be displayed in future—a trick that renders the user vulnerable to further attacks.

Melissa then looks for Microsoft's Outlook organizer program and sends copies of itself to the first 50 contacts in the Outlook e-mail address book. At various times, it deposits a quote from *The Simpsons* TV show into Word documents.

Macro viruses that propagate by e-mail have been seen before, but Melissa is the first to use a popular e-mail program to spread like wildfire. Systems hit by the virus reportedly included NATO computers involved in the war against Yugoslavia.

Hard on its heels has come a virus called Papa, which lurks in a Microsoft Excel spreadsheet file. It works in much the same way, except it also repeatedly tries to contact certain Internet addresses, effectively disabling the user's Net connection. According to Nick FitzGerald, an antivirus consultant based in Abingdon, Oxfordshire, there are two further copycats—Marauder and Syndicate.

Companies specializing in antivirus programs have written software patches that disable Melissa and Papa, and made them available on their Web sites for downloading, some argue that this approach is too slow to deal with fast-reproducing viruses.

IBM has pioneered the Digital Immune System, which it hopes to release in about a year. This will connect customers over the Net with a central computer. When a customer's computer detects an anomaly that might be a new virus, it will automatically ship the code to the central computer, which will figure out a way to detect it then send the information to everyone on the network.

Some antivirus experts remain sceptical about the Digital Immune System's chances of success. But if it does work as advertised, it should be more than a match for Melissa and its imitators. (Source: *New Scientist*, 10 April 1999)

IEEE gives go-ahead to extend VHDL language

Analogue and mixed signal extensions to the VHDL hardware description language have been approved by the IEEE. Informally, the language is called VHDL-AMS.

Officially designated as IEEE Standard 1076.1-1999, the extensions allow for the description and simulation of analogue and mixed signal blocks from the system level down to transistor level.

Rather than designing an analogue language first and then merging it with VHDL, Analogy's approach was to define a mixed-signal language that builds on the full power of VHDL. The result is a unified language environment, where analogue and digital modelling constructs complement each other. VHDL-AMS is a true top-down design language for mixed-signal system and IC design.

The approval of VHDL-AMS is a boost for Analogy, which is developing a new simulation strategy dubbed TheHDL.

"VHDL-AMS, along with the other existing and emerging hardware description languages is a key component of our TheHDL vision for a language-independent, open simulation environment", said Doug Lundin of Analogy.

TheHDL will be a single kernel simulator that supports multiple hardware description languages, including VHDL, Verilog and MAST. Use of a single kernel

means that the simulator will be more efficient at solving analogue and digital parts of the design. (Source: *Electronics Weekly*, 14 April 1999)

Beware the back-door security threat

Web browser bugs have turned the public eye to the growing problem of network security in corporate and large organizations. However, visible high-profile security infringements with malicious intent are only the tip of the sabotage iceberg.

Recently news of powerful security-breaching applications has filtered through to the public press. Dubbed back-door programs, these applications allow any person with access to an infected network machine to remotely control almost any function of that machine as if he were working it. The main difference between back-door programs and Internet-transmitted viruses is that back-door programs have to be physically installed on a machine to have any effect. They cannot be downloaded as e-mail attachments. However, back-door programs pack their own destructive potential.

The most common back-door programs at the top of a security administrator's list are NetBus and Back Orifice. The latter, created by the infamous and notoriously named Cult of the Dead Cow (CDC), is the more popular and hence more widespread of the two, although NetBus is considerably more dangerous.

Where Back Orifice is designed for Windows 95/98 systems, NetBus infects Windows NT servers, the backbone of many corporate networks. Both Back Orifice and NetBus allow the remote user to execute any commands on the host machine, list file entries, start and stop services, share directories, upload and download files, manipulate registry entries as well as kill and list any active processes on the host. NetBus can also open and close the host's CD-ROM drive, send interactive dialogues and listen to a system's microphone.

NetBus has more appeal for the corporate saboteur, but both programs have the potential to disable or use a network as a portal for disabling other networks. The latter function in particular is popular among back-door users who infect hosts to hack into interconnected networks without leaving a trail of their own.

To detect a back-door program on a network, it is important to recognize their footprints on a host machine. Both Back Orifice and NetBus make registry entries and both start services that listen to open ports. Check if the typical registry entries have been made and whether a suspected workstation has open ports which should not be open under normal circumstances. To eradicate the threat, stop the active services and remove the offending registry entries.

Instructions on detecting and removing Back Orifice can be found at www.nwi.net/~pchelp/bo.html. Information on detecting NetBus can be found at http://members.spree.com/NetBus/index.html (Source: *CIA*, April 1999)

Eat your words

Purdue Pharma of Connecticut is patenting a system for ensuring that documents are destroyed soon after they have been read (WO 98/58321). With Microsoft Word documents, a special instruction, or macro, is added to the file—just like a Word virus. Plain text is encrypted so it can be read only by a special program. Either way, however, when a document is opened, the software checks the date and erases it if it has been on a computer for more than a set period. The same system can be used to send documents over the Internet, which recipients can keep only if they pay for a key code. (Source: *New Scientist*, 12 March 1999)

The stronger the key used to encode files, the easier it is to find

They may look harmless but screensavers could betray you while you are out at lunch. Two cryptographers have discovered that the randomness of the "keys" that are used to encode encrypted documents could be their downfall.

The discovery was made by Adi Shamir at the Weizmann Institute of Science in Rehovot, Israel, joint inventor of the widely used RSA public key cryptography system, and Nicko van Someren of nCipher, a British electronic security company based in Cambridge. The more random a private signature key is, the harder it is to crack encrypted files. But by scanning hard drives for chunks of data that are particularly random, the pair found that it is possible to weed out keys stored on a disc.

Most programs organize data into some sort of level of structure, so blocks of randomness stand out and can be spotted with the same ease that a human eye can tell the difference between a good TV picture from one with lots of interference. According to van Someren, this means that even though the keys take up a mere kilobyte of memory, it could take as little as 40 minutes to find a signature key on a modern 10-gigabyte hard drive.

"It would be possible to write a program that searches the hard disc automatically and sends the key to the villain", says van Someren. This, he says, could be carried out by a virus that runs only when the screensaver is on, making it extremely difficult for the user to detect. A running screensaver could contain viral code that would tell a hacker when the user is away from their desk—and thus would not notice the computer slowing down as the virus hunts for keys.

The possibility highlights the need to keep signature keys safe, says Phil Zimmermann, who wrote Pretty Good Privacy (PGP), a popular encryption program that is reckoned to be hard to crack. "Users must never leave their private key exposed in a non-secure environment", he says. "This is as obvious as not leaving your wallet unattended on a bus bench."

Any worthwhile encryption programe encrypts the key before storing it, making it useless if found. However,

a "swap" file—a temporary file stored on the hard disc—may still hold the key in its unencrypted form, allowing it to be detected by hackers. There are ways to combat this sort of attack, such as overwriting swap files as the PGP program does. But some encryption systems are vulnerable, particularly those on Web servers where the keys are constantly in use. (Source: *New Scientist*, 12 March 1999)

Algorithms help researchers speed Web-page downloads

Technology that speeds up Web access has been developed by academics from the Massachusetts Institute of Technology (MIT).

The researchers have formed a start-up company called Akamai Technologies to promote FreeFlow, a service which improves Web-page downloads through the use of sophisticated algorithms.

FreeFlow uses several hundred Web servers distributed around the world under intelligent distributed control. It uses four powerful algorithms to distribute Web site data closer to the user. (Source: *Electronics Weekly*, 10 February 1999)

Software for energy management and auditing

Techno Software International is a technical consultancy and software development organization in India. It has developed a number of industrial management softwares for the process and power industries, particularly on energy management, energy auditing and corrosion management. The softwares—Techno Therm, Technical Audit, Techno Corr, Techno Plan, Technopas, Techno Blend, Technomaint and Scimod—are of immense use for industries to improve productivity and profitability.

Techno Therm is a total computer-aided energy management package for energy-intensive process industries like the petroleum, petrochemical, fertilizer, steel, alumina, cement, paper and other industries; as well as for non-process power generation plants, such as coal-based, fuel-based and nuclear power generation units. Techno Therm is based on the energy system analysis concept and starts with the fundamental productivity analysis of input-output ratings. It analyses the energy data of a complete system to identify critical, less critical and least critical subsystems and equipment for performance monitoring. It is cost-effective, aids in energy conservation, identifies equipment deterioration and failures, pinpoints operational problems and is user-friendly.

Techncial Audit is an independent, menu-driven, energy auditing software, that can be used effectively by the process and power industries for self-auditing the total system. It can be used for minimizing and conserving primary sources of energy, which form the major chunk of the operating costs. This software identifies the energy cost centres of the total system and pinpoints the problem areas. It can even be used in dynamic situations such as revamps, new projects etc.

Techno Corr is an independent, menu-driven, user-friendly corrosion management software, that can be effectively used by the process, power and utility industries for monitoring and managing corrosion problems based on non-destructive test data such as ferrography, ion count, conductance, thickness measurement etc. It identifies the critical, less critical and least critical equipments for monitoring purposes. It develops performance models, parametric multi-variable models, general interpolation models, user-defined models etc., from the observed data, and serves as a vigilant surveillance monitor.

