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EMERGING
TECHNOLOGY
SERIES

1 and 2/1997

Information Technology

UNITED NATIONS
INDUSTRIAL DEVELOPMENT
ORGANIZATION
Vienna, 1997

EMERGING TECHNOLOGY SERIES

INFORMATION TECHNOLOGY 1 and 2/1997

CONTENTS

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TO OUR READERS

Monitoring and awareness building are the key words in the vocabulary of UNIDO's main tasks. To fulfil these obligations we are trying to emphasise the main emerging trends in **Information Technology** of the **Emerging Technology Series**. Embedded applications constitute a trend that is already essential at present, but in the perspective of the coming year and century will, in my opinion, be crucial. This issue therefore brings a special article on the subject.

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Already, this general systemic outline of embedded applications indicates qualitatively new challenges that a designer must face. The issue paper gives a short survey of these. Moreover, the need for permanent training of designers is stressed, as well as a technical (not solely computer) background the designer should master. Apart from the authors of the paper, another UNIDO consultant, the eminent Professor Hermann Kopetz of the Technical University of Vienna in Austria, recently published a book (Kluwer Academic Press) on *Design Principles for Distributed Embedded Applications*, which could be a useful reference book for those readers wishing to delve more deeply into the subject.

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Konrad Fialkowski
Scientific Editor

TECHNOLOGY AND INVESTMENT OPPORTUNITIES

SELECTED INVESTMENT/TECHNOLOGY REQUESTS

PRODUCTION OF ELECTRONIC INVERTERS, CONTROLLERS AND METERS

Through the proposed project, it is planned to launch the existing products on a commercial basis. The company has developed four products in the field of power electronics, data acquisition, controls and factory automation. The annual capacity of the solid state inverter for industrial furnace is 50, power factor relay is 2000, motor speed controlled is 200 and power factor indicator is 2000 units.

Preferred mode of cooperation: Joint venture, buy-back arrangement, joint R&D, market access.

(For further information, please contact: Mr. Aqeel Ahmad, Director, Hi-Po Electronics (Pvt.) Ltd., Thokar Niaz Beg, Katar Bund Road, Off Multan Road, Lahore, Pakistan. Tel.: 5220748, 5412013; Fax: 5220060)

MANUFACTURE OF ELECTRONIC CONSUMER PRODUCTS

Development and manufacture of electronic consumer products for the domestic and foreign markets. The products will include uninterruptible power sources, dish satellite receivers, semi-automatic electronic panels for washing machines, electronic panels for remote controlled air conditioners and voltage stabilizers. The objective is to further expand and upgrade current R&D and production facilities to improve product quality for export.

Preferred mode of cooperation: Joint venture, market access, marketing expertise, sub-contracting, buy-back arrangement, joint R&D.

(For further information, please contact: Mr. Nauman Saeed, Chief Executive, Microtech Labs, No.11, 2nd floor, Saleem Chambers, 114 McLeod Road, Lahore, Pakistan. Tel.: (92-42) 7226328; Fax: (92-42) 7226328)

PRODUCTION OF ELECTRONIC BIOMEDICAL INSTRUMENTS

The proposed project is to manufacture electrocardiographs (single and multi channel) and computerized patient monitoring units (ECG, heart rate and temperature monitoring for up to six patients at a time). The company, through its R&D efforts, has developed these products at a cost that is far lower than that of imported articles. The project aims to improve the products further.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, technology transfer, buy-back arrangment, joint R&D.

(For further information, please contact: Mr. Nauman Saeed, Chief Executive, Microtech Labs, No.11, 2nd floor, Saleem Chambers, 114 McLeod Road, Lahore, Pakistan. Tel.: (92-42) 7226328; Fax: (92-42) 7226328)

MANUFACTURE OF PHOTOVOLTAIC SOLAR CELL MODULES

This R&D organization is specialized in the development of photovoltaic technology. At present the production is restricted to the production of modules on a non-commercial basis since the facilities are not able to cater for large-scale production. Assistance is required to upgrade the existing facilities for commercial production.

Preferred mode of cooperation: Joint venture, buy-back arrangement, equipment purchase.

(For further information, please contact: Dr. Parvaiz Akhtar, Director General, National Institute of Silicon Technology, Plot 25, H-9, Islamabad 44790, Pakistan. Tel.: 051-448470-1; Fax: 051-448469)

SOFTWARE DEVELOPMENT AND TRAINING HOUSE

The proposed project aims at establishing a computer software development and training facility. The major products of the software development component would be customized packages for various types of business, such as banking, hotel management, etc. As the products will be custom made, a production capacity definition would be irrelevant. The training facility will provide the software section with quality programmes and systems engineers, and will also provide software development and analysis training to individuals from outside the company. The company hopes to focus the major part of its business on foreign markets. The firm has the expertise required to provide solutions for the upcoming "Millenium Bug" problem.

Preferred mode of cooperation: Know-how, licensing, equipment supply.

(For further information, please contact: Mr. Khurshid A. Abbasi, Executive Director (Finance), Saigol Computers (Pvt.) Ltd., Units B & C, Block 1, Diplomatic Enclave, G-5, Islamabad, Pakistan. Tel.: 92-51-828347/8/9; Fax: 92-51-824125; e-mail: sclisb@isb.compol.com; Web site: www.cyber.netpk/sgl)

SOFTWARE DEVELOPMENT

The project aims to establish a software technology park near Lahore. A site has been purchased for the project and the sponsors would like to obtain high-end computer equipment which they would combine with their expertise and manpower to increase the already established clientele. The services to be provided would include contract software development, IT services (work/job processing, etc.) and

multimedia content design and development. The expected annual turnover from each of these is between $10 and $15 million.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, buy-back arrangement, loan.

(For further information, please contact: Mr. Mubashir A. Mian, Chief Executive Officer, Nextbridge (Pvt.) Ltd., 3-A/3 Gulberg III, Lahore, Pakistan. Tel.: 0092-42-575-0797; Fax: 0092-42-5758114; e-mail: Mmian@nextwerk.com; Web site: www.Nextbridge.com)

SOFTWARE DEVELOPMENT AND INFORMATION TECHNOLOGY SERVICES

The company is seeking to develop export-oriented software in the fields of application development and conversion, digitization and drawing management, CAD/CAM/CASE, Internet application, graphics and multimedia. The intention is to expand and modernize existing software and hardware capabilities and facilities. The company is confident it has the potential for the project to succeed in view of the availability of highly skilled English speaking experts at low cost. Being a subsidiary of a large Pakistani business group, the sponsors have strong links with local and international information technology markets.

Preferred mode of cooperation: Joint venture, sub-contracting.

(For further information, please contact: Mr. Iqtidar Zaidi, President, Pakistan Technologies (Pvt.) Ltd., House number 3, Street 57, F 7/4, Islamabad, Pakistan. Tel.: 92-51-821559, 812853; Fax: 92-51-274749; e-mail: suntech@paknet1.ptc.pk)

SOFTWARE DEVELOPMENT

The company aims to expand its current facilities of software production in the field of information technology consulting services, Internet-based services and data entry services. The purpose is to expand by increasing market share through assured business and through joint venture collaboration to introduce the latest information technology to Pakistan. The target market of the proposed project is hospitals, software houses and companies that require legal transcriptions in Europe and the USA.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, technology transfer.

(For further information, please contact: Mr. Shabbir A. Usmani, Executive Director, System Research (Pvt.) Ltd., Gulrez Plaza, Gulrez Colony, Chaklala Scheme, Rawalpindi, Pakistan. Tel.: 051-508282, 508270-6; Fax: 051-508284; e-mail: usmanisi@transcripts.com; Web site: http://204.192.4.60\index.html)

ESTABLISHMENT OF ELECTRONIC MESSAGING SERVICE

The aim is to set up an e-mail network for the entire country. The EMS network would consist of a set of central e-mail servers that are the repositories of incoming and outgoing mail. In order to achieve wide coverage, there will be several hundred or even thousands of smaller message centre clients that can communicate with the central e-mail servers.

Preferred mode of cooperation: Joint venture, management expertise.

(For further information, please contact: Mr. Shahid Jaffrey, TCS (Pvt.) Ltd., 22-A, Amber Tower, Block 6, P.E.C.H.S., Shahrah-e-Faisal, Karachi, Pakistan. Tel.: 9221-4534316; Fax: 9221-4548428; e-mail: shahid@tcsit.khi.erum.com.pk)

INTERNET MARKETING SERVICES

The Coral group of companies is proposing to set up a new project involving the establishment of an interactive Internet marketing service. The basic idea of electronic shopping is to take information from a mail-order catalogue and create a very large computer database which can be regularly upgraded and improved to display new products. This database can then be accessed by a series of smaller outlets at any strategic location such as airports, malls, neighbourhood stores and entertainment venues. The service will be provided to the general public of Karachi. The company has the necessary technical and managerial expertise.

Preferred mode of cooperation: Joint venture, technology transfer.

(For further information, please contact: Mr. Muhammad Yousuf, Director, Coral Group of Companies, Al-Sayed Arcade, R.No.5, 3rd Floor 1/c, Fl-1, Block 5, Gulshan-e-Iqbal, Karachi, Pakistan. Tel.: 9221 461407, 4993220; Fax: 9221 4993220; e-mail: mfi@khi.compol.com; Web site: www.acropoliscorp.com)

PRODUCTION OF ELECTRONIC SECURITY SYSTEMS

The proposed project aims at expanding the production of various types of electronic security systems for domestic and foreign markets. The security systems being produced at present are: security systems for private residences, commercial buildings and markets, security networks for public housing schemes and automobile security systems. The aim is to further upgrade the current level of R&D along with an expansion of production facilities.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, technology transfer, buy-back arrangement, joint R&D.

(For further information, please contact: Mr. Nauman Saeed, Chief Executive, Microtech Labs, No.11, 2nd floor, Saleem Chambers, 114 McLeod Road, Lahore, Pakistan. Tel.: (92-42) 7226328; Fax: (92-42) 7226328)

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BRAZIL TECHMART '97

Belo Horizonte (Minas Gerais) Brazil
1 – 3 December 1997

INTERNATIONAL BUSINESS FORUM

Organized jointly by UNIDO (United Nations Industrial Development Organization) and the Federation of Industries of the State of Minas Gerais (FIEMG), BRAZIL TECHMART '97 aims to promote and support the formation of technological and joint venture partnerships between and among enterprises from Brazil, particularly the state of Minas Gerais, and from other parts of the world, paricularly Austria, Italy, Slovenia and the Republic of Korea. By putting into focus the technological needs as well as the strengths of enterprises in the Brazilian metal-mechanic, agro-processing and biotechnology sectors, the event aims at forging strategic business partnerships that will promote the competitiveness and growth of these three sectors.

Over 70 Brazilian enterprises seeking technological solutions for company growth and competitiveness will be present at BRAZIL TECHMART '97, as well as trade associations, chambers of commerce, manufacturers associations, research institutes, government organizations, technology transfer agents, development banks and venture capitalists

For further information, please contact:

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- The National Project Coordinator, Brazil Techmart '97 Minas Gerais, FIEMG (Industrial Federation of the State of Minas Gerais), Av. Do Contorno 4520 - 10th floor, CEP 30110-090 Belo Horizonte, Minas Gerais, Brazil. Tel: (0055-31) 229 6645/229 6565; Fax: (0055-31) 239 4636; e-mail: fiemg@fiemg.com.br

TECHMART AFRICA '97

Grand Bay, Mauritius
24 – 26 November 1997

INTERNATIONAL BUSINESS FORUM

Organized jointly by the Government of Mauritius, UNIDO (United Nations Industrial Development Organization), SMIDO (Small and Medium Industries Development Organization) and COMESA (Common Market for Eastern and Southern Africa), TECHMART AFRICA '97 is an International Business Forum to promote direct contacts between investment and technology seekers from Egypt, Ethiopia, Ghana, Kenya, Mauritius, Namibia, Uganda, Zambia and Zimbabwe, and investors and technology suppliers from developed and developing countries. TECHMART AFRICA '97 will support private small and medium enterprises in forging technology and joint venture partnerships in the manufacturing, agro-based and agro-related industrial sectors.

Technology acquisition and joint venture partnership discussions between foreign and African coumpanies will take place during the TECHMART, and individual business meetings will be arranged on the basis of indication of interest on the technology and joint venture proposals. Technology seekers from African countries will meet foreign technology suppliers and arrangements will be made to display technologies using sample products, drawings, process flow diagrams, etc.

For further information, please contact:

- Director, Technology Services, Investment and Technology Promotion Division, UNIDO, P.O. Box 300, A-1400 Vienna, Austria. Tel: (43-1) 21131-3693, Fax: (43-1) 21131-6809, E-mail: opadickakudi@unido.org
- Director, Small and Medium Industries Development Organization (SMIDO), Industrial Zone, Royal Road, Coromandel, Republic of Mauritius. Tel: (230) 233-50 30 or 57 12/3/4; Fax: (230) 233-55 45; e-mail: smido@bow.intnet.mu
- Acting Director, Industry, Energy and Environment Division, Common Market for Eastern and Southern Africa (COMESA), Lotti House, Cairo Road, P.O. Box 30051, 10101 Lusaka, Zambia. Tel: (260) 1-229 726/32; Fax: (260) 1-225 107 or 227 318; Telex: ZA 40127; e-mail: comesa@comesa.zm

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Konrad Fialkowski
Scientific Editor

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A. SPECIAL ARTICLE

SOFTWARE FOR EMBEDDED APPLICATIONS: EMPLOYMENT OPPORTUNITIES FOR DEVELOPING COUNTRIES

U.P. PHADKE, A.B. PATKI

Abstract:

Embedded systems are being extensively used in diverse application areas. This paper focuses on the engineering aspects of developing embedded systems in the context of hardware and software components. The impact of fuzzy logic on embedded systems and the need for rapid prototyping is brought out. The authors discuss the software embedded applications as the new vistas for employment opportunities.