Techno Plan is a production planning and control software, which may be used by complex process and non-process industries comprising a number of down-stream processing units, such as power generation, refining, gas processing, petrochemical or fertilizer plants. This is a prelude to LP production planning models. This software considers the effect of feed mix, capacity utilization of individual units and sections, and their operating severity, and works out the product pattern from actual data. It may be used for diagnosing plant problems individually by means of built-in models. These may be used for product costing, energy, utility consumption, production planning, budgeting, revamping and retrofit decisions, by extensive analysis.

Technopas is a total computer-aided project appraisal system. This software may be used for product demand analysis; financial returns such as Internal Rate of Return, Net Present Value, and Profitability Index of projects; selection of alternatives; Project Costing by index method; synthesis methods etc. It may be used for existing as well as new projects. Cost-benefit analyses of various schemes may also be analysed in one run. Project performance analysis, impact of time and cost overruns on return, effect of inflation, and choice of process, equipment technology, site, vendors etc., by attribute analysis are also in-built into this software.

Techno Blend is a quality management software for petroleum industries. This may be used for determining the characteristics of product blends such as the density, viscosity, ASTM/TBP distillation conversions, EFV/ASTM conversions, calorific values, boiling points such as volumetric average boiling points, cubic average boiling points, mean average boiling points, blend economics etc. of various fractions. This may be useful for the refining and product blending and marketing agencies for product quality control and optimal product blends.

Technomaint is a very powerful total computer-aided maintenance management software that is effective for total maintenance applications. It covers rotating as well as non-rotating equipment, vessels, columns, boilers, pipes, heaters, heat exchangers, condensers etc. Its most important application is failure prediction, corrosion monitoring and performance monitoring of energy and cost-intensive equipment, troubleshooting and identification of critical equipment or maintenance and monitoring. It can be very useful for complex process industries and thermal and nuclear power plants.

Scimod is a scientific modelling software that may be used for general modelling applications, such as catalyst evaluation, inhibitor evaluation, parametric behavioural studies etc.

For more information, contact. Techno Software International, Hari Sree, Opposite Varma Studio, Sanskrit College Road, Tripunithura, Ernakulam, Kerala 682301, India. Tel.: (+91-484) 781102. (Source: *Tech Monitor*, March-April 1999)

A computer that understands your gestures

Software that recognizes and converts the gestures of sign language into text on a screen could make working on computers easier and more natural for deaf people. Researchers at the University of Sherbrooke in Quebec have developed a system capable of recognizing international sign language (ISL), which uses gestures to spell out each letter of a word.

Their success rate for recognizing ISL signs is up to 96 per cent. Since signing styles can vary, the system performs best when the person who is using the neural network also trains it. The researchers have not yet optimized the system for speed, so the program takes half a second to recognize the sign, running on a fast workstation. They believe they could improve accuracy with a feature that checks on easily mistaken signs.

Each sign is captured by a video camera and processed by a chain of software elements. The first stage is "edge detection", where the outline of the hand is mapped. Then the system determines the long and short axes of the hand to establish the exact orientation of the sign. From this, the program computes two "size functions", which measure the projection and orientation of the fingers relative to the hand's long axis. This information is fed to a neural network program, which makes a best guess at the letter by comparing the data with existing training data. When the computer has recognized the sign it shows the letter on the screen.

The program works rapidly enough for it to be developed for real-time communications, the researchers say. (Source: *New Scientist*, 19 June 1999)

G. COUNTRY NEWS

Australia

Digital copyright law hits Australian Parliament

Internet content could be subject to the same copyright laws as books and magazines under new legislation introduced in Parliament. The new Copyright Amendment (Digital Agenda) 1999 Bill is the first legislation to tackle the problem of copyright enforcement on the Internet. It is intended to give copyright holders the same level of protection on the Web as they receive elsewhere. The bill aims to eliminate current rules that limit copyright protection to wireless broadcasts. Although current material is subject to the Copyright Act 1968, officials have admitted the law does not deal with digital information. (Source: *Newsletter,* No. 16, 3 September 1999, UNESCO Observatory on the Information Society, http://www.unesco.org/webworld/observatory)

Australia's hybrid solar-fossil energy system

A team of scientists from Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) is to demonstrate that clean power can be produced on a large scale by a hybrid solar-fossil generation system that has the potential to emit minimal greenhouse gases.

Dr. Malcolm McIntosh, Chief Executive of CSIRO, announced that the A$ 7.5 million project would involve construction of a 20 KW demonstration plant at Sydney. At the leading edge of world clean energy technology, this system will demonstrate that fossil energy can be "decarbonized" using solar power to produce a fuel gas composed of hydrogen and carbon dioxide.

Electricity will be generated from the hydrogen in two ways—by using a fuel cell or a micro-gas turbine. It is hoped that the solid oxide fuel cells (SOFC) developed by CSIRO and Ceramic Fuel Cells Ltd. will be incorporated into the system. This fuel cell technology can be scaled up later, to power several homes, a factory, a whole suburb, a remote community or even an entire town.

The primary energy source for the hybrid system will be gases which contain methane. These may come in the form of natural gas, coal-seam gas, coal gas or gas emitted by landfills and processing of organic waste or even methanol derived from coal. The process uses solar thermal energy to combine the gas with water, and, after an intermediary stage, produces a mixture of hydrogen and carbon dioxide. These are separated; then the hydrogen is used to make electricity; and the carbon dioxide can be recovered in a concentrated state and permanently disposed of. Disposal may take several forms, such as injection into subterranean reservoirs, such as depleted oil or gas fields and aquifers; and injection into deep coal beds that supply methane gas to power the process of disposal in the deep ocean. For more information contact: CSIRO, http://www.csiro.au/news/mediarel/mr1998/mr98235; Dr. Malcolm McIntosh (+61-2) 6276 6621; Dr. John Wright (+61-2) 9490 8610; Mr. Jim Edwards (+61-2) 9490 8950; Dr. Sukhvinder Badwal (+61-3) 9545 2719; Mr. Chris Thompson (+61-2) 9710 6816. (Source: *Tech Monitor,* May/June 1999)

Porn police

Australia plans to introduce the world's toughest legislation to outlaw pornography on the Net. Among its provisions is a controversial requirement for service providers to block access to offensive material on overseas sites.

The industry is openly defiant, describing the law as laughable. "We will not be incorporating unworkable provisions such as mandatory filtering of overseas content", says Peter Coroneos, Executive Director of the Australian Internet Industry Association. "No other nation has thought it desirable to take these sorts of steps", adds Kim Heitman of Electronic Frontiers Australia, which campaigns against on-line censorship.

In May, the bill passed a crucial vote in the Senate when two independent senators holding the balance of power sided with the government. The legislation will now be introduced to the House of Representatives, where the government has a majority. It is almost certain to pass with little amendment, and will be implemented on 1 January.

Under the new law, anyone will be able to complain to the Australian Broadcasting Authority (ABA) about illegal or offensive material on-line. If the ABA agrees that the material is unacceptable, it can then ask Net providers to prevent access to the material. If the material

is on an Australian server, it must be taken down; if the host computer is overseas, providers must take "reasonable steps to prevent access if technically feasible".

The precise definition of "reasonable steps" is likely to be hotly contested, experts predict. (Source: *New Scientist*, 12 June 1999)

China

Funding channel planned

China will create an investment foundation to help develop its fledgling high technology industries, indicate sources from the Ministry of Science and Technology. The foundation, the first of its kind in China, will be prepared by the Ministry, United Securities Co. (comprising major domestic firms), and the Netherlands-based ING group.

The initiative will involve 2 billion yuan (US$ 240 million), revealed a spokesman from the Ministry's Torch Programme Administration Centre, in charge of high-tech development.

The Ministry's priority will be to develop industries involving information and biotechnology, new materials, new and renewable energy resources, and energy-saving and environmental protection technologies. This will ensure that funds are used efficiently, suggested Zhang Jingan, the Centre's director.

China has 13,000 high-tech enterprises in 53 high-tech industrial zones. But most face similar difficulties—insufficient capital investment and the lack of technological innovation and venture capital regulations.

The ministries of Finance and Science and Technology, the Bank of China and other departments are enhancing venture capital regulations, indicate sources from these ministries.

China began allowing venture capital operations in highly developed areas in 1985, when the country implemented reforms in its science and technology systems, said department official Shen Zhongqi. Some enterprises tried the system, but failed due to their poor knowledge of venture capital and the immature financial conditions.

China has 20 scientific and technological innovation and investment firms in Beijing, Shanghai and Guangzhou. Their capital investments come from regional financial departments and cooperation with overseas institutions.

The company, established in August 1997 with the approval of the Ministry of Science and Technology and the former Ministry of Electronic Industry, is the first Sino-US information technology joint venture supported by venture capital.

More than 30,000 scientific technological research findings are annually published in China. These discoveries will be used to attract venture capital. (Source: *Tech Monitor*, March-April 1999)

Costa Rica

Villages to join Internet—without wires

Costa Ricans will soon reap the benefits of a research project designed to show that cutting-edge wireless technology can link remote villages to the Internet, at a surprisingly low price. Called Unwiring the World (www.media.mit.edu/unwired), the project—sponsored by the Massachusetts Institute of Technology's (MIT's) Media Lab and the Costa Rica Foundation for Sustainable Development—is supplying hardware and satellite linkages that give even mountain dwellers the ability to swap data at 1.5 megabits a second—the equivalent of a T-1 line.