Key Words: Embedded Systems, Fuzzy Logic, CAD Tools, Employment Opportunities

1. Introduction

Software Embedded Systems encompass a wide variety of software components running on hardware, either microprocessors or microcontrollers. These systems are contained within a larger, usually non-electronic applications environment. These embedded systems perform specific and dedicated functions in applications ranging from large systems such as satellites; atomic power stations; process control through medium range applications like hydraulic manipulators; commercial fire alarm systems; machine control, to consumer applications such as automobiles, washing machines, portable and hand held gadgets. Essentially, the embedded hardware and software performs control functions including add-on intelligence with increasing digital technology usage. Embedded applications of software emerged with the availability of microprocessors in the late 1970s. The word "embedded" is used to bring out the distinction from standard mainframes, minicomputers, workstations and personal computers. Embedded software with associated hardware performs specific functions as opposed to general functions of computers. Recent advances in microelectronics have resulted in an emerging discipline in the form of industrial practices towards hardware and software co-design, including the host system environment aspects. The present level of transistor density and integration achieved in very large scale integrated (VLSI) circuits enable the building of complete systems on a chip, permitting computational functionalities beyond the capabilities of the "retrofit" approach that was predominant in the initial stages of the growth of applications specific integrated circuits (ASICs).

The market for embedded electronic systems has grown with the advent of microprocessor based microcontrollers. Apart from industrial automation systems, the emerging trends in utilizing embedded hardware/software systems to speed up existing software applications have resulted in new vistas for embedded systems in the field of network and communication applications. A typical embedded system consists of a processor core with memory (RAM/ROM), interface circuitry for analog to digital and digital to analog conversion, glue logic and one or more ASICs.

It is expected that in future, embedded systems will play a significant role in large systems development, similar to the role played by ASICs in electronic hardware on printed circuit boards in the past.

2. Engineering considerations in building embedded systems

Usually the life span of an embedded system is the same as the life of the host system. Thus, embedded systems have to satisfy several stringent requirements including safety aspects, real time response, fault tolerance considerations, etc. Embedded computer systems and their production technologies are important engineering considerations. Since the electronic embedded systems use digital technology, it is natural that they are built around commercially available processor cores running embedded software. When the standard microprocessor/microcontroller or digital signal processing chip-based approach is adopted for developing embedded systems, the software plays a significant and critical role in the performance of such systems. This methodology is preferred for small volumes as against the approach of VLSI level hardware dominance for high volume requirements. The use of quality techniques in the early phases of embedded systems development are of utmost significance. Organizations that have already adopted ISO-9000 standard practices have a better potential to quickly respond to software embedded applications development, since the ISO-9000 practices have to be adhered to at all stages of system development covering the hardware, software, host environment, etc.

2.1 Hardware and software design issues

Typically, an embedded system is implemented partly in hardware and partly in software. Thus, from the design angle the three broad areas, viz: hardware design, design of embedded software and hardware/software co-design need to be integrated. While many commercial CAD tools are available for synthesis, optimization and verification for hardware at logic level, these tools lack higher level design support such as application specific processor architecture alternatives, CAD tools required in the planning phase, etc. The hardware design has been further influenced by the advent of hardware description languages. Thus, VHDL/ Verilog based VLSI CAD tool suites with adequate support from silicon foundries are being increasingly preferred by the VLSI design community. VHDL is very similar to a programming language but the end result is a net-list description of a piece of hardware and not an algorithm to be executed on a processor in the workstation, personal computer or mainframe [1]. Developing and simulating VHDL models is a major concern in designing large embedded systems. In order to reduce the cost and time needed to design, upgrade and replace digital embedded hardware, VHDL with object oriented extensions need to be used throughout the design process, from system to gate level. This facilitates abstract modelling required to study architecture level trade-offs and the performance of embedded applications [2].

The VLSI CAD library containing a broad range of standard cells, as also several foundry specific mega-cells, offers the possibility of integrating complex components such as microprocessors and memory devices into embedded system design. These components are highly optimized from

area/time considerations. The hardware design automation perspective needs to be extended to include the support for architecture level abstraction, application specific instruction set processor, arithmetic logic unit optimization, etc. The design of the instruction set processor involves software profiling and analysis to optimize the instruction set.

In VLSI hardware development, any design modification at a later stage means at least one additional fabrication run. Thus the design process for embedded applications calls for the starting point shift in the conventional sense of VLSI design, i.e. to commence design at a "high level", with the integrated tools. Planning phase CAD tools that are fully integrated with VLSI design activity are needed and should include in-depth validation and verification software. Embedded system hardware developers view the VLSI hardware design automation tools as equivalent to library elements used in the design for processor, memory and glue logic. Gate and operation level parallelism is supported in classical hardware design tools, but the CAD support for instruction level parallelism for "fetch-decode-execution" is the requirement for complex embedded systems, calling for more design trade-offs at higher levels of abstraction. This leads to a wide acceptance of design techniques from the computer architecture domain in the embedded systems area. In the absence of integrated planning and VLSI design CAD tools, the practice of reliance on human skills is adopted. This results in a longer project development cycle with the possibility of adverse effects on the production phase as well.

The characteristics of embedded software typically are relatively modest size, tight hardware software coupling, low error rates, real time constraint requirements, safety-critical issues, etc. Typically, a C program is considered as a hardware specification, but is regarded as implementation in software. The code optimization for an embedded system goes beyond the traditional compiler optimization. Also, a mix of assembly language with C is the practice followed in developing the embedded systems software having the typical code size in the range of 10,000 lines.

2.2 Impact of fuzzy logic technology on embedded system applications

Fuzzy logic is based on the fuzzy set theory developed by Professor L.A. Zadeh. It uses concepts, principles and methods developed in fuzzy set theory to create various algorithms for approximate reasoning. The boundaries of the fuzzy sets are not required to be precise. Three decades of fuzzy systems development have moved from the academic phase, through the transformation phase, including successful practical applications development, into the fuzzy boom phase, which is characterized by a rapid increase in successful industrial applications [3].

Fuzzy logic has influenced both information technology products and consumer products. The characteristics of portable products incorporating fuzzy logic include limited space, lightness in weight, ease of operation, low battery power drain, etc. Fuzzy logic based embedded applications are providing intelligent control, making systems more adaptable. These use specialized ASICs and/or a mix of digital circuits and dedicated embedded software implementing a fuzzy algorithm. Thus, consumer products such as washing machines, vacuum cleaners, lift control systems, video systems, etc., execute fuzzy logic based algorithms. There is a strong need for a rapid prototyping CAD environment for developing fuzzy logic based embedded systems. A preliminary study carried out by the authors for developing a rapid prototyping CAD environment indicates a need for incorporating user interaction right at the design stage. A case study of developing an embedded application around fuzzy logic based Rater System [4] brings out the need for prototyping CAD tools. Some of the important considerations are:

(a) Characterizing features to standardize input-output representations and extracting product specifications;
(b) Reducing dependence on manual intervention in the software simulation phase to incorporate user interactions with the product at the design stage;
(c) Provision for supporting iterative processing for implementations in the product layout plan and associated functions, behavioural software;
(d) Providing linkage and interface with a product layout plan to the ASIC and standard ICs in interconnections as an entity vis-à-vis downloading in field programmable gate array.

The pilot study in developing a rapid engineering CAD integrated prototyping environment (RECIPE) highlights the need to develop an appropriate platform with provisions of features to support commercially available design automation software tools, along with integrated functioning of a programming language such as C/C++, VHDL, software utilities for VLSI layout, printed circuit board design, etc., as object oriented modules. The development of fuzzy logic based hardware is itself a growing area and will have its impact on hardware design methodology for embedded applications. Some experiences in developing fuzzy logic hardware have been reported, which have an impact on existing software language translators such as VHDL and C++ [5]. It is felt that as the discipline of embedded system application grows in the near future, fuzzy logic is likely to play a significant role in embedded systems hardware and software development.

2.3 Testing of embedded system applications

Testing is an important engineering aspect in embedded system development. Unlike general purpose software testing, software embedded systems have to be tested in the host environment. Usually, the electronics with software is tested for test data vectors conforming to the internal functions. But the host system environment is in simulator/emulator form. Thus, there is a need to have extra test points and test patterns for the host system interface. The major challenges are in demonstrating safety-critical requirements and fault tolerance during testing. While the real time response requirements are usually satisfied, the safety-critical aspects are difficult to test. The electronic "0" and "1" test vector approach for safety-critical requirements amounts to functional testing and the actual safety-critical testing can be carried out only when the embedded system is operating in the actual host environment. Safety-critical testing includes tools for creating and analysing fault trees, failure mode effects and criticality, automatic generation of guard code, etc. [6]. For smaller systems, it is easy to demonstrate, but for complex systems such as a process control embedded system, testing of a complete system for a safety-critical domain can only be undertaken as field trials. Usually, the functional testing of embedded software is carried out in a workstation-based host environment, simulating the hardware drivers and interrupt handlers of the target system. The other building blocks in the host environment severely affect the performance of the embedded system module when it comes to assessing the safety critical aspects. In electromechanical systems, the inertial delays play a significant role in propagating the faults resulting in failures. CAD support does not exist to simulate such inertial delays in the host system building blocks.

3. Software embedded applications—developmental aspects

Development of the software process takes a central role in the embedded systems engineering community. The problem is further compounded as the electronics and automation industries are not only re-engineering their products but modernizing the environments used to maintain the control software used in embedded applications. This underscores the need to introduce effective tools for managing software changes in software embedded systems. The reason behind software changes is not only the need to correct bugs/faults, but also adaptation to a new development environment. Reverse engineering tools for producing structure charts based on the existing code are useful. Thus, software process and software development issues take a more important role in embedded systems development as compared to applications software development and include process modelling, reusability and maintenance as part of application management. Some of the important elements in software development for embedded systems are as follows:

- Synthesis of software programs for embedded control applications.
- Object oriented constructs for VHDL for abstract modelling support to study architecture level trade-offs.
- Software Reuse Technology for embedded applications.
- Incremental prototyping technology for embedded software using graphical animation.
- Code generator capable of producing full real-time C-code from high-level structured designs and specifications.
- Requirements engineering for embedded computer systems (structured and object oriented techniques).
- Tools for object-oriented development of embedded systems including documentation guidelines and testing practices.
- Simulation based testing of embedded software, including fault tree, failure mode effects and critical analysis.

Embedded system applications pose new design challenges. Hardware and software design should be carried out as a combined approach with the host system included as a run-time environment all through [7,8,9]. Thus, a co-synthesis approach to achieve computer aided design of the embedded system is the key methodology. Co-synthesis is divided into performance modelling, partitioning of hardware and software, integrated approach for synthesis and simulation of hardware and software to incorporate user feedback at the design stage itself. The impact of other emerging technologies on software embedded applications also affect the software design of embedded systems.

Thus, software embedded applications are likely to create many new avenues for research, applications development, development of new sets of skills, etc. The main opportunities will be in the following areas:

(i) New CAD tools for design and testing
(ii) Training kits using multimedia
(iii) Collaboration between hardware and software industrial units.

3.1 Need for new CAD tools development for design and testing

The present practice in developing embedded systems is predominantly a manual design process at the abstraction level, leading to long design times and high costs of design. The need to meet the growing demands for embedded applications has given rise to CAD tools for design including rapid prototyping of integrated hardware-software co-design, simulation and product adaptation to incorporate user feedback. The hardware/software co-synthesis spans many disciplines from CAD theoretic aspects, such as algorithms, to system implementation issues of partitioning. This creates opportunities for the development of special CAD tools for embedded systems development addressing hardware architectural selection, software profiling and analysis, system performance estimation, simulation capable of incorporating user feedback for improving product adaptability, etc. [10,11,12].

Automatic partitioning into hardware and software is an important step in embedded system development. Critical parts in software are identified by profiling the code and a simulated annealing based algorithm is used to select the parts to be moved to hardware. This is also necessitated by trends in the area of VLSI design.

All the above CAD tools will have to be supported on PCs as well as workstations requiring DOS/Windows and UNIX operating systems, respectively. By and large, design automation software works on workstations in the UNIX operating system. However, in view of the potential of the field programmable gate array (FPGA) based approach of building digital hardware systems, some electronic design automation tools, such as Viewlogic systems, are available on the PC-DOS platform. This trend will further open up opportunities for porting many VLSI CAD related and associated software packages from the workstation arena to the PC platform. This trend suggests the development of new CAD tools for hardware-software co-design on the PC platform to facilitate third party software support.

3.2 Training kits using multimedia

Development of embedded systems requires a multidisciplinary approach. In the present education systems, the emphasis is either on teaching computer science or computer engineering. On several occasions, this proves to be a handicap when engineering systems are to be developed, calling for continuing education and/or on-the-job specialized courses. Since the host environment is of paramount importance for embedded systems, the developers need to have a basic background in engineering with hardware and software as tools of a "computer workshop". Thus, it is expected that multimedia-based training kits will be required to be developed which will replace the existing methodology of training through software tutorials and help utilities. This opens up several opportunities in the area of "training for trainers", giving hands-on exposure in embedded systems. Such multimedia systems will be required to have integration capabilities with instrumentation and devices like logic analysers required for testing the software embedded applications.