Wireless can bring the Internet to the cyberwilderness, where people have little chance of ever getting a fibre-optic cable line. Academic institutions in Latvia and Mongolia, for example, are trying out wireless Net links. The MIT project, says the Media Lab's Alex Pentland, aims to hook up entire communities by taking advantage of new, cheap technology: Palm Pilot-sized devices that uplink to satellites and cost about $40. The lab, which demonstrated the project with a Costa Rica-Cambridge link, plans to equip 25 communities with "digital town centres" consisting of computers and other equipment housed in recycled shipping containers, at a total cost of $50,000. The hope is that communities will use them for everything from checking current crop prices to transmitting a sick patient's vital signs to a distant doctor.

Linking the entire world to the Net—what experts call "100% connectivity"—may be possible using wireless, says David Hughes, who runs a company called Old City Wireless Communications in Colorado Springs. But a key factor, he says, is connection costs. The Costa Rican villages will keep the price to about $3,000 per year by buying their own satellite links rather than relying on outside providers who charge by the minute. (Source: *Science*, Vol. 284, 9 April 1999)

European Union

Amended proposal for a coherent legal framework for electronic commerce in the Single Market

An amended proposal for a Directive to establish a coherent legal framework for electronic commerce within the Single Market has been put forward by the European Commission. The amended proposal takes into account the favourable opinion from the European Parliament, adopted on 6 May 1999, on the original proposal that fully supported the Commission's Single Market approach. A number of clarifications have been introduced in the amended proposal concerning, *inter alia*, definitions of information society services and of consumers, the link between the electronic commerce

proposal and existing consumer protection and data protection Directives, the treatment of unsolicited commercial communications via electronic mail and determination of the moment when an on-line contract is concluded. However, in order to preserve the careful balance of interests featured in the original proposal, the Commission has maintained the proposed rules limiting the liability of on-line service providers who act as intermediaries. (Source: *Newsletter*, No. 16, 3 September 1999, UNESCO Observatory on the Information Society, http://www.unesco.org/webworld/observatory)

Report highlights barriers to electronic commerce

European companies are beginning to realize the potential benefits of e-commerce, but there remain significant hurdles to be overcome, according to a recent ICX report supported by the European Union's Espirit programme. The report, "Blockers to E-commerce", is a distillation of knowledge from experts in the USA and Europe in the fields of computer security, management consultancy and multinational business, put together by Chris Taper of International Computers Ltd. for the International Commerce Exchange (ICX). It showed that the climate in Europe is lagging behind the United States where electronic commerce has been embraced wholeheartedly, encouraged by enabling technology, electronic signature legislation and low cost access to the Internet compared with Europe. Different states are even tackling the implications of possible loss of tax revenues. (Source: *Newsletter*, No. 16, 3 September 1999, UNESCO Observatory on the Information Society, http://www.unesco.org/webworld/observatory)

Ghana

Ghana gets e-mail for the masses

In two months, Internet service provider (IS) Africa On-line registered 30,000 e-mail customers in Ghana, a country which only had 20,000 personal computers at the last count.

The secret is an exclusive deal with local post offices, through which Africa On-line offers any Ghanaian an e-mail address free of charge. Customers can then send messages at around 25 cents a go. So far only a handful of post offices provide this service so there is large potential for expansion.

"It's wonderful: everyone makes money", enthuses Ayisi Makatiani, Africa On-line's 32-year-old chief executive. Makatiani co-founded Africa On-line in 1994 while at the Massachusetts Institute of Technology.

"To begin with we help the post offices set up and split the fees 80:20. Later on that will go down to 55:45. It's like a post office box, except ordinary Ghanaians can boast they have an e-mail address."

Africa On-line operates in Kenya, Tanzania, Ghana, Côte d'Ivoire and Zimbabwe, and there are plans for further expansion. Its Internet subscription base has grown from 3,000 to 8,000 in two years, and in 1998 revenues are expected to exceed $6 million.

Makatiani says the past year has been difficult. A lack of finance has meant Africa On-line in Kenya could not buy until recently the 512 kbps line needed for fast access for its growing clientele. (Source: CIA, April 1999)

Iceland

Iceland's power game

The most sparsely populated country in Europe and one of the coldest is incubating an energy revolution. Within 20 years, Iceland aims to be the first country in the world to cut its links with fossil fuels and create a "hydrogen economy", based on its most abundant resource—water. Energy analysts say it is a strategy that could turn this country of 270,000 people into one of the world's "energy sheikhs" by the middle of the twenty-first century, and if adopted worldwide would banish global warming.

Iceland has already gone some way towards kicking the fossil-fuel habit. Its electricity comes largely from hydroelectric power, and it heats its buildings by tapping geothermal energy from hot volcanic rocks. Now it wants to wean its transport system away from oil.

The new power source will be hydrogen, made by splitting water molecules using the island's abundant hydropower. The hydrogen will be liquefied and fed to fuel cells that will power electrically driven buses, trucks, cars and even the fishing fleet. And within a few years, Icelandic hydrogen could be on sale at filling stations around the world.

The breakthrough came in February, when the world's leading companies in the fast-growing fuel-cell business signed up with Iceland to conduct a countrywide experiment. The key partners in the deal are: the car maker DaimlerChrysler, which unveiled a prototype vehicle the following month; the oil company Shell, which opened its first hydrogen filling station in Hamburg in January; the Norwegian hydroelectric company Norsk Hydro; and Canadian fuel-cell designers Ballard Power Systems of Vancouver.

Under the plan, DaimlerChrysler's fuel-cell buses, now on trial in Chicago and Vancouver, will soon be running in Reykjavik. The firm converted fishing boats, which should be working within 18 months. Last year, the Icelandic Government outlined plans to phase out all fossil fuels and "create a hydrogen economy within 15 to 20 years".

Power from hydrogen fuel cells has been a long time coming. As long ago as 1839, the Welsh physicist William Grove showed that combining oxygen and hydrogen in a cell with platinum electrodes will generate electricity. The first practical fuel cells were developed for the American space programme. In a modern fuel cell, a platinum electrode strips electrons from the hydrogen. The resulting hydrogen ions pass through an electrolyte to the opposite electrode. The electrons are captured in an external circuit and combine with the hydrogen ions and oxygen to produce water and electricity.

Vehicles running on fuel cells are quiet and produce virtually none of the pollutants associated with petrol engines, such as nitrogen oxides and the greenhouse gas carbon dioxide. Only water vapour comes out of the exhaust pipe. The chief problems holding back this technology are cost, the difficulty of storing liquid hydrogen safely, and packing enough on board to give the vehicle adequate range and power, but as controls tighten, the fuel cell looks increasingly attractive.

Energy analyst Christopher Flavin of the Worldwatch Institute in Washington, D. C. says fuel cells could revolutionize energy supply. But he warns: "Developing a system for storing and transporting hydrogen will be a major undertaking."

Buses and taxis powered by fuel cells have already been tested. But cars, with their limited capacity to store hydrogen, are tougher to design. In March, DaimlerChrysler launched the fourth in a series of prototype new electric cars, the NECAR-4. Based on a five-seater Mercedes, it can travel 400 kilometres without refuelling.

The difficulty of storing hydrogen meant that its predecessor, the NECAR-3, carried methanol as its fuel, and used it to generate hydrogen in an on-board "reformer". This hybrid technology, developed by Shell, splits methanol to produce hydrogen and carbon dioxide.

Hydrogen can power more than just vehicles. Norsk Hydro is considering plans to spend $1 billion building two hydrogen-fuelled power stations in Norway. The company plans to split methane from North Sea gas into carbon dioxide and hydrogen. It will then pump the carbon dioxide back into the ground for storage.

Iceland, meanwhile, sees itself as the ideal testing ground for a hydrogen economy. A small, but wealthy, island, with a vehicle fleet physically cut off from other countries, it is better placed than most to convert to hydrogen. It is also well placed to manufacture the fuel in an environmentally friendly way and to export it.

The energy needed to split water molecules can come from any convenient source—although using coal or oil would largely defeat the object because it would maintain dependence on fossil fuels. Using renewable energy breaks the link, and Iceland is ideally placed to do this. (Source: *New Scientist*, 1 May 1999)

India

Indian DoT to set up national backbone

The Department of Telecom (DoT), India's monopoly telecom player, will establish its own Internet backbone, crossing the entire Indian subcontinent within six months. The Telecom Commission of India has set 26 January 2000 as deadline for setting up Internet access nodes at every district in India. The project cost for the national Internet infrastructure is estimated to be in the tune of $100 million. The DoT has the basic network in place. "The DoT has plans to set up its own backbone covering nearly 45 cities in the first phase," says N. Parameswaran, Deputy Director-General, DoT. (Source: http://www.internetnews.com)

Ireland

IT at a price

While Ireland is quickly becoming more technology minded, one aspect of the technological revolution does not seem to have made its mark. A recent survey by the Amarach Consulting firm states that a mere 16 per cent of the population use the Internet. High cost is believed to be the reason for the low figure, especially for those who are just "surfing". Of the 16 per cent who use the Internet 30 per cent of those are at work, another 30 per cent are in educational institutions or cyber cafes, and 9 per cent are elsewhere. Seven per cent of those surveyed answered that they do not just use the Internet at home, but elsewhere as well.

So far the Internet has not proven itself to be the indispensable tool that computer companies would like it to be. As a source of information the user can find out about the latest news from Tokyo or the weather conditions in the Andes, but most people seem to get what they want to know by scanning the day's events in a newspaper, Cyberspace is often bypassed this way, as people choose cheaper, more accessible sources of information.