3.3 Collaboration between hardware and software industrial units

The spectrum of industrial units depicts a scenario of localized software houses, electronic hardware manufacturers, system integration units, etc. The multidisciplinary nature of embedded systems and the growing market opportunities likely to come up in this area underscore the need for strong collaborative efforts amongst hardware and software industrial units. Presently, such integrated approaches are on a very limited scale. In the coming decade, however, this will be on the rise. In this regard, one can expect the growth to be on similar lines to that seen in the past between the electronic design automation tool developers and silicon foundry units with each playing a complementary role to the other.

4. Employment opportunities for developing countries

In order to consider the employment opportunities in this field, we discuss the present practices adopted in the software embedded applications industry. The hardware is built around the central processing unit (CPU), which is commercially available. The popular CPUs used are 8051, 683XX, Z80/180, 386/486, 680X0, etc. The programming language adopted is usually a mix of assembly and C with the code size in the range of 10,000 lines. Preferred debugging tools include Emulators, ROM monitors, Logic analysers, Scope, etc. Also, the developers per project are in the range of 4 to 5 with an average developer having an experience of about 10 years. Most of the developers refer to technical magazines such as **Embedded Systems Programming, EDN, Electronic Design, Computer Design**, etc.

Developing countries can play a role of consumer as well as producer for software embedded applications. As a consumer, the role would include the ability to spot potential areas for software embedded applications, drawing up detailed technical specifications for outright purchase or development of products/systems, installation and commissioning, operation, maintenance, upgrades and replacements, etc. Embedded systems call for some special skills which can be acquired through short-term courses especially oriented for the experienced work force. In addition, the new entrants can be equipped with specialized laboratory course modules during academic curricula at the diploma level. This results in an immediate requirement in the form of "training for trainers". Multimedia-based training kits can serve a useful purpose for this requirement.

The new vistas opened up by software embedded applications bring out the need for developing new CAD software tools. In the past, developing countries have played a significant role in software development, both on-shore and off-shore. However, unlike the software development for database systems and commercial and business applications, such as banking and insurance, the embedded system software is highly engineering oriented. Thus, the new employment opportunities will be primarily in the CAD tool development for engineering applications. There is tremendous potential, but undertaking such tasks is difficult as an off-shore activity carried out solely in a developing country. However, with the interest shown by multinational companies in opening operations in developing countries, the likelihood of a solution path exists. This calls for some action on the part of developing countries as well.

From the foregoing, it is clear that software for embedded applications is more towards the higher end of the software domain and is currently a niche market. One of the competitive advantages which developing countries have vis-à-vis the developed countries is that of relatively inexpensive manpower, spanning the range from unskilled manual labour to highly skilled and trained professionals with engineering and science degrees. It must, however, be reiterated that even the skilled professionals would require considerable upgrading of their skills and the acquisition of new inter-disciplinary skills before they can effectively contribute to this area. Given the complex nature of this field, it is felt that employment opportunities would be much less to cater to the domestic market in developing countries, with the potential more likely to be for end-use in developed countries. This could be in the form of offshore development for developed countries or as on-site development contracts in developed countries. An interesting parallel can be drawn from experience in India, which is internationally acknowledged as a developing country with a significant potential in software. While domestic software in India grew from Rs. 4,900 million (US$ 1 = Rs. 35) in 1992-93 to Rs. 16,900 million in 1995-96, the software and services exports grew from Rs. 6,750 million to Rs. 25,500 million. A recent internal study has projected a turnover of Rs. 125,000 million by 2001-2002 for the domestic software industry as compared to Rs. 218,000 million of software and services exports. More interestingly, in the area of ASIC design and related services, there is an insignificant domestic market in India whereas the export turnover in 1995-1996 is about US$ 10 million, which could be boosted to US$ 200 million with an aggressive pro-active role by the Government.

In the area of trained manpower for software embedded applications, the situation today is not very encouraging and needs the introduction of theoretical and practical laboratory courses in academic curricula at the university level. The authors have had first-hand experience of the substantial efforts needed in training students from engineering colleges to bring them up to a suitable level before they can be introduced to embedded system applications design. In most developing countries the bottleneck in the IT area is not a lack of resources to develop infrastructure, but the non-availability of professionals who can identify meaningful applications, and thereafter design the requisite software and then implement these systems. University programmes and curricula, along with user training could be two major focus areas of immediate attention. Developing countries such as India, Malaysia, Zambia and others have already taken steps in training manpower in information technology area. These efforts need to be further focused in the area of embedded system software development.

User training is often a neglected area resulting in low absorption rates of new technologies, and software embedded applications are no exception to this. Training methodologies for end-user application development should focus on extensive end-user participation in application development activity calling for development of customized training material and its delivery at a pace the organizations can absorb. The practice of borrowing curricula from elsewhere needs to be modified to suit the local requirements and infrastructure of the country and also to reflect the application environment.

It is felt that industry associations will have to come forward to face some of these challenges if they want to tap the market segment of software embedded applications. While collaborations with other organizations are stop-gap arrangements, the industry associations' participation as sponsors in boosting opportunities in this field has to come more liberally and enthusiastically. Policy formulators and decision makers in the governments of developing countries would have to create a conducive environment for such a role by industry associations. The initiative could come in the form of establishing regional centres for embedded software applications which can play a pioneering role in the area of applications development and demonstrations, as well as training the workforce. Such centres can play a pivotal role in opening up avenues for entrepreneurs to form consortia for this industrial sector. With the cooperative joint collaborations amongst academic institutions, industry, and R&D laboratories, the activity could be expanded for tie-ups with developed countries. This will help in opening new market linkages.

In order to set up infrastructure facilities for "training the trainers", in many developing countries UNESCO efforts were found useful in the past. With the advent of a new technology like multimedia, the objectives can be achieved within shorter timeframes of three to five years, resulting in many employment opportunities in developing countries. The employment potentials for project leaders, CAD tool

developers, trainers, application developers, etc. are likely to be seen in the near future.

5. Conclusions

This paper outlines the software embedded applications and its impact on employment opportunities for developing countries. The paper brings out the technical issues associated with embedded applications development and illustrates the scope and potential for software development. The impact of an emerging technology like fuzzy logic on software embedded applications is brought out. It is felt that with the joint effort of industry associations, policy formulators and decision makers in the governments of the developing countries, employment opportunities for developing countries can be boosted in the field of software embedded applications.

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B. NEWS AND EVENTS

Computer telephony integration

Do it yourself computer telephony integration (CTI) is clearly not something the average worker is going to tackle, but most small and medium-size enterprises (SMEs) have one or more technically adept employees on the premises. The business case for considering CTI is compelling. Saving money is the most obvious, but being "in charge" is probably more important, particularly in the medium and long term.

The DIY route to a CTI solution also allows the smaller companies to start with simple equipment and expand in line with experience and new requirements. Going outside can often mean specifying more functionality than is needed in the short term and this could very well cause disruption within the organization. Typically an icon driven CT application generator is a set of Windows tools that enables sophisticated applications to be created in a matter of hours. A mouse is used to link up various predefined and tested functions and thereby create a script that looks like a classic flow chart. Voice messages are then added. NextInfo from VoiceBit can be used to develop slick CT applications that employ impressive messaging functionality. It also offers a seamless link with the GSM infrastructure that enables mobile workers to dial into the CT server and retrieve their GSM messages, along with other voice mail, e-mail, and faxes. If access is carried out through the Internet, then this service is virtually free. Every time that users check their e-mail, the server will download all message types. (Source: *Communications International*, 23(11), November 1996)

Publishing on the Web: pros and cons

Publishers are rushing to establish a presence on the Web: the possession of a URL address is seen as essential to maintain credibility. What is still not entirely clear, however, is what Web "surfers" really want in terms of content.

Some of the key requirements, however, have been established. Frequent updates, links to other good sites, a restrained use of graphics and hard information content all seem to help make a site popular.

The barriers to publishing on the Internet are invitingly low. Far less investment is required than is the case with print or television: a few computers, someone's server, phone lines and a few staff are all that is needed. Publishers have responded in various ways. Some sites are merely electronic analogues of printed publications, while others make extensive use of animated graphics, audio and video.

Three information providers are experimenting with "smart" Web publishing. In January this year, the (US) National Agricultural Library began to place its *Agricultural and Libraries Information Notes (ALIN)* on the Net at *http://www.nal.usda.gov/alin*. Sociological Abstracts, Inc. (SAI), has a home page at *http://www.socabs.org* which features detailed information about the SAI databases in print, on-line and on CD-ROM. The Web edition of *The Scientist* (*http://www.thescientist.library.upenn.edu*) includes text, photographs and cartoons.

A further title worthy of note is *Feed (http://www.feedmag.com)*, which makes intelligent use of the Web's capabilities. It does more than simply present pages of text, yet does not force the user to waste time downloading gratuitous audio and video clips. (Source: *NFAIS Newsletter*, 38(8) August 1996)

Plantin doubts: academic publishing in the electronic age

The academic publishing model has survived unchanged for nearly two hundred years, from the first proceedings of the learned societies set up in eighteenth century England. Today, however, it faces a crisis, and it is worth looking at the strains on the model to see what has gone wrong.

Research has fragmented. For example, the first journal on chemistry is now one of thousands, with every specialist subject area boasting several competing journals. For each journal, the publisher is struggling to make a profit from a reduced market: there may be 5,000 universities teaching chemistry worldwide, but only a few hundred might have an interest in a particular field. With so many journals to subscribe to, university libraries are under pressure. If a publisher has to raise the price of a journal to cover the costs from a smaller subscriber base, that base will shrink yet further.

One solution may be the electronic journal. However, publishers need to respond to the challenge of the Internet by creating electronic journals that are more than simply copies of the paper product. To do this will involve three processes that already take place in the printed model, such as peer-review, as well as a new process that is possible only through the electronic medium: interaction. After these have been addressed, the publishers and their customers must still establish a new means of commerce. (Source: *Managing Information*, (3) 10 October 1996)

Out of Africa and onto the Internet

Cyberculture has taken another step towards world domination with the opening of a cybercafé in Dakar, the capital of Senegal—the first to go on-line in West Africa.

The café is named Metissacana, which translates as "mixed blood". This unusual name was chosen to reflect a union between African culture and European technology. Metissacana has 10 computer terminals, which will give local children and college students a much-needed connection to the Internet. Currently, only about 400 Senegalese have Internet access, Metissacana's owners say.

Although there are more than 250 cybercafés worldwide, until now there have only been six in Africa, all in the south of the continent. Metissacana's owners aim to change this imbalance and have plans to expand into Mali, Côte d'Ivoire and Burkina Faso. (Source: *New Scientist*, 19 October 1996)

Light emitting polymer plant planned

The British companies Xyratex and Cambridge Display Technologies (CDT) are collaborating to set up the world's first high volume manufacturing plant for light emitting polymer devices. They will initially have a pilot plant in the Cambridge area. This will be followed by a volume manufacturing facility in a yet-to-be determined UK location. Production is scheduled to begin in the fourth quarter of next year, with high volume production in place by late 1998.

The devices are expected to offer strong competition to LCDs and LEDs. They can be produced economically through the application of a thin film of the light-emitting polymer onto a plastic or glass substrate coated with an indium-tin-oxide transparent conductive electrode. A layer of aluminum is evaporated or sputtered on top of the polymer to form the second electrode. The polymer emits light when a voltage is applied between the two electrodes. Most of the displays are green, but red and blue versions also have been produced.

The first commercial use is likely to be as a display backlight, as the displays operate from a few volts, eliminating the inverter supply normally needed for electroluminescent backlights. The lifetime of flexible displays on plastic film is not yet as long as those on glass. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

British Telecom secures payment service over the web

British Telecom is preparing to launch a secure electronic commerce service over the Internet. The processing and purchase management for the service will be undertaken entirely by British Telecom, which is expected to increase the level of confidence among business users.

At present, British Telecom is seeking small and large businesses to take part in its trial, with a service launch scheduled for the beginning of 1997. The service will be able to provide communications products and software to its users, delivered either to the door or downloaded over phone lines directly onto hard discs.

British Telecom will use Sun's servers and software from Open market in the US. BT will have dedicated on-line links with banks and other financial institutions for user credit details.

Once the users log onto the service and leave their credit card details, they can access and view their up-dated transactions at any time. Security is based on the industry standard SSL (Secure Socket Layout) protocol with the SET (Secure Electronic Transaction) protocol being incorporated in 1997. (Source: *Electronics Weekly*, 23 October 1996)

Videoconferencing

Videoconferencing is at the fashion epicentre of the Internet universe and it has become very bandwidth hungry, as it not only demands the transmission of data, but the transfer of data into a particular sequence at the correct speed. The Internet is not able to cater for the demands of an estimated 25 million users worldwide. The overburdened wires cannot support real time multimedia without difficulty. Videoconferencing works best over leased circuits of ISDN (Integrated Services Digital Networks) as these allow data to be transmitted as a continuous stream rather than in bursts. However, this is expensive and ISDN access to the Internet is too slow to give a good enough frame rate. It may be the technology of the future, but it is not yet ready. The other available option is Ethernet which offers high bandwidth capacity, but has the disadvantage of using packet switching rather than circuit switching. Another complication is that data needs to be compressed for network transmission using a standard compression algorithm. In order for two organizations to communicate, they must both use the same compression standard and the only existing one is H.261 for ISDN.

Without a standard, two videoconferencing systems developed by different software vendors may not successfully communicate with each other over the Internet. Membership in the videoconferencing club is expensive, as it requires particular hardware such as a camera and a powerful computer that will need updating to cope with increasingly powerful multimedia demands. Videoconferencing over the Internet epitomises the complexities of all Internet developments with the bandwidth requirements becoming increasingly urgent. One company prepared to take a gamble is First Virtual Corporation which is developing Internet videoconferencing systems which use ATM (Asynchronous Transfer Mode). It will not be widely implemented until the next century. However, videoconferencing over the Internet should not be rejected—there are a number of possible applications including telemedicine. In its current imperfect form it is not appealing to a professional audience. As a result, it is being reshaped and marketed as video collaboration which involves the sharing of packages such as world processing applications for corporate consumption. Only time will tell if this is an important trend. (Source: *Communicate*, October 1996)

Internet to be hit by information taxation

Pressure is building for some form of taxation of services provided by the world's Internet computer network following the publication of a discussion document by the US Treasury Department. Treasury departments in Europe are already considering a so-called "bit-tax" on all digital information carried on the Internet.

North America is the leading market for Internet services and represents the centre of the world's traffic, so any taxation issues raised by the US treasury's discussion document will be watched closely in Europe.

Details of how taxation can be applied to something as complex as the Internet is as yet unclear, but the sheer volume of business now conducted over the Internet means that Governments cannot afford to ignore these issues. (Source: *Electronics Weekly*, 4 December 1996)

IMEC backs optical lithography future

Good news for chipmakers is that they will not have to move to the unquantifiable expense of X-ray, E-beam or Ion-beam lithography until the sub-0.1μm—the 64 Gbit—generation of chip, says Europe's top microelectronics research house, IMEC of Leuven.

Bad new for the chip men is that they may have to pay between 50 and 100 per cent more for next-generation steppers, says ASM Lithography.

At present the most advanced steppers use 248 nm wavelength UV, but IMEC is collaborating with ASM Lithography to produce next generation steppers which use 193 nm wavelength, and are inviting chip makers to join the project.

Steppers using 193 nm wavelength will have a light source generated by an Argon Fluoride excimer laser instead of the 248 nm wavelength UV generated by Krypton Fluoride excimer lasers. However, a current 248 nm stepper costs $9 m.

The first steppers capable of handling 12 inch or 300 mm wafers will probably be on the market in 1999. (Source: *Electronics Weekly*, 4 December 1996)

Information technology agreement talks make progress

Prospects for completion of a global Information Technology Agreement (ITA) have improved dramatically, thanks to a new working understanding on tariffs between the USA, Japan and the European Union, reported the

Semiconductor Industry Association (SIA). In the new arrangement, negotiated by the USA, Japanese and European trade officials at a recent meeting in Seattle, the Europeans agreed to expeditiously eliminate tariffs on a broad range of information technology products, including semiconductors. The USA and Japan, meanwhile, agreed to postpone the first meeting of the Semiconductor Council—a new industry organization—to give the Europeans time to implement their tariff-elimination plan.

The goal of the Information Technology Agreement is to eliminate tariffs on chips, computers, software, telecommunications equipment and other information technology products. The USA, Japan and Canada have already eliminated tariffs on semiconductors, but the European Union still maintains a 7 per cent duty on many chips, including DRAMs and microcontrollers. The SIA has called upon all major semiconductor producers, including those in Europe and the Republic of Korea, to eliminate their tariffs immediately. Industry experts estimate this technology agreement would save more than $1 billion per year for USA industry and reduce costs of high tech products for consumers. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

The challenge of computer security

Computer security means protecting systems—including computers, networks, programs and data, from three threats—accidents, mistakes and attacks. There are a number of motivations for crackers, which range from satisfaction to tangible rewards to be gained from selling stolen data. Attackers may be patrons, staff, vendor staff and outsiders. Threats to be countered include data extraction and modification, service theft, password collection, service denial and sabotage. Public access terminals are easily accessible and unmonitored so they are often the first point of attack; a second point is unattended staff terminals. Security starts with planning and all aspects of the operation need to be analysed. It should include the way in which the system will be operated and include user training. Security always carries a cost, not only in terms of money but also in convenience.

Some attacks are technical and may involve stealing and cracking a password file or involve the exploitation of known bugs in computer software. Packet snooping and communications snooping, as well as mail interception, may allow capture of valid passwords and usernames. Some attacks are non-technical—crackers may look around office areas and terminals for passwords and usernames or encourage a user to help in gaining illegal access. Most systems are not monitored for security breaches; although analysis of computer logs could show extra failed login attempts from privileged accounts; unusual patterns of activities; or missing or inconsistent log records. Once a system has been attacked, it is important to identify exposure; identify the hole used for penetration; determine collateral damage; and find any other systems that have been compromised.

Recommended procedures for a secure file include maintaining strict control over privileged accounts and shell and command line interface (CLI) access; protecting all access points; creating fail-safe patron accounts; limiting staff accounts; establishing firewalls; and maintaining strict physical security of all servers and hosts. A constant programme of user education is needed. Computer security is a rapidly changing field in which only a professional computer security expert has time to keep up with changes. It is concluded that the only protection is a comprehensive security programme with policies, procedures, continuing education programme, good backups, and a commitment to safe system operation which will cost money, time and effort. (Source: *Feliciter*, 42(9), September 1996)

Threat to national security from computer terrorists

The threat to national security from computer terrorists is vastly overblown. Most hackers are after nothing more than an intellectual thrill. However, the theory that legions of hackers are poised to send networks crashing down around our ears is gaining in popularity. But despite these prophecies of doom, the threat from electronic warfare appears to have been overstated.

Hacking is become increasingly widespread, but most hackers insist they are not out to terrorise companies or Governments by deleting files or crashing servers. Instead they are dedicated to what they call "ethical hacking". This involves finding ways into computer systems for the pure intellectual excitement of it. At the same time, a hacker can show the owners of the system that their security can be breached.

Civil liberties groups and human rights organizations, with one recent exception, have so far avoided asking hackers to help them in their campaigning. Amnesty International, for example, uses anonymous remailers to protect the identity of its sources, but says it has not considered using hackers to gain more information or put pressure on unsavoury regimes. A spokesman explains that the organization has to be seen to be law-abiding in order to carry out its work, and so allying itself with hackers would be counterproductive. The recent exception is Norwegian Save the Children, which recruited 15 hackers to help scour the Internet in search of paedophiles. (Source: *New Scientist*, 2047, 14 September 1996)

Legislative information on the Web

About 20 national parliaments have sites on the World Wide Web, although only a few national parliaments have mature Web sites. In Australia, Canada, France, Germany and the USA, an Internet user can expect to find answers to basic questions about rules, organization, membership and recent activities together with the text of recent debates and images of parliamentary buildings and artwork. Other parliaments are making progress in developing their sites and have already developed useful features. It is premature to expect that most parliaments will have Web sites that facilitate the distribution of information, as their countries do not have the infrastructure to support Internet access. However, parliamentarians, parliamentary librarians and information officers are beginning to recognize the value of well-developed Web sites.

Features of parliamentary Web sites are identification of representatives; personal details of members; information on the electoral system and results; organization and rules of parliament; parliamentary decision-making processes; current schedules and legislative agenda; text of basic documents, proposed and adopted legislation, together with digests; existing statutes and laws; text of parliamentary journals and debates; historical information and photographic tours; photographs of artwork; visitor information; educational material; summary of members and parties; pointers to relevant Web sites; and a bibliography, index and search engine.

The British Parliament lags behind other parliaments of the older democracies in establishing Web-based resources. Eventually parliaments will discover the multimedia and interactive potential of their Web sites. (Source: *Electronic Government International*, 1(1) October 1996)

Higher education and the Global Information Infrastructure

The Global Information Infrastructure (GII) is the historic innovation which has the potential to change higher education fundamentally. As a communication medium, GII has the potential to change the social relationships which constitute the organization of scholarly communication, teaching and learning, and administration. In the first innovative stage, computer technologies have been focused on creating more efficient means to create, store and manage information, rather than on productivity, which needs the reorganization of social relations with which knowledge is created, taught and learned. At today's second stage of innovation, there is the potential to change the social relationships in higher education and it is remarkable that this is largely unplanned. The Internet was based on technological innovations coming from the technical community supporting military research and it has suddenly grown explosively into a global communications medium without central planning or authoritative governance.

The essential first step to planning an optimal technical environment for higher education in the GII is to explore what is known about the nature of communication in networked environments as these may offer solutions to problems. From a social scientist point of view, the GII should be described as primarily a communication medium. Technical design is also social engineering and the design of a communications technology tacitly contains a new design for social relationships and organizations. Understanding the network as a medium for communication suggests that its dynamic has the same source as did the print medium. The network is a medium for free speech and democracy; just as print has been—with this difference: the network allows every user to publish and access information on a global scale.

The most exciting aspect of GII and the most fundamental creative challenge for the next phase of its development is how public policy protects legitimate interests in intellectual property. (Source: *Journal of Academic Librarianship*, 22(5) September 1996)

Network computing

The computer industry is split on the importance of network computing, with descriptions ranging from non-starter to a new paradigm for information technology. According to Sun Microsystems, one of the other companies supporting the new concept, network-centric computing is nothing less than a new paradigm for information technology which will take us into the next millennium. Oracle too is supporting the concept. Network-centric computing is being portrayed by these suppliers, as well as some independent commentators, as the next great age of computing, following the mainframe-centric and PC-centric eras.

In the mainframe age, everything was centralized: processors, data and applications. The PC-centric age dawned in the early 1980s, ushered in by the development of the microprocessor and Apple's pioneering graphical user interface. Now, the third age of network-centric computing is being made possible by the emergence of low-cost, high-band-width networks using technologies like asynchronous transfer mode.

The Internet gives a global model of how network-centric computing can work. Many organizations are adopting the Internet's standards and techniques within their own internal networks, creating what have become known as Intranets. This enables them not only to access the thousands of new information sources available via the Internet, but also to unlock and share information held in people's PCs.

The crux of network-centric computing, then, is that information can be shared across an expanded organizational network, via the Intranet, and between the organization and the outside world, using the Internet. This requires the use of standards-based, low-cost, high-speed networking. The influence of open client, server computing, the Internet and Intranets could allow organizations to re-engineer themselves and create new ways of operating. (Source: *Electronic Government International*, 1(1) October 1996)

PC costs shift support to NC

Users are becoming reluctant to upgrade their PCs quite so frequently as before. Realization that the costs of ownership associated with PCs do not stop when they are first purchased is causing many organizations to re-appraise the merits of the network computer (NC). Forecasts suggests an imminent slowing down in the conventional PC market, in part because of the costs associated with their use.

Whilst defending the conventional "Wintel" platform strongly, Microsoft has admitted that the price of a PC would have to decline by 30 per cent to meet the challenge posed by the NC. At the same time, the recent launch of *Windows CE*, the OS for handheld computers, would suggest that the company intends to have a foot in both camps, and may be contemplating the introduction of a RISC chip-based NC device itself. (Source: *MicroScope*, 15(39) 2 October 1996)

Year 2000 special

A survey undertaken by *Computing* has suggested that IT managers are encountering difficulty in persuading business managers that the year 2000 problem is real and urgent. Despite this, many organizations claim to have a strategy in place, although how well thought-out these plans are is not known. Most firms have yet to prepare impact analyses, or to identify exactly which applications are threatened.

The full cost of ensuring that IT systems in the UK are millennium-proof is likely to be enormous—one estimate has put the figure as high as £30,000 million. Where this money will come from is also unclear.

There is the distinct possibility that user companies may sue software suppliers regarding systems which fail to take account of the millennium. The matter of legal liability, however, is by no means clear-cut, as it depends on the precise wording of the contract involved in a given transaction.

Not unnaturally, a growing number of companies are offering their services to address the problem of system upgrades. Intersolv expects its services revenue to increase between five and ten times over the next year as a result of year 2000 work. Disaster recovery firm Safetynet is offering a facility which enables businesses to simulate the coming of the millennium to observe how critical systems respond. (Source: *Computing*, 3 October 1996)

Samsung exhibits new TFT-LCD

Samsung Electronics Co. has successfully developed the first TFT-LCD (thin film transistor-liquid crystal display) with the highest-definition among world famous companies. An official of Samsung Electronics said "The company succeeded in developing a TFT-LCD with 5.76 pixels (1,600 x 1,200), which is 1.5 times more than the current TFT-LCD pixel capability." (Source: *Korean Business Review*, November 1996)

Wiped out by WIPO

The World Intellectual Property Organization (WIPO) has published a proposal intended to govern the protection afforded to published databases. (A copy of the protocol—*Substantive Provisions of the Treaty on Intellectual Property in Respect of Databases*—may be examined on *http://www.aslib.co.uk/news/.)* The protocol, which appears to favour Governments and publishers at the expense of users, was discussed at the Diplomatic Conference in Geneva in December 1996.

It appears to cover virtually any database, whether available or not to the general public. The treaty requires a minimum term of protection of either fifteen years (the EU) or twenty-five years (the US).