The cost of installation probably puts a lot of people off buying facilities and the hours surfing the Net result in higher telephone bills. Just having the Internet costs at least £12 a month, and not everyone thinks it is worth the price.

That attitude might change. The Government has a programme to increase public awareness of IT, and the Minister for Science, Technology and Commerce has promised to connect every school in the country to the Internet.

Clearly the industry believes that interest will increase. Competition in the Internet market will increase in 1999, as more Internet service providers will set up shop in Ireland. Presently, Ireland On Line can claim to have 33 per cent of the market, Telecom Internet 25 per cent, Esat net 10 per cent and Indigo 18 per cent. These companies will be challenged this year by new players such as America On Line, Esat Clear and UUnet. In the last few months, Indigo, one of the ISPs, has made an effort to hang on to its share, by giving away free trial CDs with various periodicals. (Source: *Technology Ireland*, March 1999)

Co-operative networking

Over the last year, small-to-medium enterprises (SMEs) have been doing something unusual for market competitors. They have been cooperating. The companies have grouped together as part of the Inter-Firms Co-Operation Network pilot programme initiated by Enterprise Ireland in 1997. The programme aims to help SMEs overcome inherent weaknesses such as low production capacity, shortage of finance, low levels of R&D and management or marketing deficiencies by sharing risks and costs, gaining critical mass and pooling expertise

through networking. During the pilot stage, interested SMEs were screened to assess their suitability for teamwork, matched with suitable partners, and taken through the initial stages of networking with trained facilitators. Several of the teams found the process useful and agreed to continue the cooperation network. (Source: *Technology Ireland*, March 1999)

Teleworking

Teleworking, or working remote from the office, either at home or on the road, using telematics has been given a sharp boost by the increasing traffic congestion in Ireland's main cities. A Government commissioned report on teleworking should also help raise awareness levels and provide an incentive for action to develop the practice.

The National Advisory Council on Teleworking, set up last April and chaired by Prof. Tom Callanan of the University of Limerick, recommended in its report that the council should set out a detailed blueprint for action and that the Government has undertaken to act quickly on the Council's recommendations. The Council members are drawn from all sectors involved in teleworking issues, and among the aspects being considered are the possible benefits to disabled people.

At a recent European conference on teleworking, held in Vienna, Horace Mitchell, director of European Telework Development, said that the right combination of different methods of telework can generate substantial benefits for both employers and employees. "Companies which use telework report savings as high as 50 per cent—notably through reduced outlay on premises and equipment—and productivity gains of almost 40 per cent", he said.

Compared to the rest of Europe, Ireland is in the middle range in terms of using IT, yet is considered well placed for teleworking.

The recent European Commission report on telework concluded that the focus and direction of the National Advisory Council on Teleworking, together with its effectiveness in converting ideas into action, could significantly influence the shape and extent of teleworking in Ireland for many years to come.

Much depends on effectively addressing barriers to local teleworking. Most of the problems centre around non-technical issues, since the telecoms, computer and data transfer technology for teleworking is already in place. Riona Carroll, executive officer of Telework Ireland and a member of the Advisory Council, said that Ireland's employment and tax legislation needs amending. The introduction of specific tax allowances for teleworkers would be a big incentive to the development of the practice.

Issues like broadband capacity are fairly well settled at this stage and following the recent final deregulation of the telecoms market, the cost of telecommunications, including Internet access, is likely to fall quite substantially.

Teleworking is growing in Ireland, despite the drawbacks. The number of teleworkers is roughly estimated at 15,000 to 20,000, or 1.5 per cent of the workforce. Sweden has the highest proportion of teleworkers in Europe, four per cent of its workforce. The European Union as a whole has over four million teleworkers and that number is forecast to grow astonishingly over the next few years, to over 40 million by 2007. In the US, which is the most developed country in the world for teleworking, about six million people are teleworking, or five per cent of the workforce.

Teleworkers are a very diverse group. Some are computer and telecommunications specialists and journalists, while a much more common group are the so–called nomads, engineers, sales people and technicians who are on the road, but who keep in close touch with customers and head office through portable computers, groupware and mobile phones. A third group works from telecottages.

Apart from the practicalities of home working, teleworkers have to consider other issues, too, like computer security and the need to have public liability insurance if anyone from their company is visiting them at home. Setting aside a designated work area at home is one of the key components of teleworking success.

The aim of the new EU Framework Research Programme, the fifth, which runs until 2002, is to develop teleworking as part of a user-friendly Information Society. The European Foundation for Living and Working Conditions, based in Loughlinstown, Co. Dublin, is working on three teleworking topics, the legal and contractual situation; the social security situation and health and safety. (Extracted from *Technology Ireland*, February 1999)

Japan

Law on recovery of electronic scrap

In Japan, the principle of producer responsibility now also applies to the electrical equipment area. With the support of the Japanese industry ministry (MITI), a law was adopted on the return and recycling of used electronic equipment.

The legislation contains obligations to take goods back, as well as recycling targets for TV sets, refrigerators, washing machines and airconditioning equipment. The annual waste potential of these categories of electrical goods is approximately 600,000 tonnes.

Electrical equipment is already being accepted back by local district authorities, but these are only individual cases of recycling. Only some metal and glass components are currently being recovered. The rest is landfilled, some of it first being shredded. However, the lack of landfill capacity in Japan provides a major incentive to increase the recycling effort.

According to the law, the goods have to be returned mainly through the distributors: consumers are obliged to return their old equipment to them. Distributors have to accept the equipment back, either when consumers acquire a new product or if the distributor has sold the old product himself. Distributors may also commission third parties to undertake this task or set up separate facilities for accepting the equipment back. Local district authori-

ties may also continue to accept back the post-consumer equipment, particularly in sparsely populated areas.

The new legislation is intended to lead to a significant intensification of recycling. For example 50 per cent of the quantity of waste which accrues should be recovered. These targets are directed at manufacturers and importers of equipment. Distributors, district authorities and third parties are obliged to pass on the equipment collected by them to the manufacturers and importers. The latter are then obliged both to accept and to recycle the products. The above obligations will apply from 2001.

Compliance with the requirements will be monitored by central government institutions. The costs for collecting the electronic equipment by the local district authorities will be borne by the owners of the waste, as before. Manufacturers and importers as well as distributors and local district authorities will be able to charge consumers fees for collection and recovery.

But these fees must not exceed actually accrued costs. Publication of fees broken down for manufacturer and type of equipment will also be assured so that consumers can take the cost of disposal into account at the time when they are purchasing a new piece of equipment. According to first estimates, the cost will be about 2,500 to 5,000 yen (approximately 17-35 US$), depending on the type of equipment. For further information contact: MITI, 1-3-1, Kasumigaseki, Chioda-Ku, 100 Tokyo, Japan. Tel.: (+81-3) 350 1511. (Source: *Tech Monitor*, March-April 1999)

Japan has high hopes

The Japanese electronics industry should have a much better year in 1999 according to the Electronics Industry Association of Japan (EIAJ) which predicts growth of 2 per cent.

This compares with a disastrous year in 1998 when Japanese electronics manufacturers saw sales decline by 6.2 per cent compared with 1997.

The EIAJ is predicting that growth in memory chips, flat panel displays and consumer electronics to help push the industry into growth again this year.

All the major Japanese electronics companies have been making large cuts in their operations in order to weather a large recession in Japan and the effects of the Asian economic crisis. They have also cut back on building chip fabs which could lead to problems if the chip recovery continues to build this year. (Source: *Electronics Weekly*, 6 January 1999)

Israel

Internet2 connection to Israel completed

The physical connection between Israeli inter-university computation centre Machba and the US-based network centre for Internet2 was completed in July 1999, with official inauguration just around the bend. The satellite connection is executed via Gilat to the backbone of Internet2 in Chicago and at a rate of 45 megabits per second. This type of satellite connection to Internet2 is the first in its field, and many are waiting to see if the optical fibre connection matches the network performance standards of on-land or underwater connections. Israel is connecting to Internet2 as part of a four-year programme at an expense of $40 million. In the future, this connection will be expanded to 622 megabits per second. (Source: http://www.internetnews.com)

Pakistan

Pakistan PTCL installs Internet infrastructure

Pakistan Telecommunication Company Ltd. (PTCL) has installed the world's latest Internet system which will be operational from 30 September, aimed at providing modern facilities to the country's Internet users. According to PTCL, it will provide a total of 300,000 Internet connections in phases and in the first phase 50,000 connections will be provided throughout the country. The world's most modern Internet infrastructure has already been completed and now is being tested and will be put into operation on 30 September after which the Internet connections will be offered to PTCL customers. (Source: *Newsletter*, No. 18, 17 September 1999, UNESCO Observatory on the Information Society, http://www.unesco.org/webworld/observatory)

Senegal

INTELSAT trial showcases recent advances in rural telephony

The International Telecommunications Satellite Organization has announced that it has begun its second recent rural telephony trial. This three-month trial is taking place in Senegal with the cooperation of the *Société nationale des télécommunications du Sénégal* (SONATEL), the signatory for this country to INTELSAT. The trial will serve multiple villages and is using two very small aperture terminal/wireless local loop (VSAT/WLL) stations. The objective of this new trial is to demonstrate the technical feasibility of providing satellite interconnection for WLL installations through INTELSAT satellites, including backhauling telephony services into the public switched network.