There has been little or no discussion in the wider community of its terms prior to submission. Indeed, many information professionals are unaware of it. If not queried, however, the protocol could have a profound impact on the operation of the world's knowledge base. (Source: *Managing Information*, 3(2) December 1996)

Data visualization

Absent from all the discussion about the infinite potential of the information technology (IT) revolution are some well-kept secrets. One is that many enormous business bets continue to be seat-of-the-pants decisions because the needed information can be neither accessed nor presented intelligibly—never mind the finite ability of the human mind to wrestle conceptual understanding from rows and rows of tabular data. Another is that we have never had so much data and that this information gap persists even though IT investments are approaching 50 per cent of the annual capital expenditures for some large corporations. In a strategic sense IT lags its potential because it is easy to underestimate its key organizational role. Emerging as a driver and facilitator of every corporate function, IT's influence has expanded far beyond the mere ability to automate data processing. And that influence is growing. Fueled by the rapidly increasing power of computer hardware and software, IT is challenging management to understand the technology's new potential for accelerating corporate performance. Part of that new potential is data visualization, the art and/or science of accessing, structuring, and graphically presenting the information contained in corporate data. After all, not only is a picture worth a thousand words, but it is quicker to comprehend. Data visualization represents a special opportunity as companies struggle to build enterprise IT structures to accommodate the future. Despite industry's sophistication in accumulating business operating data—databases are surging from gigabytes to terabytes—the dirty little secrets persist. Industry is showing signs of recognizing the challenge of too much data and too little information. For example, data-warehouse methods have emerged whereby accumulated operating data are fed into decision-support systems to facilitate executive decision-making. Another positive sign is the acceptance of computer-aided design in product development.

But some successful companies are going further—not only to eradicate the information gap, but to harness data visualization to support corporate change initiatives.

For a 1998 model, Ron Bienkowski (executive engineer at the Technical Computing Center, Auburn Hills, MI) reports that "we found over 1,500 interferences, and we were able to correct them in the computer before we made the first physical prototype". Another facet of Chrysler's VPD work is an evolution toward a whole-vehicle assembly model. "In the past our focus was on the components," says Bienkowski. "We are moving to a total vehicle orientation where we can describe the relationship between parts and production systems."

John Mazzola, president of EDS Unigraphics, Maryland Heights, Mo., sees that as a general trend in design: "Data visualization is going beyond simply being able to depict a 3-D part. In the design step, data visualization is now encompassing multipart assemblies, whole vehicles, and it is moving towards being able to define the relationship between data elements over time. That would make it possible to visualize [and analyse] the dynamics of how that product passes through manufacturing, testing, service life, and eventually, disposal.

"The trend is proceeding from using data visualization for static analysis to using the technology for dynamic analysis. Whether in an engineering or management context, the point is that many variables define any one situation, and I would like to be able to analyse all of them in relationship to each other.

Data visualization is also important because dynamic analysis or simulation is sometimes the only option. For example, as part of NASA's Discovery Program for planetary missions, engineers at the California Institute of Technology's Jet Propulsion Laboratory (JPL), Pasadena, Calif., are using VPD to simulate the landing of a spacecraft on Mars. The simulation program they are using is ADAMS mechanical system software from Mechanical Dynamics Inc., Ann Arbor, Mich., the package is designed to realistically simulate and analyse the dynamic behaviour of complex mechanical systems to determine the notion of moving parts and loads exerted on them. JPL runs the software on Hewlett-Packard 700 workstations.

While simulation via software such as ADAMS is coming into greater usage in engineering, the virtual reality (VR) approach to simulation is still in the research stage, albeit a highly active one. In this immersive form of data visualization, the human operator undergoes the personal experience of being an actor in a computer environment containing 3-D representations of real-world objects. VR has already played a role in the aggressive product-development programs of several companies.

Waiting on the horizon is a variation of VR, augumented reality (AR), that some speculate may prove far more useful in the long run by helping people to navigate and work better in the real world. In AR, computers display information in such a way that it seems embedded in the external scene and serves as a guide to the user, says Ulrich Neumann, a computer scientist at the University of Southern California, Los Angeles.

Meanwhile, data visualization continues to be the leading contributor to improving the way we interact with the computer.

In addition to being a way of dealing with all the manifestations of information overload, data-visualization solutions are a compelling opportunity for the next century because of their widespread applicability. (Extracted from *Industry Week*, 19 August 1996)

Bandwidth inadequacies and the "dream" modem

Demand for the Internet is focusing the minds of telephone access technologists. Just when telephone operators thought that they were coasting along with digital technologies like ISDN and ATM ready and waiting as and when users require more data bandwidth than a 28 kbit/s modem can provide. Then the bandwidth needs of the Internet threw a great rock into the pool.

With thousands of new users clicking on the World Wide Web each day and all of them complaining about the

bandwidth inadequacies of their 14.4 and 28.8 kbit/s modems, operator and terminal suppliers have gone into overdrive to provide the "dream"modem product for a market which literally did not exist 18 months ago.

ISDN, which provides Internet users with two 64 kbit/s digital telephone connections, may be the logical way for operators to increase the Web bandwidth, but despite falling prices the cost of ISDN lines remains high. Consequently the modem technologists are attempting to fill the Internet bandwidth gap with new types of asymmetric modems. Asymmetric, because they support a higher downloading bandwidth to the user than on the return channel back to the exchange.

Modem chipset specialist Rockwell set the ball rolling when it told the computer world that it would demonstrate a 56 kbit/s modem technology at the Comdex computer show in November 1996. The significance of the 56 kbit/s data rate is that it matches the US standard single line ISDN rate (56 kbit/s compared to Europe's 64 kbit/s), over existing analogue telephone lines.

Modem maker US Robotics is the latest supplier to jump into the "high speed"Internet market with the announcement of its first asymmetric 56 kbit/s modem. Dubbed "x2", the modem supposedly doubles the the V.34 analogue modem rate of 28.8 kbit/s for downloading Internet traffic to the user. The asymmetric transmission architecture has been tailored specifically for Internet or remote access because information sent to the individual desktop is typically graphics-based and requires a high-performance channel. User requests, such as World Wide Web http commands, require less bandwidth and can be transmitted quickly "upstream"at conventional 28.8 or 33.6 kbit/s.

Motorola and Lucent Technologies both important suppliers in the modem market, both for silicon and terminals, are also lining up their first 56 kbit/s products. Lucent Technologies high speed modem interface known as V.flex2, will be incorporated into the DSP1643/74 members of its Apollo modem chipset family. While the chips are expected, when available next year, to support 56 kbit/s downloading, there may also be support for two way communications at 45 kbit/s. (Source: *Electronics Weekly*, 23 October 1996)

Uses for videoconferencing expand

Although not a brand-new concept, videoconferencing increasingly is changing the way companies do business. Because of technological advances that allow video images to be transmitted clearly, cheaply, and even in life-size proportion, this means of communication is being accepted as a complement to face-to-face meetings at every tier of the corporate structure.

Whether used in a company's own offices, a conference facility, or a nearby hotel, it can be a cost-effective way for two or more parties to communicate. The money that otherwise would have been spent on airfare, hotels, rental cars, and food can be saved. And the time saved by not travelling can be put to better use. More important, videoconferencing can be used as a proactive tool to build business.

The cost of a full-room system can run as high as $100,000, whereas a desktop computer unit now costs only about $1,000. Yet payback time on a large investment for a major corporation may only be a matter of a few months. Although rental charges at videoconferencing centres vary, hourly rental rates can run about $250 an hour for each party at each end of the video conference. Additional hourly charges are incurred for Integrated Services Digital Network (ISDN) or regular analog phone-line time.

Although predominantly thought of as a meeting, educational, or interviewing tool, several new applications for videoconferencing recently have been introduced. For example, Hartness Technologies, Greenville, S.C., has developed a system for manufacturing facilities. Its Video Response System (VRS) features a wireless camera and a cordless headset. The system can be used not only to facilitate conference-room meetings between two locations, but also to broadcast live video from a plant floor. For example, when a machine breaks down, instead of waiting for someone from the machine's original equipment manufacturer to fly in and repair it, the OEM representative can view the machine by way of VRS, analyse the problem, and tell an on-site technician how to repair it. Instead of a production line being down for a day or more, the problem can be corrected almost immediately.

Although the problem may not always be solvable by video, in many cases it can be.

The benefits of a VRS-type system are many. Machines can be monitored by unmanned cameras; one need only dial in to the camera to see them. Video transmissions can be videotaped for future use, and the video signal can be bridged, allowing multiple sites to be linked. At construction sites, the technology can be used to broadcast outdoor site visits, ensuring that engineers do not all have to fly in to check on a building's progress.

Depending on how much videoconferencing equipment a company already has, the cost of VRS can vary from the mid-$20,000 range to almost $70,000.

TelePort Corp., Englewood, Ohio, and Armonk, NY-based IBM Corp. have added a unique twist to the traditional form of boardroom videoconferencing. They have created the TeleSuite, which features a room in which all participants appear simultaneously on screen, life-size, without any delay and seemingly just across the table from one another. It is as if a conference room had been split in half, with one side of the table at a different location. There are no visible wires, microphones, speakers, or cameras.

The TeleSuite system currently is in use at the Waldorf-Astoria in New York and the Capital Hilton in Washington.

Stratosphere Multimedia Corp., a videoconferencing complex in midtown Manhattan, enables trade-show participants to beam product presentations to other locations. At one recent US show, five suppliers made product presentations to 500 people in Japan. Thanks to the video link, the participants in Japan were able to see the products and then pose questions face-to-face to the presenters.

One area poised for growth is desktop videoconferencing. According to ITCA, 20,000 PC-based units were produced in 1994, but the market segment is expected to grow to more than 7 million units in 1997. (Source: *Industry Week*, 18 November 1996)

Videoconferencing poised for take-off

US-based Compression Labs introduced compressed digital video in 1982 to launch the videoconferencing market. This market was slow to grow and it is only recently reaching critical mass. It is now growing at the rate of 48 per cent annually with sales of approximately US$ 1.1 billion in 1995, with an expectation of US$ 2.7 billion by 1998. The marketing and mechanics have changed greatly over the past

14 years with the first system being large room-based affairs designed for full board meetings. The next development was "rollabout"systems which could be wheeled from room to room, followed by smaller, desktop stand-alone systems designed to be used by individuals or small groups. Although all these are still being purchased, the big change was the development of PC systems. Almost any modern PC can be upgraded to provide videoconferencing functionality while an increasing number of machines now have built-in capabilities. BT is an exception among retailers in that it is a carrier that is developing its own system, in addition to selling products from PictureTel and Intel.

Bosch Telecoms and Nortel retail a combination of their own products in addition to those of other manufacturers. Telecomms companies are more interested in selling bandwidth than shifting hardware. As the market for audio, video, data, and telecomms are converging, customers are going to vendors and expecting to get a complete system from one source. Big manufacturers such as Tandberg, GPT, PictureTel, Vtel, Compression Labs, Sony, Intel, and Creative Labs have deals with telcos, PC and software manufacturers. The most popular bandwidth infrastructure for videoconferencing remains ISDN but this could be changing as ISDN is expensive in some countries, not readily available in others, and suffers from a lack of standards. Leased lines, frame relays, and ATM can be used to provide internal videoconferencing, but these are usually private, closed networks and do not have ISDN flexibility. Videoconferencing over LANs is also growing but this is also a closed network application. While most videoconferencing systems have run on 128 kbit/s, the optimal speed is increasing to 384 kbit/s, and picture transfer is increasing from 15 to 30 frames per second. Split screens are becoming commonplace and multiconferencing units (MCUs) are being added to systems. Applications for videoconferencing are growing in an increasing number of fields—engineering, medicine, education and business. System specifications for Bosche; Sony; CLI; GPT; Intel; Tandberg; and PictureTel are listed. (Source: *Communications International*, 23(11) November 1996)

RAID (redundant array of independent discs)

RAID (redundant array of independent discs) systems were originally developed to provide continuing data availability in the event of failure of any single drive. Its cost tended to mean it was used on higher-value systems. Now, however, that cost is falling, making it competitive with technologies employed in other areas, such as jukeboxes.

Striping—distributing data across an array of physical drives—allows faster completion of reads and writes, since several discs can be accessed in parallel. Reliability can be achieved by data duplication, although this is an expensive option. Less expensively, verification (parity) data can be added to the file data, incurring an overhead cost of only about 20 per cent. The speed penalty incurred by employing parity checking can be more than offset by the use of disc caching.

Consideration must also be given to how component failures are managed. The simplest approach is the *cold swap*, but the *warm swap* is more convenient: the application must be run down but system power can remain on while the exchange is effected. *Hot swapping* permits components to be replaced while the application is still running.

Depending on the application, various levels of RAID may be considered appropriate. RAID 0, for example, has no duplication or verifiction, while RAID 1 fully duplicates data files across two or more discs. RAID 6 incorporates additional verification data so that the system can recover if any two discs fail. It is not widely used, as the probability of two discs failing simultaneously is very small. (Source: *Information Management Technology*, 29(6) November 1996)

C. NEW DEVELOPMENTS

Capacitors from chip fabrication

Close on the heels of AVX's announcement that it will be using semiconductor wafer sawing techniques to make tantalum capacitors, Siemens has revealed that it is working on capacitors made entirely using semiconductor fabrication methods.

The resulting capacitors offer a similar high capacity/unit volume as electrolytics combined with the high stability of polymer types with respect to temperature, voltage and frequency. Maximum voltage rating is currently 100 V.

Standard on-chip capacitors made by fabricating an Si-SiO_2 (or SiN)-Si sandwich are commonplace in integrated circuits, but the capacitance achievable with a reasonable area of substrate is small. Siemens have increased the capacitance per unit area by more than two orders of magnitude using holes etched into the substrate, forming the sandwich around the inside walls of the holes.

Siemens are calling the new technology Siko, and point out that it is still in the laboratory and not ready for mass production yet.

Specific capacitance is 4μFV/mm3 for Siko with 12 predicted, this compares with 8μFV/mm3 for aluminium electrolytics. Temperature range is -55° C to +200° C which is said to be the best available and capacitors between 10nF and 10μF can be fabricated.

The final die size made at the moment is 0.9 x 0.9 x 0.2 mm, tailored to fit into SOT23 and SOD123 packages. (Source: *Electronics Weekly*, 23 October 1996)

Security and Java

Schlumberger Electronic Transactions has unveiled a secure commercial smartcard based on a 1,024-bit key RSA public key cryptography. The card, called Cryptoflex, enables applications such as electronic commerce, confidential storage of personal data, secure e-mail and storing e-cash. It carries a chip from Motorola and an on-board maths co-processor. Sun Microsystems will try to build support for smartcards running its Java computer language. At least 14 companies are expected to support the move. One hardware supplier is VeriFone, which is launching its Omni 1250 terminal that will accept electronic cash payments from up to four smartcard platforms such as Mondex and EMV. (Source: *Electronics Weekly*, 30 October 1996)

A welcome contrast

Designers of television and computer monitors are always trying to make the screen colours as pure and true-to-life as possible. The colours are produced by dots of phosphorescent dyes coated onto the back of the screen which glow red, green or blue when struck by an electron beam "fired" from the cathode ray tube.

The colour that appears on the screen depends on the relative brightness of each phosphor dot, but the wavelengths emitted by the phosphor dots tend to overlap—the highest wavelengths emitted by the red dye are the same as the lowest wavelengths emitted by the green, with a similar overlap between green and blue. This muddies the picture, degrading the purity of the colours and the picture contrast.

Researchers from Chunghwa Picture Tubes in Taiwan have developed a solution to this problem. A screen generally has one or more external surface coatings to repel static or impede reflections. The team has introduced another element to these coatings—organic dyes that absorb the offending overlap frequencies.

The researchers list a wide variety of possible dyes that absorb wavelengths between 450-500 mm (between red and green) and 560-600 mm (between green and blue). Azo, triarylmethane or anthraquinone dyes are ideal—these are chemically bonded to the active ingredients of the screen coatings via a silane coupling. Silanes are generally used in the coatings anyway, because of their antireflective properties, the researchers note. (Source: *Chemistry & Industry*, 21 October 1996)

Phosphor research improves FEDs

Sandia National Laboratories in the USA claims to have discovered something new about phosphors, the light emitting chemicals used in TV tubes and flat panel field emission displays (FEDs).

It has found that the amount of light emitted does not depend on the thickness of the crystal but upon the density of a defect: oxygen atoms missing from their places in the crystal. Single electrons that remain in the vacant spaces emit green light when a mild electric current is introduced.

Sandia is currently working with zinc oxide because of its simple, two-component lattice; most phosphors comprise three, four or even five elements in complex lattices. By activating the phosphor surface, Sandia scientists believe they can produce phosphors that operate at 0.5 kV. (Source: *Electronics Weekly*, 27 November 1996)

Silicon fab goes flat out

A new technique that enables fabrication of atomically-flat silicon surfaces as opposed to the "terraced" surfaces that exist in current devices could bring big improvements to performance and yield of silicon microelectronic and optical devices.

The technique, developed by materials scientists at Cornell University, uses high pressure and temperature to force atomic steps on the silicon surface to migrate to specially created boundaries. Though the slight irregularities, on the nanometre scale in current silicon layers, do not have much effect on the operation of the present generation of devices, future miniaturization is going to make smoothness a critical factor.

Normal surfaces of silicon, though looking flat, consist of short, smooth terraces each ending in a step of atomic dimensions at about 1.5 mm.

Using their new manufacturing procedure, the Cornell team has been able to create extensive regions on a silicon wafer that have no atomic steps at all. They have achieved this by creating a grid of ridges, 0.5 μm high and 1 μm wide on the surface of the wafer and clearing the intervening squares of their atomic steps by forcing them into the ridges.

The grid is created using electron beam lithography, and each square, about 10 μm wide, has about a billion atoms on

it, with several thousand atomic steps all across the square. The sample is then subjected to ultra-high vacuum and then high temperatures of 1,020° C-1,150° C.

At these temperatures, silicon atoms are detached from the atomic steps so that in effect the steps migrate to the ridges at the boundary of the square, leaving the surface of the square atomically flat.

More information from Jack Blakely, Materials Science and Engineering, Cornell University, Ithaca, NY, USA. (Source: *Electronics World*, December 1996)

High-yielding photo cells

A significant breakthrough has been achieved in the production of high-yielding solar or photo cells. A team from the laboratory of Physics and Semiconductor Applications (PHASE) of the French Centre for Scientific Research in Strasbourg led by Jean Claude Mahler has managed to obtain high-yielding photo cells in a very short time by using furnaces with tungsten-halogen lamps for doping. This technique could make solar energy competitive when compared to other power sources.

Till now doping has always been done in heat furnaces in the vapour phase. But this is a long and polluting process as considerable heat mass has to be generated and the entire installation has to be maintained under a gas flow, which is toxic at high temperatures.

The new technique developed at Strasbourg reduces the number of heat stages and thereby the number of intermediate chemical stages. It is thus less polluting. Only the required material is heated in tungsten-halogen lamp furnaces. In less than three seconds, it reaches a temperature of 1,000° C from 25° C. The doping time is thus reduced to less than a minute.

A first line of photovoltaic cells may be produced in the next three or four years using this process. This should pave the way for low-cost photo cells. (Source: *Tech Monitor*, November-December 1996)

New world record in photovoltaic technology

A new world record in converting sunlight to electricity using a thin-film solar cell has been achieved by United Solar, an American joint venture between Energy Conversion Devices, Inc. (ECD) and Canon Inc. The record 14.5 per cent initial conversion efficiency, announced by the US Department of Energy (DOE), was achieved on a multi-junction, amorphous silicon alloy solar cell.

The research that led to the world record was performed under a cost-shared industry/Government programme, the Thin Film Partnership.

United Solar used a triple-cell approach where the component cells are designed to capture different colour photons of the solar spectrum to increase the sunlight-to-electricity conversion efficiency.

United Solar and ECD, both based in Troy, MI, have developed a solar cell manufacturing technology which uses one-half-mile-long substrates in a roll-to-roll process, a manner similar to the production of a newsprint or photographic film. A production plant is scheduled to come on-line in early 1997 with the ability to annually produce solar panels capable of delivering five million watts of electrical power. (Reprinted with permission from *Semiconductor International Magazine*, December 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Fault current limited by superconducting phenomenon

The Central Research Institute of Electric Power Industry has developed a new system based on superconducting technology that prevents damage to generators and transformers by limiting the large fault currents usually generated when problems occur in power transmission lines.

This current suppression system uses the phenomenon of the superconducting state being instantaneously quenched and the resistance increased during large current flows. The current is not cut off completely, so that power interruption can be avoided while protecting power line equipment. Related results have been confirmed only through small-scale experiments, but the plan is to enlarge ancillary experiment equipment to commercialize a system applicable to power transmission lines.

The device is based on the magnetic shielding effect of a superconducting material eliminating the magnetic flux. The system has a simple construction, with an iron core passed through the central part of a cylinder consisting of a high-temperature superconductor with a winding of a copper wire. When a current is passed through the copper wire, the magnetic flux inside the coil is eliminated by the action of the superconducting cylinder, lowering electrical resistance and enabling power transmission interruption.

Further details from Central Research Institute of Electric Power Industry, Public Communications Division, 1-6-1, Ohtemachi, Chiyoda-ku, Tokyo 100. Tel.: +81 3-3201-6601; Fax: +81 3-3287-2863; e-mail: www-pc-ml@criepi.denken.or.jp (Source: *JETRO*, September 1996)

Vacuum micro-device with MOS transistor structure

The Electrotechnical Laboratory of Japan's Agency of Industrial Science and Technology has succeeded in developing an entirely new type of vacuum micro-device with MOS transistor structure.

The vacuum micro-device consists of a superfine protrusion called the emitter and several draw-out electrodes along the peripheral parts. When a voltage of several volts is impressed on the draw-out electrodes, electrons are emitted from the emitter tip into the vacuum. With the conventional type of device, the emitted flow of electrons is variable due to the non-uniform shape and/or changes in the surface conditions of the emitter, which has hampered application up to now.

The newly developed device has a MOSFET structure and incorporates the function of emitting electron flows very accurately. In addition, it can be mass produced with ease by compatible IC processes, and is highly resistant to device fracture. The device features excellent functions despite its simple structure, and resolves existing problems such as unstable operation and non-uniformity associated with conventional counterparts and therefore has a broad range of applications including the commercialization of display devices.

Further details from Electrotechnical Laboratory, AIST, 1-1-4, Umezono, Tsukuba City, Ibaraki, Pref. 305. Tel.: +81-298-58-5503; Fax: +81-298-58-5507. (Source: *JETRO*, September 1996)

Progress in superconductivity

Research is continuing on the current-carrying metric of high-temperature superconducting wire. For example, a new

"silver-wire-in-tube"manufacturing process has demonstrated more than 100,000 amps per square centimetre, say scientists at the US Department of Energy's Argonne National Laboratory, Argonne, IL, and the University of Pittsburgh. They compare that with prior powder-in-tube methods capable of only 20,000 to 30,000 amps per square centimetre. The new process builds on the observation that current flows almost exclusively through a thin interface, the layer of superconductor close to the silver casing. In the new process the high-temperature superconductor occupies the space between a silver wire and the silver tube. After being drawn and rolled, "we get a thin layer of superconductor one to two micrometres thick," says Roger Poeppel, director of Argonne's Energy Technology Division. The composition: bismuth, lead, strontium, calcium, copper and oxygen. (Source: *Industry Week*, 19 August 1996)

Nanocomposites may make digital X-ray imaging a reality

Two DuPont chemists have described what they believe is a totally new approach for making X-ray sensitive photoconductors. Such materials are being pursued because they could be used to transform X-ray imaging (radiography) into an "all-digital" technique like magnetic resonance imaging. Before the DuPont work, scientists had found only one potentially useful X-ray photoconductor: selenium. This material, though, has many drawbacks. Seeking a better alternative, Ying Wang and Norman Herron of DuPont's Experimental Station in Wilmington, DE, propose using nanocomposites that combine the advantages of inorganic and organic compounds. Their best candidate so far consists of a 50 per cent-by-weight dispersion of finely powdered bismuth triiodide (BiI_3) in nylon-11, $[-NHCO(CH_2)_{10}-]_n$. When films of this material are exposed to X-rays, the electrons and holes that are generated quickly migrate to the film surface and recombine to give complete discharge, as would be desired. The nanocomposite's performance matches or exceeds selenium's in some ways, but falls short in other ways. Wang finds the early results "very encouraging" and says the approach offers great potential. (Source: *Chemical and Engineering News*, p. 25, 5 August 1996)

Microlens arrays for high-resolution imaging

A lithography system using microlens arrays for high-resolution imaging of multichip modules, large area flat panel displays (FPD) and microelectro-mechanical systems (MEMS) has been jointly developed by Hugle Lithography (San Jose, CA) and the Institute of Microtechnology (Neuchatel, Switzerland). The imaging system consists of several stacked microlens arrays forming an arrray of micro-objectives. This lithography technique provides a resolution of 2 to 5 μm for a printed area of 300 x 300 mm or larger in a single shot.

Optical systems using lens arrays are not new. However, this is the first application to lithography systems.

The optical system uses stacked arrays which project overlapping images onto the image plane. One array inverts the image. A field lens array is placed in the intermediate image plane to improve the radiometric efficiency of the system and two field lens arrays near the intermediate image plane enhance optical performance. By demagnifying the intermediate image, crosstalk between adjacent imaging channels can be effectively eliminated. A fourth lens array completes the optical system and reinverts the image. Finally, because the optical system is symmetrical, anti-symmetrical wave-front aberrations such as coma, distortion and magnification chromatic aberrations are minimized.

Microlens lithography offers an alternative to steppers and proximity printers. FPD manufacturing, for example, is moving towards 550 x 650 mm substrates and 3 to 5 μm resolution. (Reprinted with permission from *Semiconductor International Magazine*, December 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Samsung develops microgyroscope

Samsung Advanced Institute of Technology (SAIT) has developed a single-chip microgyroscope prototype, the world's first sensor to detect less than 0.1 degree of movement per second. The silicon microgyroscope, which measures 1 mm x 1 mm, is packaged in a high-vacuum environment (10^{-3} Torr). Samsung laid 7.5 μm thick polysilicon on a silicon substrate using surface micro-machining technology. This development is the result of joint research efforts involving SAIT, Korea Advanced Institute of Technology (KAIT) and Seoul National University. (Reprinted with kind permission from *Semiconductor International Magazine*, December 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Single crystal "microwhiskers" process developed

Containerless Research (Evanston, IL) has developed a method for epitaxially growing single crystal micro-whiskers on silicon. Applications for the whiskers include field emitters, scanning tunnelling microscope tips, microfabrication tools, planar light traps and high emissivity radiation sources.

The whiskers are grown on <111> silicon substrates, using what is called the vapour-liquid-solid (VLS) process. Standard whisker diameters are 2 to 8 μm, lengths are from 10 to 200 μm and array spacings are from 15 to 100 μm. They can be grown as arrays or as single whiskers on areas or posts 1 to 5 mm in diameter.