INTELSAT is using a DAMA network infrastructure supplied by STM Wireless of Irvine, CA, operating over the *Intelsat-603* satellite at 335.5° E, to conduct the trial in Senegal. (Source: *ITU News*, April 1999)

Singapore

Singapore Government plans business e-commerce communities

The Singapore Government has announced it will join with a number of industry bodies to develop a set of common electronic business platforms for each industry sector of the economy. The Ministry for Communications & IT will work with various industry bodies and business associations to create 10 to 20 e-commerce communities, dubbed e-Business Communities, over the next two years. Lim Swee Sway, Minister of State for

Trade and Industry, said the initiative was one way to speed up the adoption of e-commerce by Singapore businesses, from the current 9 per cent to about 20 per cent. (Source: *Newsletter* No. 16, 3 September 1999, UNESCO Observatory on the Information Society, http://www.unesco.org/webworld/observatory)

United Kingdom

Scotland braves it with chip fab plans

A Government plan to create the first Scottish-owned semiconductor manufacturing company has been launched by Scottish minister Gus Macdonald. It is the centrepiece of an initiative to double the size of Scotland's electronics industry in five years.

Under the business plan to encourage home-grown start-ups and the relocation by overseas firms to the area, the number of people employed in Scotland's electronics industry will reach 14,500 by 2004.

Industry and universities are involved in the plan which has a goal to create an indigenous Scottish-owned semiconductor manufacturing company. The cost of such a venture could be around £1 billion.

The region has a number of successful fabless chip design-houses, but all the Scottish fabs are foreign-owned.

Another aim for the initiative, which will be supported by the Government and Scottish Enterprise, include the creation of Scotland's first global optoelectronics chip manufacturer. (Source: *Electronics Weekly*, 16 June 1999)

H. STANDARDIZATION AND LEGISLATION

Standardization

Affordable multi-megabit/s network access to Internet via telephone lines to be fostered by single transmission standard

The International Telecommunication Union (ITU) announced that its Telecommunication Standardization Sector had formally approved a set of new world standards providing Multi-Megabit/s network access via ordinary telephone subscriber lines by using ADSL (Asymmetric Digital Subscriber Line) technology, thus meeting its commitment announced last October. The approved standards, also called ITU-T Recommendations, are effective immediately.

Systems based upon these ITU-T Recommendations are being introduced in many countries to provide affordable access to Internet, teleworking, distance learning, and multi-media services at speeds many times faster than possible via today's "dialup" modems, thus completing the "last mile" in high-speed subscriber-to-subscriber data connections.

The approved ADSL Recommendations establish a set of coordinated specifications for compatible systems that operate over a range of bit-rates from less than 1 Mbit/s to about 7 Mbit/s. Furthermore, these Recommendations have strong commonality with regional ADSL standards. As a result, work in ITU-T led to worldwide agreement on a single standard transmission method for ADSL systems, the technical specifications having been agreed by Study Group 15 last October, thus providing the technical stability required by manufacturers and service providers to start bringing compatible products to the market. This single transmission method for ADSL is now in use by network operators, service providers and telecommunications equipment and computer systems vendors around the world, facilitating the interoperability of ADSL systems from different equipment suppliers.

Indeed, several companies have announced progress in demonstrating multi-vendor interoperability of ADSL systems based on the earlier drafts of the ITU-T Recommendations.

System interoperability provides both consumer and business customers with the freedom to choose among equipment from many different vendors.

The set of the approved ITU-T ADSL Recommendations covers:

- ADSL transmission at rates up to about 7 ML/s with the use of a filter to split data from voice-band signals (G.992.1)
- ADSL transmission at rates up to 1.5 Mb/s with a simplified service installation and reduced modem cost. This typically avoids the need to install new wire or a splitting filter in the customer premises (G.992.2)
- Method for DSL systems to negotiate mutually supported operating modes (G.994.1)
- Reference architecture for ADSL system (G.995.1)
- Test methods for ADSL systems (G.996.1)
- Management of ADSL systems (G.997.1)

For more information, please contact: Mr. Fabio Bigi, Deputy Director, Telecommunication Standardization Bureau, ITU. Tel.: +41 22 730 5860; Fax: +41 22 730 5853; e-mail: fabio.bigi@itu.int (Source: *News Release*, 5 July 1999)

Wireless browsing steps up

Wireless Web browsing moved a step closer with the setting up of an open standard initiative to promote use of the Internet Protocol (IP) for third generation mobiles.

An alliance of nine communications firms and wireless operators has set up the 3G.IP industry forum to ensure that the trend to the packet-oriented IP under way in fixed networks will also be applied to the differing needs of mobile communications.

Mobile, unlike fixed line networks, is still voice dominated. Accommodating the emergence of mobile data, the thinking has been to add packet-based services on top of the circuit-switched network currently used for voice.

The nine companies will work to define the standards and protocols for a common core network to support IP-based voice and data. It will also address the air interface of mobile phone standards like W-CDMA and EDGE.

Trade and Industry, said the initiative was one way to speed up the adoption of e-commerce by Singapore businesses, from the current 9 per cent to about 20 per cent. (Source: *Newsletter* No. 16, 3 September 1999, UNESCO Observatory on the Information Society, http://www.unesco.org/webworld/observatory)

United Kingdom

Scotland braves it with chip fab plans

A Government plan to create the first Scottish-owned semiconductor manufacturing company has been launched by Scottish minister Gus Macdonald. It is the centrepiece of an initiative to double the size of Scotland's electronics industry in five years.

Under the business plan to encourage home-grown start-ups and the relocation by overseas firms to the area, the number of people employed in Scotland's electronics industry will reach 14,500 by 2004.

Industry and universities are involved in the plan which has a goal to create an indigenous Scottish-owned semiconductor manufacturing company. The cost of such a venture could be around £1 billion.

The region has a number of successful fabless chip design-houses, but all the Scottish fabs are foreign-owned.

Another aim for the initiative, which will be supported by the Government and Scottish Enterprise, include the creation of Scotland's first global optoelectronics chip manufacturer. (Source: *Electronics Weekly*, 16 June 1999)

Another drawback from consumers' point of view is that both formats are likely to include a new copy-control system developed to satisfy the big record companies. The sound is encrypted, and a digital "watermark" is added. This still allows the disc to be copied onto analogue tape, but record companies will have the option of adding extra codes to the discs to control how many digital copies you can make, and of what quality. (Source: *New Scientist*, 20 March 1999)

Legislation

V-chip hits price snag

The introduction of the V-chip into US-sold TV sets is facing problems after TV manufacturers have protested about the high licence fees being demanded from patent holders.

A 1996 law mandates that by July 1999 at least half of all TV sets with 13 in. or larger screens must include the V-chip to filter out violent and adult content. But several companies have laid claim to key parts of the V-chip technology and are demanding that the TV manufacturers pay the licence fees on the patents they own.

The Electronic Industries Association developed the specifications for the V-chip standard in 1997 but since then, several companies have alleged that the standard infringes on their patents.

The dispute over intellectual property rights could lead to demands from TV manufacturers that the law's deadline be extended until the disputes are resolved. (Source: *Electronics Weekly*, 17 February 1999)

A new digital recorder could break an agreement to protect copyright

An advanced hi-fi system that allows music on CDs to be stored and digitally recopied could destroy a long-standing agreement between the recording industry and electronics companies.

Domestic digital recorders such as CD recorders can copy an original music CD, but under the agreement they are not supposed to be able to make a copy of a copy. Now an Edinburgh-based company, Memory Corporation, has come up with a system that breaches this principle by copying CDs onto a disc drive, and then allows them to be copied from there into the memory built into a personal stereo.

MP3-GO is the umbrella name for a complementary pair of units planned by the company. One of them, called the Music Store, is a combined CD player and 4-gigabyte hard disc that can record up to 100 CDs in the digital MP3 format. The Music Store can be connected to a hi-fi to play the music back. The second component of the system, called SoulMate, is a portable player that docks with the Music Store to digitally copy an hour of music in 10 seconds into 64 megabytes of microchip memory.

The company's chief executive, David Savage, says the whole system will go on sale late 1999 for under £300. He would like to see kiosks in stores that sell music by downloading it into a customer's SoulMate, but has no firm deals lined up.

But Memory Corporation faces hurdles. Ten years ago, hi-fi makers, the International Federation of the Phonographic Industry (IFPI) and the Recording Industry Association of America (RIAA), signed an agreement on copy protection. This stipulates that all digital audio disc and tape recorders currently on sale incorporate the Serial Copy Management System (SCMS), which stops large-scale copying of copyright music by making it impossible to make a copy of a digital copy.

Last year, Diamond Multimedia Systems of San Jose, CA, won a legal battle with the RIAA to sell Rio, a solid-state personal stereo that copies music from the Internet. The IFPI and RIAA then began the Secure Digital Music Initiative (SDMI) to come up with Internet copyright control techniques.

Although MP3-GO does what SCMS prohibits by making copies of a copy of a CD, Memory Corporation thinks this is acceptable because the copy is accessible only for hi-fi listening, analogue copying, a or digital copying into its SoulMate. (Source: *New Scientist*, 27 March 1999)

Court ruling clears legal path for Microsoft to develop Java variant

Microsoft may have the legal right to develop its own Java-like technology.

The company had asked US District Judge Ronald Whyte, presiding in the legal dispute between Microsoft and Java developer Sun Microsystems, to clarify his preliminary injunction that ordered Microsoft to change its versions of Java to comply with Sun's standard. Microsoft wanted to know whether the ruling applied to versions of Java that do not use any of Sun's Java code. Whyte recently issued a new ruling that the injunction only applies to Sun's Java.