The VLS process uses a molten gold-silicon alloy as a catalyst. The patterned wafer is allowed to react with silicon tetrachloride and hydrogen to form the whiskers. The gold pattern determines the whisker locations, and the growth temperature determines the whisker diameter. The remaining gold particles are removed by an acid process that also sharpens tips of the whiskers to a radius of $\leq$1.0 μm. An oxidation and etch process can be controlled to further sharpen them to $\leq$5 nm. Polycrystalline diamond coatings may also be deposited on the whiskers, which can then be sharpened down to $\leq$20 nm.

The sharpened whiskers and diamond-coated whiskers have outstanding field emission properties for vacuum microelectronic applications. Stable emission currents up to 500 μA have been obtained from the diamond-coated whiskers. The coating also makes the whiskers robust against ion bombardment and chemical interaction, opening the possibility for use in field emission displays. Stable emission currents up to 500 μA have been obtained from the tips.

Further information may be obtained from Containerless Research, Inc. at 906 University Place, Evanston IL, 60201; Tel.: (847) 467-2678; e-mail at cri@containerless.com; or by accessing their web site at www.containerless.com. (Reprinted with permission from *Semiconductor International Magazine*, December 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Reconfigurable success

A British semiconductor company claims to have developed the world's first reprogrammable analogue components—an analogue version of FPGAs.

Zetex, based in Oldham, developed its reconfigurable analogue circuit (TRAC) devices to be used for analogue circuit design much in the way FPGAs are used in digital design. Applications include filters, phase locked loops, VCOs and frequency to voltage conversion.

The main consultant on the project, and the original inventor of the digital gate array ASIC is Professor David Grundy of Huddersfield University and UMIST. He has been developing the concept of field programmable analogue devices (FPADs) for some years, and has developed a computational approach to analogue VLSI design. He identified a set of operations required for all analogue designs. These are addition, negation, integration, multiplication, division and rectification. Unfortunately, the last three are difficult to integrate with the others but this has been overcome with the use of logarithms.

The first announced TRAC device contains 20 analogue cells, each of which can implement any of the operations. A complete software and development package is provided for the design and programming stage.

The first TRAC 020 uses just over 2,000 transistors; larger devices are expected in future. (Extracted from *Electronics Weekly*, 2 October 1996)

Researchers eye up artificial intelligence

In a joint research programme with University College, London, Sira Technology is aiming to develop the first intelligent artificial eye, combining visual sensing, artificial intelligence and virtual data presentation.

Individual projects will specialize on machine vision, sensor arrays, neural networks and software agents.

The plan is to initially develop a visual inspection system, identifying defects by previous experience of what was acceptable and what was not. Subsequently this should be expanded to detect intruders and establish personal identities. (Source: *Electronics Weekly*, 2 October 1996)

Fluorescent flat panel display technology

Researchers at Sandia National Laboratories have made a discovery that may lead to phosphorescent flat panel displays. Phosphorescent displays are used in televisions and are the most common, but practical flat panel displays cannot support the voltages required, about 25 kV, to produce a useful picture using common phosphors. CCD arrays are used in flat panel displays, but they go blank when viewed at an angle, placed in direct sunlight, subjected to rapid changes in temperature or rapidly accelerated. In addition, CCD arrays are backlit, using power even when no information is being presented.

Sandia scientists have discovered that the amount of green light emitted by zinc oxide depends on the surface density of the oxygen vacancy defect, not on the thickness of the material. Only a mild current is required to produce green light when an electron is captured in that defect. Using enhancement technologies, such as the formation of cone-shaped microscopic structures, they believe they can produce phosphorescent displays that operate at 0.5 kV.

Although the chromacity of the zinc oxide phosphor is not quite right for use in colour displays, it is still very useful. Its simple, two-component lattice permits zinc oxide to be studied with relative ease, paving the way for more complex phosphors to be studied. In the meantime, displays using the zinc oxide phosphor can be balanced, blanched, or simply used in monochrome displays. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Copper/SiOF interconnect structure demonstrated

Researchers at NEC have successfully demonstrated a copper damascene/SiOF interconnection technology that does not require a traditional barrier metal layer, such as TiN. The process instead forms a thin barrier layer of SiON on the surface of the SiOF dielectric films by a NH_3 plasma treatment. This barrier layer is sufficient to prevent oxidation and diffusion of Cu, say the researchers, enabling a lower resistivity than that achievable with a Cu/TiN approach.

The process follows the following sequence: first, SiOF films are deposited on silicon by ECR-CVD, and trenches are patterned and etched. Next, the SiOF was exposed to a NH_3 plasma, creating a thin SiON layer. Cu was then sputtered into the trenches and reflowed at 400° C for 30 minutes in atmospheric N_2/H_2 mixture gas. This was followed by a final Cu-CMP step. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

SRAM cell designs advance

Traditionally, stand-alone static random access memories (SRAMs) and on-chip SRAM cells have been fabricated with significantly different methods, one involving the use of four transistors (4T cells) and the other six transistors (6T cells). That may soon change, as power supplies are scaled below 1.8 V, according to researchers from Motorola in Austin, Texas.

Due to tradeoffs that must be made in several key areas—cell size and process complexity, process commonality between logic and memory, memory cell stability, and soft error rate—common process flows based on the six transistor design may eventually be adopted for advanced microprocessors and stand-alone SRAM products.

The Motorola researchers report that 4T SRAM cells have dominated the stand-alone SRAM market since first introduced in the 1970s, and 6T SRAM cells have been dominant for on-chip storage in advanced microprocessors and other logic circuits. But now, 6T designs appear ready to dominate both stand-alone and on-chip SRAM applications, since it appears as if it will be difficult to scale 4T cells below the 1.8 V generation. While 4T cells are typically smaller, they generally require a more complex process and are not as stable, especially at lower voltages.

Interestingly, the economics of SRAM production are such that it makes sense to add process enhancements that add to overall process complexity and cost in order to achieve a smaller cell size, which can increase the number of good die per wafer. Methods used to obtain smaller cell areas include strap local-interconnects, self-aligned contact to gate, buried contacts and damascene local interconnects.

A problem is that many of these enhancements make the SRAM process less compatible with logic processes. The processes using strap and self-aligned contacts, for example, require the use of insulator-capped polysilicon (or polycide), which requires that the gate poly be doped prior to gate patterning. This is very different from the typical logic process, where the gate poly is doped after patterning using the source/drain implant, followed by self-aligned silicidation. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

300 mm wafer imaging

MRS Technology (Chelmsford, MA) has applied its advanced large area flat panel display technologies to image 300 mm wafers. The MRS 5200GHR PanelPrinter was

recently used by a major semiconductor manufacturer to align and image multi-level devices over the entire area of 300 mm wafers. This capability, a first step in the development of large-scale manufacturing of 300 mm wafers, provides the patterned features necessary to demonstrate the uniformity of other processes, such as deposition and etch.

The major differences between FPD and IC fabrication are the size and physical characteristics of the substrates being processed. FPD substrates are usually rectangular and made from glass, which has neither the thermal stability, flatness, tensile strength or size standardization of silicon wafers. Furthermore, the design rules for silicon wafers are smaller, less than 0.25 μm. The equipment and processes for fabricating ICs must accommodate these differences.

The 5200 consists of an ultraviolet light source with shutter, mask, reduction lens and precision x-y movable stage. Travelling the area of a 300 mm wafer was the easiest step, because the system was originally designed to image glass FPD substrates nearly four times larger. Precise x-y stage positioning control is critical to achieve good lithographic results on all layers of the wafer. At each exposure site, the x-y stage and reticle-field stop-blades are positioned so that reticle subfields are imaged at the appropriate position on the substrate. The 5200 images multiple chip patterns in a single shot with typical resolutions of <0.8 μm.

A 300 mm wafer chuck pattern was designed into the latest x-y stage to facilitate patterning experiments. The new stage has specific machined vacuum patterns designed to accommodate the large silicon wafers. To reach all parts of the wafer with the imaging lens, laser interferometer controlled travel of at least 300 mm is required on both axes. Finally, process efficiency is enhanced with an automatic calibration feature by eliminating costly and time-consuming send ahead requalification procedures. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Tiny transmitters

RF Solutions believes it has produced the world's smallest licence-exempt AM transmitters. They have two pins and are 7 x 11 x 4 mm, produce 250 μW (the legal maximum) and consume 2.5mA. A company spokesman said: "You use them just like LEDs, all the power comes from the data input". In operation, one pin is grounded and the other is connected to a data line, via a resistor, and the aerial. A logic "1" causes the device to break into SAW-controlled oscillation. Varying the resistor allows them to operate from between 2.5 and 13 V. (Source: *Electronics Weekly*, 6 November 1996)

35 GHz at UMIST

A compact 35 GHz amplifier suited to long distance, high speed optical communications has been co-developed by a group of UK and Portuguese academics. The device, which uniquely combines digital filtering and analogue amplification, is claimed to be the fastest of its type, capable of working with 40 Gbit/s communication systems.

The circuit design, involving UMIST, University College London and the University of Aveiro in Portugal, uses a distributed amplifier.

The circuit, implemented as a single monolithic microwave IC (MMIC), has been built by the Frauenhofer Institute in Germany using a 40 GHz HEMT process. Different lengths of the transistors define the delays and coefficients of the filters.

An integrated front end would have applications in very high speed optical fibre such as transatlantic or Pacific links.

The next stage is to make an adaptive system that adjusts the filter's coefficients and the amplifier's gain depending on the signal received. (Source: *Electronics Weekly*, 4 December 1996)

Flip-chip assembly increases component density on board

A project has been launched to promote the benefits of a flip-chip on board (F-COB) assembly technology.

The Welding Institute (TWI), a Cambridge-based research facility jointly owned by over 2,000 European companies, has begun a group sponsored project to study the cost savings and increased packaging density of F-COB techniques over those of conventional surface mount technologies (SMT).

One benefit of the technology is the reduction in board area occupied by components. The density increase is due to the removal of IC packaging, allowing solder bumps to be applied to the bottom side of the bare IC, which is mounted directly on to the PCB. The density increase can be as much as 80 per cent.

The removal of the packaging also enables faster inter-device communication through the reduction of inductance, resistance and capacitance parasitics. (Source: *Electronics Weekly*, 4 December 1996)

"TrenchMOS" discrete process introduced

Philips Semiconductors has developed a TrenchMOS technology for its new range of discrete power MOSFET devices. This technology achieves very low values of ON resistance for automobile and other applications where currents may reach 50 A.

In conventional MOS power transistors lower values of $R_{DS(on)}$ have been achieved by reducing the size of the individual cells that together form a device. However, if the polysilicon gate is made too small, it will not operate effectively, and the parasitic "JFET" resistance of small, densely packed cells causes the overall device resistance to rise.

In a TrenchMOS device, the polycrystalline silicon gate is formed in a trench alongside the p^+ doped area. The channel of the device is formed vertically on the walls of the trench, so current flow is nearly vertical. Philips claims TrenchMOS devices have a resistance of about half that of conventional devices in which a channel is formed horizontally under the polysilicon. The "JFET" effect that restricts current flow between adjacent cells of conventional devices is eliminated. The trench structure is claimed to be inherently more amenable to future size reduction for still lower values of $R_{DS(on)}$. Some hundreds of thousands of these individual MOSFET transistors, each with a hexagonal structure for optimum packing density, are connected in parallel to form a complete device.

Philips states that the TrenchMOS structure offers a specific chip resistance of 105 mΩmm^2 instead of 250 mΩmm^2. This results in the usual 20 mΩ value of $R_{DS(on)}$ being reduced to 8 mΩ maximum, 6.4 mΩ typical, for a TO220 package.

The parasitic resistance of the connections is negligible in conventional devices compared to the resistance of the transistor. In TrenchMOS devices resistance is reduced by increasing the number of bond wires from two to three and by increasing their thickness, two 250 μm wires with a resistance of 1.5 mΩ being replaced with three 350 μm wires with a

resistance of 0.5 mΩ. The thickness of the aluminium source has been increased from 3 μm to 5 μm to reduce its resistance from 1.0 mΩ to 0.6 mΩ.

The new process enabled customer requests to be met for the inclusion of gate-source zener diodes. These provide ESD protection of up to 2 kV. They simplify and reduce the costs of design-in and end product manufacture. (Extracted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

New discharge excitation technique for carbon dioxide gas lasers

Matsushita Research Institute Tokyo, Inc. has established a new discharge excitation technique applicable to carbon dioxide laser systems which are employed for steel plate cutting and welding.

This new technique uses the magnetrons used in microwave ovens as the energy source for exciting the laser medium. A high laser output power is obtained, and the laser system has a high potential for compactness. The company plans to develop a practical laser oscillator with the aim of commercializing the system during 1997.

Up to now, in exciting the laser medium with microwaves, the microwave was irradiated from only one direction, so discharge was caused only in a part of the laser tube, making the generation of a high output laser difficult.

The new technique consists of irradiating two microwaves generated by two magnetrons from two directions against a laser tube filled with laser medium containing carbon dioxide gas. Discharge extending over a broad range is generated inside the laser tube, so that a large volume of laser medium is excited at once and high laser output power is obtained.

The new technology, introducing the two orthogonal electric fields, has improved the laser oscillation efficiency and the power input density which makes high laser output possible. The efficiency of the prototype has been 20 per cent of the input power, which is the world's highest level for high power microwave excited carbon dioxide lasers. Because the input power density is very high, the system as a whole has the possibility of being made more compact than before.

The carbon dioxide gas laser is used for the complex machining of electronic components and the cutting and welding of steel plates. At present, the systems of DC and RF discharges have been commercialized, while laser oscillation by the microwave system appears highly probable as a next-generation mode of laser oscillation.