Recent reports indicate that Microsoft has been debating whether to introduce a Java competitor code-named Cool. Although Microsoft says that Cool is aimed at improving C++ applications development, the ruling could encourage it to produce its own Java version.

Whyte's ruling might not protect Microsoft from further legal problems. Sun has warned companies that such Java variants might still violate its IP. (Source: *Electronics Weekly*, 24 February 1999)

I. RECENT PUBLICATIONS

"Slaves" revolt in scientific publishing

What goes up and never comes down? The answer can be found in the physics of gravity. It can also be found in molecular biology, chemical engineering and endocrinology.

It is the price of academic journals, which have long been regarded as the lifeblood of the scientific process itself.

The estimations vary in the detail, but they all indicate that average increases in journal subscriptions have run at about 10 per cent every year for the past decade. The Association of Research Libraries in the United States has estimated that member libraries are paying over 140 per cent more for journals than a decade ago.

At the same time, the total number of academic, particularly scientific, journals has continued to grow at a similar rate. As science breaks down into ever more specialized sub-disciplines and the pressure grows on researchers to publish, academic journals are proliferating steadily.

The burden of keeping pace with this burgeoning activity falls on the college and research libraries at which these journals are primarily targeted. These libraries now typically spend between one-third and two-thirds of their budgets on periodicals, and the proportion is rising, with obvious consequences for other services.

Operating in captive markets, the major publishers can ask for, and receive, annual subscriptions of several thousand pounds for some more frequently published "core" journals. Subscriptions of £200 and above for journals which publish four or six editions a year—and which may be consulted in the library no more than 100 times—are normal. The captive nature of this market is well expressed in the two-tier subscription structure: institutional subscriptions to journals are typically three times the price of individual subscriptions.

This spiral is one manifestation of the remarkable economics of journal publishing, which are truly bizarre. Consider this: The raw material is supplied to the publishers free of charge by academics who are paid (mostly) from public funds. The resources which academics put into the research behind their papers and into the writing of those papers are covered by their institutions, again mainly from public funds.

The overheads associated with the supply of this raw material, e.g. equipment, accommodation, travel, are also covered by the authors' institutions or by research grants from public or private sources. The supply of raw material is guaranteed by the institutions, which expect their academic employees to publish more and more papers.

Early stages of the production process are managed free of charge by editors and referees, again academics paid from public funds. The published journals are sold back to the libraries of academic institutions who pay for them (mostly) from public funds. The publishers acquire, with the supplied raw material, the rights to use and re-use it in any format and to charge others for any re-use, e.g. even in article collections edited by the authors themselves.

The pressure on academics to publish causes pressure on their libraries to buy more journals in order to keep in touch with published work. The manner of academic publishing, with its constant cross-referencing, adds to the pressure on libraries to buy more journals. The dependence of academic libraries on journals means publishers can continue to raise prices without corresponding loss of sales. Pricing is said to be inelastic.

Add to this that, in some instances, authors pay (per page) for their papers to be published, and that the journals may be consulted in the libraries no more than 100 times a year. And a picture is painted of a uniquely distorted market.

Not surprisingly, journals publishing is an exceptionally profitable business.

The increasingly dominant position of a handful of publishers has provoked a reaction from the academic community, notably in the United States where the tradition of publishing by scholarly societies is stronger than it is in Europe.

The Scholarly Publishing and Academic Resources Coalition (SPARC) is an alliance of libraries that aims to rekindle competition in the academic publishing market. It was set up with support from the Association of Research Libraries and works with "publishers who are developing high-quality, economical alternatives to existing high-price publications". Its partners include learned societies and university presses—the American Chemical Society and the Royal Society of Chemistry were among the first to join up.

Under its arrangement with SPARC, the American Chemical Society, which has over 150,000 members worldwide, will publish a new journal every year for three years. The first of these is *Organic Chemistry Letters*. Starting as a bimonthly, it will cost less than one-third of the competing *Tetrahedron Letters*, a weekly Elsevier publication, costing over £6,000 a year.

Through its library supporters SPARC provides a subscription base for new journals with a "fair price". The coalition promotes the use of electronic communication technologies to reduce the cost of distribution and provides financial support to networks using electronic publishing for exchange of research information.

University of Arizona biologist Michael Rosenzweig took the goodwill and standing of the journal which he edited from the hands of Wolters Kluwer, and relaunched it, with SPARC's backing, as *Evolutionary Ecology Research.* Professor Rosenzweig has reportedly described the resistance to the commercial publishers in the academic field as a "slave revolt".

Stanford University, in California, established an electronic publishing service, HighWire Press, in 1995, beginning with the online production of the weekly *Journal of Biological Chemistry,* said to be the most frequently cited peer-reviewed journal. Like SPARC, HighWire Press is based on collaboration among scientists, librarians and publishers.

The prestigious US general-science journals, *Science* and *Proceedings of the National Academy of Science* (PNAS), are available online through HighWire, which links to 110 sites. Oxford University Press has transferred to HighWire the management of access to the electronic versions of 160 journals. HighWire manages both individual and institutional subscribers' access to the journals it puts online.

At California Institute of Technology (Caltech), a "hyperforum" site is being set up for exchange of scientific information among the academic community. It is envisaged that this community would do the peer review and editing currently performed through commercial publishers.

Since 1991 the Los Alamos physics archives have been publishing papers electronically and now receive 25,000 new papers each year. The submitted "pre-prints" are made available directly to the tens of thousands of users.

Electronic publishing technologies have made a serious challenge to the domination of established journal publishers possible. The publishers have themselves taken advantage of the technologies to cement relations with customers, but their additional charges for access to the electronic editions are a further cause for resentment.

Learned societies are developing Internet facilities for more rapid publication of papers, but also for access to archives and for debate. The technologies are being applied to develop richer forms of communication between authors and readers, as members of a community.

Journals published by scientific societies tend to include, at no extra charge, access to the electronic version with the subscription to the print edition. In some instances, the accepted papers are available online weeks before they appear in print. In many cases, large parts of the journals are accessible free of charge to all Web users.

The Institute of Physics and its German counterpart, Deutsche Physikalische Gesellschaft, are experimenting with a new model of publication, which is all-electronic, free of charge, and funded by charges to the authors of the published papers.

The major publishers have gained too much from making their journals indispensable to walk away. The battle will test the strength of the research community's commitment to the free flow of scientific information. (Extracted from *Technology Ireland,* June 1999)

Heritage management

Using space-age technology to conserve and manage the remains of ancient civilizations, "GIS and Cultural Resource Management" is a new UNESCO/World Heritage Centre publication that will introduce a well-known computer programme—Geographical Information Systems—into a new realm of heritage management. Designed as an easy to use introduction to GIS technology, the manual shows how this technology can be used. In addition to explaining its application, it cites case studies that demonstrate technology usage in a number of contexts, including the original pilot site: Angkor Wat (Cambodia). Other featured sites include Stonehenge (England), Banff National Park (Canada) and Patan Durbar Square, in the Kathmandu Valley. (Source: *UNESCO Sources,* No. 114, July-August, 1999)

Information Technology Services: A Handbook for Exporters from Developing Countries

Handbook focusing on drawing up strategies to promote and develop information technology services exports from developing countries—describes information technology (IT) services having potential export markets; gives overview of the global market; outlines levels of institutional support needed to promote foreign trade in IT services; introduces use of Internet to obtain information on business opportunities and gives lists of relevant information sources; provides hints for successful marketing of IT services; examines business opportunities for marketing information technology components in internationally funded projects; identifies skills and technology requirements to sustain exports of IT services and means of acquiring them; contains list of useful addresses. Free, from ITC, 54-56, rue de Montbrillant, 1202 Geneva, Switzerland. Postal address: ITC, Palais des Nations, 1211 Geneva 10, Switzerland or at http://www.intracen.org

New CD-Rom: Trade Information Tool Kit

A collection of ITC trade information products is now available on CD-Rom. The "Trade Information Tool Kit" simulates an Internet web site, and provides fast retrieval of information. It includes:

► **ITC Bibliographical Databases.** International Trade Databases, Published Market Research, Multilateral Trading System and the Index to Trade Information Sources.

► **COMREG.** A software for managing company register, based on international standards and codes, and using the ITC Classification of Product Groups and Services (correlated to the Harmonized System).

► **ITC's Virtual Exhibition Centre.** This ITC web site promotes trade of artisanal products from developing countries and economies in transition.

► **Classification of Products Groups.** A correlation between the Harmonized System Classification 1996 and the ITC Composite Product Group Classification.

► **Selected trade information articles and training materials** to develop information products and services, including the Internet section in this magazine.

The "Trade Information Tool Kit" was developed by ITC's Trade Information section. It is available free to trade support institutions, such national trade promotion organizations, chambers of commerce, professional associations and training centres. Contact ITC by e-mail at turrel@intracen.org

Fourth edition of the ISO/IEC Compendium of Conformity Assessment Guides and Standards appears

Rapid technological developments and increased international trade have brought about an increased need for common recognition of basic elements of certification systems and other conformity assessment-related matters. To provide guidelines for compatible implementation at the national, regional and international levels, ISO and IEC, through the work of ISO/CASCO (ISO's policy development committee on conformity assessment), have produced a series of international documents.

CASCO's guides and International Standards are its primary source of information; in 1997, ISO authorized CASCO to develop International Standards to enable the development of CASCO documents prescriptive in addition to descriptive purposes and thus more clearly reflect their intended aims.

In response to demands from users, the results of the ISO/IEC work on conformity assessment were grouped in the form of a compendium in 1985 for the first time. To further enhance its usefulness, this fourth edition of the compendium includes not only published guides, but also draft ISO/IEC guides and International Standards currently in preparation.

Each document reproduced in the ISO/IEC Compendium is the result of years of work by experts from all over the world. The Compendium represents the accumulation of a huge amount of knowledge of, and experience with, conformity assessment, and one of the fundamental international reference works on conformity assessment in the voluntary sector.

This fourth edition contains 16 individual documents when published separately, two of which are revisions of those appearing in the third edition and seven of which are new in this edition. One of these documents, Guide 2:1996, *Standardization and related activities—General vocabulary*, has been reproduced only for the part dealing specifically with conformity assessment terms. Also contained in this edition are two draft documents whose separate publication has not yet occurred but is sufficiently imminent to justify their inclusion on the basis of their importance in making this Compendium as nearly complete as possible. It is recognized that the continuously evolving ISO proceedings whereby old documents are revised and new ones are created leads to the periodic need to issue a replacement edition of the Compendium. Its importance demands that this be frequently done.

It is very significant to note how the guides reflect the balance of interests that participate in the activities of CASCO, the conformity assessment committee that is responsible for producing them. The last revision of Guide 22 was produced with considerable input from industry, both the suppliers and purchasers, who find it most useful. The revised Guide 43 is for the laboratory community, and reflects the considerable input of laboratories and their accreditors. Guides 65 and 62 reflect contributions from certification bodies, while Guide 61 represents considerable work by their accreditors.

As a reflection of ISO/CASCO's new mandate to produce International Standards on Conformity Assessment, Guide 39:1988, *General requirments for the acceptance of inspection bodies*, and Guide 57:1991, *Guidelines for the presentation of inspection results*, appearing in the prior edition, have been revised into International Standard ISO/IEC 17020: 1998, *General criteria for the operation of various types of bodies performing inspection.* This document is based on a CASCO decision to adopt a European Standard using the fast-track procedure. Furthermore, ISO/IEC TR 17010:1998. *General requirements for bodies providing accreditation of inspection bodies*, has been produced to respond to the immediate need for an international document on accreditation of inspection bodies. Finally, ISO/IEC Guide 25, 1990, *General requirements for the competence of calibration and testing laboratories*, is being revised as ISO/IEC 17025. ISO/IEC *Compendium of Conformity Assessment, Guides and Standards,* Fourth edition 1998, 204 pages, ISBN 92-67-10287-7, Price CHF 101.-; available from ISO members or from the ISO Central Secretariat, 1 rue de Varembé, 1211 Geneva 20, Switzerland; Tel.: +41 22 749 01 11; Fax: 733 34 30, e-mail: sales@iso.ch

From knowledge management to strategic competence

Measuring Technological, Market and Organizational Innovation edited by Joe Tidd (Imperial College).

The business and academic communities pay much interest to the concept of knowledge management and strategic competencies or core capabilities; that is, how organizations define and differentiate themselves. This book attempts to establish the links between strategic competencies, knowledge management, organizational learning and innovation management—specifically, how an organization identifies, assesses and exploits its competencies, and translates these into new processes, products and services.

The contributors to the book include leading researchers and consultants in the field. Adopting a practical but rigorous approach to the subject, they focus on the measurement, management and improvement of organizational, technological and market competencies,

and identify the relationships with strategic, operational and financial performance.

Readership: Practicing managers, consultants and academics interested or responsible for measuring and improving the management of technology and innovation. 33 pp (approx.) Pub. date: Autumn 1999, 1-86094-188-5, US$ 58, £36. USA World Scientific Publishing Co., Inc., 1060 Main Street, River Edge, NJ 07661, USA, Toll-Free: 1-800227-7562, Toll-Free-Fax: 1-888-977-2665, e-mail: sales@wspc.com

Idea generation and commercialization in R&D laboratory organizations

By Frank Hull (Fordham University)

Why do some laboratories generate ideas that are more commercialized than others? This book compares 120 R&D laboratory organizations and 267 scientists and engineers to provide an answer. The most important single factor was practicing the principles of concurrency, which means diverse functions perform their tasks simultaneously rather than serially. For example, laboratory organizations engaged in teaming across functions, such as research, development, manufacturing, marketing, and headquarters were not only more inventive, but also more commercially successful.

Readership: Managers, scientists and engineers. 300 pp (approx.), Pub. date: Autumn 2000, 1-86094-105-2, US$ 46, £32. USA World Scientific Publishing Co., Inc., 1060 Main Street, River Edge, NJ 07661, USA, Toll-Free: 1-800-227-7562, Toll-Free-Fax: 1-888-977-2665, e-mail: sales@wspc.com

The knowledge enterprise

Implementation of Intelligent Business Strategies

By J. Friso den Herlog (MERIT, University of Maastricht, The Netherlands) & Edward Hulzenga (Altuition in Den Bosch, The Netherlands)

Price and quality alone are no longer sufficient to gain competitive advantage. It is high quality knowledge which provides the opportunities for adding exclusive value to products and services. At the same time, the development of knowledge is gaining momentum. Knowledge is becoming obsolete more quickly and becomes more complex. The danger of this development is that organizations will continue to play the same competitive game and are often unaware that they are lagging behind.

This book provides organizations with a way to shift the knowledge ambition and realize it in practice. For this purpose, an intelligent business strategy is offered based on the experiences of seven market leaders in the Netherlands combined with modern insights from the organizational theory.

The authors devote much attention to the tools available to the knowledge enterprise, such as lateral structures, personnel management and information technology.

Readership: Academics, managers and advanced graduates. 280 pp (approx.), Pub. date: Autumn 1999, 1-86094-136-2, US$ 38, £26. USA World Scientific Publishing Co., Inc., 1060 Main Street, River Edge, NJ 07661, USA Toll-Free: 1-800-227-7562, Toll-Free-Fax: 1-888-977-2665, e-mail: sales@wspc.com

How to 2000

580 pages.
Published by IDG. Price US$ 49.99
Reviewed by Bruce Conradie

How to 2000 is a huge project plan for dealing with the Y2K crisis. The authors have identified nine phases of a full Y2K conversion programme and have devoted a full chapter to each phase. Most of the material consists of lists of steps to be taken or checklists of facets to be covered.

Verdict: a year ago this would have been a highly useful book if you had not started your Y2K programme. At this late stage, however, if you have not already implemented the planning steps detailed in the book, it is probably too late. You may be better off kicking into crisis mode and trying to fix just those subsystems that are absolutely critical. On the other hand, the book checklists may be just the thing for a Y2K project manager who is trying to do too much, too late.

Year 2000 Solutions for Dummies

(2^{nd} Edition) by K. C. Bourne
384 pages.
Published by IDG. Price US$ 29.99
Reviewed by Terence Kennedy.

Your initial reaction to *Year 2000 Solutions For Dummies* will probably be a groaning, "Oh no, not an entire book devoted to Y2K". That would be a mistake. Here between these yellow covers is everything you ever, or never, wanted to know about the looming crisis and enough detail to decide, without the interference of expensive consultants, whether it is as bad as the media hype makes out.

If Bourne's in-depth book has one shortcoming it is the imprint under which it appears. Most Managers would not be seen dead reading a "Dummies" book. Yet this is a goldmine for even the most sophisticated IT manager. The approach covers a lot of ground, from what will happen, when and why, to the legal ramifications, testing what to ask your consultant and how to assemble your own Millennium Bug SWAT team. There is even a CD-ROM including some of the most popular testing programs so that, all in, this is the cheapest way to get a handle on an urgent and vexing issue.

It will not fix your PCs or your networks. Few quick fixes will and at the end of the day you will probably still need to call in the experts. But it is a sensible first step along what promises to be an increasingly rocky road. (Source: *CIA*, 18 May 1999)

Neural Networks—Dependable Systems—Selected Papers

ERA Report 97-0365

Neural networks have the potential to be used in a wide range of industries. The current under utilization of

this technology may be due to the lack of proven dependability of these systems. The ways of monitoring and measuring reliability and dependability are increasing, however until these methods are acknowledged as providing proof of dependability, industry will remain reluctant to use the technology, particularly in commercially or safety critical areas.

The selected papers in these proceedings focus on network dependability and on the practical reality of producing dependable systems. They look at how to obtain the most reliable predictions from NNs, verification and validation, and practical experience with NNs together with the latest developments on standards and certification.

These proceedings will be particularly useful to all professionals with a working knowledge of neural networks and their pros and cons. Price: £60, 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

Profiting from Automated Visual Inspection—Selected Papers

ERA Report 98-0107

Automated Visual Inspection (AVI) systems can be used in a variety of industries including manufacuring, packaging and electronics. These systems can result in long term cost savings as well as significant improvements in quality and yield. They are ideal for manufacturers using high-speed production lines that require consistently high levels of product quality. However, they remain underutilized due to lack of knowledge of their capabilities and the high capital expenditure required to purchase and install the initial system.

These papers will identify what it is possible to detect using both off the shelf and bespoke AVI systems. They also look at justifying the purchase of such a system and the business sense behind getting inspection right.

The report will raise awareness of the capabilities of current technology, and show how to save time and money whilst improving quality. It will let you read about companies that have already had systems installed, and understand the business case that justifies 100 per cent automated inspection.

Do you work in an industry where customers demand high quality all the time, or you are required to have 100 per cent inspection of your final product, or do you produce large numbers of items that are leaving the production line at high speed? This report will help your company to reduce costs, improve quality and gain a competitive advantage. Price £90. 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

CiA goes local

Having served Africa's computer users on a pan-African basis for over a decade, *CiA* is being relaunched with three regional editions—*CiA East*, *West* and *Southern Africa*.

"The dramatic spread of information technology in our markets, particularly stimulated by the Internet and telecommunications liberalization, makes it necessary for us to provide more coverage of local market developments and issues", said publisher Sean Moroney in announcing the launch.

All three editions will continue to publish the same high quality international industry information and product reviews that readers have come to expect under the editorship of Bruce Conradie, based in Johannesburg. But each will have its own customized editorial content on local market issues and industry news provided by contributing editors and correspondents based in each of the regions.

As part of the development *CiA* has incorporated Botswana-based magazine, *PC News*. Its editor for the past three years, Terence Kennedy, has joined AITEC as editor of *CiA Southern Africa*.

In Kenya, Jack Makau, one of the country's most experienced IT journalists, has been appointed as Contributing Editor. Kwami Ahiabenu, Executive Director of AITEC Ghana, and Federick Wamala, Executive Director of AITEC Uganda, will be Contributing Editors for their countries.

CiA is going to mount a major circulation drive in all its target countries, with overall circulation doubling to 14,500. In addition to *CiA*'s established subscription and news-stand circulation, the magazines will be distributed on a regular basis to volume purchasers of IT equipment selected from AITEC exhibition visitor lists. And the magazine will also be distributed at all of AITEC exhibitions and conferences.

CiA East Africa will be launched at the BIZTEC Tanzania 99 exhibition in Dar-es-Salaam, to be held over 12-14 May 1999. *CiA West Africa* will be launched at the West African Computing & Telecommunications Exhibition to be held in Accra, Ghana over 27-29 May 1999. (Source: *CiA*, April 1999)

Master your PC's operating system

You will never waste your time mastering your computer's operating system and computers books represent a cost-effective means of doing it. There are books for every level of user: novice, intermediate, and advanced. Here are just a few.

Using Windows NT Workstation 4, 2nd Edition

By Paul Cassel; Published by Que; US$ 80 (estimated retail price)

Using Windows NT Workstation 4 strikes a pleasing balance between depth of information and ease of use. The book is comprehensive enough to turn the novice into a power user, but brief enough to be manageable. The

writing style is straightforward and the page layout clean, crisp and easy to read.

This book is aimed at those who are beginners or intermediate users of NT. The emphasis here is on users. Network administrators and support staff will want something more technically in-depth.

Special Edition Using Windows NT Workstation 4, 2nd Edition

By Paul Sanna, et al; Published by Que; $50.

Despite its similar title, this book is authored by different people and is not simply a more detailed version of *Using Windows NT Workstation 4*.

Special Edition is aimed at "Accomplished—Expert" users and is correspondingly heavier in the depth and volume of information presented. More information is crammed on each page and there are more pages (nearly 900 versus the 600 of the lighter book). A CD-ROM is added with the Microsoft Tech Net Sampler. This offers a searchable knowledge base, bug reports, work-arounds, case studies, and information on a variety of technical topics.

Strictly for technical staff or those end users who wish to master the NT operating system

MCSE NT Workstation 4 Study Guide, 2nd Edition

Published by Sybex; $80.

Whereas the Que Using books are aimed at end users, this book is aimed at enabling MCSE students to pass the MCSE exams. It comes bundled with a CD-ROM featuring mock exams and other learning material.

Microsoft BackOffice Resource Kit, 2nd Edition

Published by Microsoft Press; $220

The BackOffice Resource Kit is a megastore of information for technical staff supporting Microsoft BackOffice. The four volumes of the kit provide a colossal 4,200 pages of technical information designed "to take Microsoft BackOffice to new heights of performance".

The four volumes are resource guides for:

- MS Systems Management Server 1.2
- MS SQL Server 6.5
- MS Exchange Server 5.5
- MS SNA Server 4.0.

A bundled CD-ROM includes dozens of tools and utilities. The layout is simple and reminiscent of some of the software manuals produced by Microsoft in recent years. The four books plus CD-ROM come conveniently packaged in a display box that will prevent the books falling over on a shelf.

Prospective buyers must realize that the Resource Kit is a part-teaching, part-reference work aimed at technical users who have already grasped the basics of the BackOffice suite. The kit is not suitable for students or novices wishing to become support technicians or to write their Microsoft Certified Systems Engineer (MCSE) examinations.

Windows 98 Secrets

Published by IDG Books; $80.

The 1,200 pages of *Windows 98 Secrets* are the closest you will come to finding a complete information source on Windows 98.

The book is aimed at intermediate to advanced users, but because it provides its step-by-step explanations it is suitable for inexperienced users (they will, however, need to know the basics of Windows).

Aspirant power users of Win 98 will get excited just reading the contents page of *Windows 98 Secrets*. Here is a vast repository of the in-depth information that will enable you to master your PC. To give you an idea of how in-depth this book is, there are:

- 33 pages devoted just to shortcuts;
- 27 pages on the start menu;
- 54 pages on Windows Messaging; and
- 31 pages on mice and pointing devices.

An add-on CD-ROM offers a collection of shareware, and demo versions of various programs and utilities.

Running Microsoft BackOffice Small Business Server, Professional Select Edition

Published by Microsoft Press; $40.

Microsoft Small Business Server (SBS) is a suite of applications that supplies in a single package all the software you need to run a network of up to 25 workstations. SBS allows file and printer sharing over a network; sharing of modems; and internal email, to name a few functions. SBS consists of ten modules and these include:

- MS NT Server 4
- MS Exchange Server 5
- Ms Proxy Server 1
- SQL Server 6.5.

According to *Running Microsoft BackOffice Small Business Server*, SBS is best for a company with the following characteristics:

- A single location. This can be with or without remote users (people who connect to the network while out of the office).
- An existing or planned dial-up connection to the Internet.
- A staff member who will learn about all aspects of SBS.

The book maintains that "a reasonably savvy person can set up and maintain a network with only a modest amount of help". The book aims to provide that help in the form of all the hand holding needed to install and configure SBS. Readers should be PC literate, but do not need to have had specialist technical training.

This book is not overbearing in its technical depth (it is 500 pages long), but as with any book learning, readers will need to be self-motivated.

All prices quoted here are estimated and may vary from country to country. (Source: Bruce Conradie, *CIA*, December 1998/January 1999)

Linux books—better than downloading

Reviews of six books that will help you Implement Linux—by Grant Walton

The Internet is awash with useful information on Linux, most of which is free of charge. Books on the other hand are expensive but may be the only practical way to get the information you need. Books compile material into indexed, readable volumes and they do no downloading over rickety phone lines with slow connection speeds. Here are reviews of some of the books you might use.

Linux Unleashed, 3rd Edition

By Tim Parker. Published by SAMS. Price $39.99.

This was published in 1998, which makes it a bit behind the Linux times. The stated level competence is from intermediate to advanced, but this book would be a good resource for first-time Linux users.

Clear, logical explanations are provided ranging from a description of Linux itself, to hardware requirements, installation procedures, troubleshooting, configuration of advanced options, Linux programming. Also covered are many popular Linux application programs.

There is too little on networking, particularly with Linux as a server in an office network environment. A pity, since this is now one of the major uses of Linux.

Linux Unleashed comes with two CDs with a copy of Redhat Linux 5.1. Overall this is the best of the books reviewed.

Linux System Administration

By Anne Carasik. Published by M&T Books (IDG). Price $39.99. In comparison to *Linux Unleashed*, the title Linux System Administration is more up to date (it came out in 1999).

It is also aimed at intermediate to advanced users and is also well written, but is more confusing. It is less comprehensive. It is useful as a complement to the first book but by no means replaces it.

It is based on the slackware release of Linux and includes a CD with Slackware 3.5.

Teach Yourself Linux in 24 Hours

By Bill Ball. Published by SAMS. Price $24.99. *Teach Yourself Linux in 24 Hours* is supposedly aimed at beginners but in reality requires some working knowledge of Linux for a full understanding. It is useful as a quick reference once you have an idea what you are doing. It comes with a CD containing Redhat 5.0 (already replaced at the time of writing by version 5.1). This is the least helpful of the Linux books we reviewed.

Teach Yourself Star Office for Linux in 24 Hours

By Nicholas Wells and R. Dean Taylor. Published by SAMS. Price $19.99

This book covers from installation to advanced use and the use of StarOffice with other file formats such as Microsoft Office files. It is clearly laid out and developed, section by section. A pity it does not include a CD with StarOffice for Linux.

This title is recommended for future users of StarOffice for Linux.

Linux in a Nutshell, 2nd Edition

By Ellen Siver. Published O'Reilly. Price $24.95.

This is one of O'Reilly's extensive Linux library. The book is a reference work listing Linux commands, with an explanation of each command, and a list of parameters. This is purely a reference work.

Linux Device Drivers

By Alessandro Rubini. Published O'Reilly. Price $24.95.

This is for a support technician who needs to support peripherals or new hardware under Linux. It is thus very specialized. The reader would need to understand the programming language C+, plus Linux itself. Very specialized. (Source: *CiA*, August/September 1999)