Further details from Matsushita Research Institute Tokyo, Inc., Corporate Planning Group, 3-10-1, Higashi-Mita, Tama-ku, Kawasaki City, Kanagawa Pref. 214. Tel.: +81-44-911-7866; Fax: +81-44-931-1078. (Source: *JETRO*, October 1996)

Basic operations of high-temperature superconducting quantum interference device performed successfully

The Superconductivity Research Laboratory of the International Superconductivity Technology Centre (ISTEC) of Japan has succeeded in performing the basic operations of a high-temperature superconducting device using the single magnetic flux quantum that is the smallest unit of magnetic flux as the data medium.

The high-temperature superconducting device is made of two kinds of superconducting quantum interference devices (SQUID) with superconducting loops containing one or two superconducting junctions. The theoretical operations of data storage and erasure are performed with a single magnetic flux quantum and with external signals. High speed and extremely low power consumption have been confirmed. Low cooling cost, speed of a hundred times faster than silicon counterparts, and extremely low power consumption are realized simultaneously.

The superconducting loop of this basic device is provided with superconducting junctions, input signals are supplied from an external source, and the magnetic flux are induced into each single magnetic flux quantum inside the SQUID loop. Physically, since the minimum unit of magnetic flux is used, the device represents the ultimate type of device.

With the prototype device, indentations were made on a magnesium oxide wafer with a flux concentration ion beam and neodymium-based high-temperature superconducting thin films formed to create fine junctions of 0.2 μm thickness. This method could fabricate a direct-current (DC)-SQUID with two junctions and a radio-frequency rf-SQUID with a single junction.

By using these junctions in combination, a device was first fabricated with a loop, was coupled with a DC SQUID, magnetic flux was induced inside the SQUID by current pulse input, and data retention and erasure were performed at a high speed of 5 ns, through which the operations of data storage and erasure were confirmed.

For the devices coupled with rf- and DC-SQUIDS, the threshold value characteristics of the rf-SQUID were applied and the logical product and logical sum operations were verified. It was also possible to apply the devices to the fabrication of multifunctional circuits which are actually unit devices but with logical controls performed from the outside.

Up till now, these single magnetic flux quantum operations had been confirmed mainly with niobium-based low-temperature superconducting materials in these works. The single magnetic flux quantum device shows high speed and low power consumption characteristics which pave the way for the realization of superhigh-speed operation at 100 GHz and superlow power consumption of 10-18 J per logical gate, which had been impossible with ordinary semiconductors.

Further details from Superconductivity Research Laboratory, International Superconductive Technology Centre, 1-10-13, Shinonome, Koto-ku, Tokyo 135. Tel.: +81-3-3536-5703; Fax: +81-3-3536-5717. (Source: *JETRO*, October 1996)

Energy dispersive glancing-incident X-ray analyser for thin films

Professor K. Matsushige and Dr. T. Horiuchi and their colleagues at Kyoto University have developed a thin film analyser that uses X-rays incident on a sample film and detects the dispersed energy of the reflection.

An organic electroluminescence (EL) device will be the key component of a next-generation commercial display apparatus, but present devices become fatigued by ohmic heat. How the fatigue occurs remains unknown, but must be found to increase the EL device reliability.

Optical, electron beam, STM (scanning tunnelling microscope), and AFM (atomic force microscope) approaches have been used to investigate the fatigue process of the EL device, though the initial process cannot be observed. The new analyser will be used in a film deposition chamber to look at growing films such as functional organic thin films, organo-metallic CVD high-temperature superconducting films, ferroelectric films, and plasma CVD diamond films. The observed conditions of those films can be used to control the parameters of film deposition to increase production

efficiency. The *in situ* observation allows insight into what is happening in the growth of films from the beginning.

The analyser is composed of an X-ray source, a table on which a sample film is placed, and a solid state X-ray detector. The source emits X-rays with a continuous spectral distribution of white X-rays. The incident X-rays are cast on the sample at a glancing angle, and reflected to the detector. The reflection has interference fringes. The dispersed energy of the X-ray fringes is analysed to determine the density and thickness of each layer included in the film, and the roughness of the interface between two abutting layers.

The properties of films have been determined by the angular dispersive X-ray analyser. Unfortunately, the conventional device involves illuminating a sample many times with an incident X-ray beam at the same angle. The measurement takes a long time, and often cannot achieve satisfactory precision, so it is difficult to observe the initial stage of fatigue in an EL device.

The new analyser can observe the beginning deposition of functional organic films and other materials, and could identify a thermal deficiency of subnanometre size on an interface within a multilayer film. The new non-destructive approach does not require time-consuming angular scanning. The new analyser completes the measurement of a sample in tens of seconds, and can be used in a semiconductor production line.

Further details from Kyoto University, Department of Electronics Science and Engineering, Faculty of Engineering, Yoshida-honmachi, Sakyo-ku, Kyoto 606. Tel.: +81-75-753-5310; Fax: +81-75-753-5749. E-mail: thoriuti@kuee.kyoto-u.ac.jp. (Source: *JETRO*, October 1996)

2nd-generation 1-Mbit synchronous burst SRAM

Mitsubishi Electric Corp. has developed a high-speed 1-Mbit synchronous burst SRAM (static random access memory) featuring a maximum working frequency of 150 MHz. Samples are being distributed for its use in workstations and host personal computers.

The high-speed SRAM is used as a secondary cache memory to supplement the transfer speed difference with the main memory and to preserve data used frequently, to cope with the debut of high-speed personal computer mainframe miniature processing units (MPUs).

The new synchronous burst SRAM works on a source voltage of 3.3 V with a working frequency of 66 MHz to 150 MHz.

Further details from: Mitsubishi Electric Corporation, Public Relations Dept., 2-2-3, Marunouchi, Chiyoda-ku, Tokyo 100. Tel.: +81-3-3218-2172; Fax: +81-3-3218-2431. (Source: *JETRO*, October 1996)

Laser trimming system for resistance adjustment

NEC Corp. has developed a laser trimming system, Laser Trimmer SL436G, for rapid adjustment of resistance values such as those of thick-film chips and networks.

The system uses a high-accuracy, high-speed beam positioner, a short-pulse, high-output laser S116G, a newly developed measuring instrument enabling rapid measurements of high resistances, and a new high-speed probe unit, by which the processing time has been shortened by about 30 per cent compared to the company's present systems, and features the world's fastest trimming capacity. An optional specification can adjust superlow resistances of less than 100 milliohms, which has been impossible up to now.

The new system is applicable to adjusting current detection resistances, a sector that has become prominent recently, or for adjusting the superlow resistances of personal computers and peripheral equipment, switching power units and automobile servo-systems.

Further details from: NEC Corporation, Industrial Automation Division, 5-7-1, Shiba, Minato-ku, Tokyo 108-01. Tel.: +81-3-3798-6195. (Source: *JETRO*, October 1996)

Low k nanoporous silica to be commercialized

A promising new material that can easily achieve dielectric constants of less than 2 is being commercialized through a joint venture between NanoPore, the material's inventor, and Allied Signal, a well-known supplier of spin-on glass (SOG). The material, a nanoporous silica, reportedly avoids many of the problems of low k organic polymers, such as poor thermal stability and poor adhesion, while also avoiding the porosity-related problems of similar aerogel and xerogel materials. It is manufactured with the same precursors as SOG (i.e., TEOS) and applied in a manner similar to SOG, and eventually winds up as a SiO_2 film with nano-sized pores. Sample quantities are expected to be available some time in 1997.

The material's properties were largely discovered and demonstrated by Doug Smith, a professor at the University of New Mexico in Albuquerque. The initial deposition of nanoporous silica films is very similar to other spin-on materials such as SOG, but it is really the post-processing steps that determine the film's properties.

Other advantages of the material are that it can be deposited in thicker films than SOG because its tensile stress is lower; it has no thermal stress because of its porosity; and it can be treated to produce hydrophilic or hydrophobic surfaces. Conceivably, Smith says a "porosity gradient" could even be formed to produce a higher dielectric constant at the top of the material than at the bottom. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Hermetic glass-silicon micropackage

Researchers at the University of Michigan have developed a hermetic micropackage with high-density (200 per millimetre) on-chip feedthroughs for sensor and actuator applications. Originally developed for implantable biomedical applications, it can be used for chemical or vacuum sensors in hostile environments.

A custom made glass capsule is electrostatically bonded to a polysilicon layer to form the hermetic seal. Sufficient planarity of the polysilicon layer, achieved with conventional processing, is critical to the success of the seal.

An oxide layer is grown on a silicon substrate, then polysilicon is deposited, doped n-type, and patterned to form the leads. After 200 mm of oxide is grown on the polysilicon, phosphorosilicate glass (PSG) is deposited and reflown. After etching the PSG, a $SiO_2/Si_3N_4/SiO_2$ stack is deposited as a moisture barrier. After etching down to the substrate, another polysilicon layer is deposited. The dimensions of the leads are chosen to ensure sufficient planarity of the PSG after reflow.

The bonding is done to a polysilicon layer because the temperature required to perform the bonding, about 320° C, is low enough for internal components to tolerate. Bonding to oxide requires temperatures above 400° C.

According to the research, the package has a MTTF of over 100 years in a moist environment at 37° C. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Advances at the nanoscale level

Researchers at Purdue University, West Lafayette, IN, have created an ultra thin film—made from tiny clusters of gold atoms—that conducts electricity by allowing electrons to "hop" one at a time from cluster to cluster. Electrical current passing through a device in this fashion would largely eliminate the problem of heat build-up in electronic devices (which currently rely on a continuous flow of current through silicon-based circuits, explains Ronald Andres, professor of chemical engineering). Synthesis of the new material, called a linked cluster network, is also an important step in the development of nanotechnology—for more powerful computers and devices so small that they could be inserted into the body. The approach solves both the heat build-up issue and the inability of photolithography to make circuitry that tiny. Andres believes products made with the technology "could be low cost, although it will be several years before we see these structures in consumer products". (Source: *Industry Week*, 18 November 1996)

Embedded nanorods enable superconductor to carry more current

Charles M. Lieber, a professor of chemistry at Harvard University, and graduate student Peidong Yang have shown for the first time that magnesium oxide (MgO) nanorods incorporated into copper oxide superconductors create an ideal defect structure to boost high-temperature superconductors' current-carrying capacity. The nanorods enable the materials to remain superconducting while carrying larger currents at higher temperatures and magnetic fields than would be possible in the "pristine" materials.

Yang and Lieber grew MgO nanorods with an average diameter of 20 to 30 NM and lengths of more than 2 μm. These nanorods were then incorporated into thick films of $Bi_2Sr_2CaCu_2O_8$ (BSCCO), a superconductor being developed for use in power transmission cables. The resulting composites showed large increases in the critical current density—especially at higher fields and temperatures—compared with reference samples, according to Lieber. He attributes this effect to enhanced pinning by MgO defects.

MgO is a favoured doping material because it is largely unreactive under the conditions of superconductor synthesis and processing. And because of MgO's lattice structure, about half of the nanorods tend to organize themselves perpendicular to the superconductor's copper-oxygen planes, an orientation that maximizes pinning.

Now that Lieber has shown that "smaller is better", he hopes to get even more impressive results by using thinner nanorods (10 NM or less in diameter) and by increasing their density in the composite 10-fold. The size and density of defects achieved in this way would more closely approximate the nature of the defects achieved with ion radiation. (Extracted from *Chemical and Engineering News*, 30 September 1996)

Carbon nanotube ropes

Edging towards the ultimate nanowire or nanoprobe, a research team, led by chemistry and physics professor Richard E. Smalley of Rice University in Houston, has found an efficient way to create crystalline bundles or "ropes"of metallic, single-wall carbon nanotubes.

The higher quality, uniformity and electrical conductivity of these nanotubes, compared with earlier versions, demonstrates that they are moving closer to becoming practical materials for future nanotechnology.

Previously, Smalley's group reported they had used a laser to vapourize a graphite/metal composite rod inside a flow tube heated to 1,200° C in an oven. The metal, a 50/50 mixture of cobalt and nickel, catalyzed 50 to 60 per cent of the carbon to form single-wall nanotubes. These "buckytubes"grew and agglomerated in the gas phase and were deposited on a cooled surface in the form of a felt mat.

Smalley and co-workers have now optimized this synthetic method and have shown that it provides cleaner, higher quality nanotubes. To vapourize the graphite/metal target more uniformly, they use two different lasers that fire 50 nanoseconds apart. This produces 70 to 90 per cent yields of single-wall nanotubes that are highly uniform in diameter (13.8Å).

"The most remarkable thing about these nanotubes is that they are in the form of ropes", says Smalley. X-ray diffraction and electron microscopy show that the ropes contain 100 to 500 nanotubes packed "precisely like toothpicks in a box." These ropes extend for hundreds of micrometres.

Direct measurements of the electrical resistivity of a single rope gave a minimum value of 3.4×10^{-5} ohm-cm. This is not quite as good as copper, but it does indicate that these ropes are the most highly conductive carbon fibres known. (Extracted from *Chemical and Engineering News*, 29 July 1996)

Nanowires isolated in organic polymer matrix

Chemists at Cornell University have devised a minuscule mimic of the commonplace electrical cord. They have embedded nanometre-diameter inorganic wires in an insulating organic polymer matrix, creating an electrically conducting composite that could be another step towards practical nanoscale electrical or optical devices.

The new materials consist of lithium molybdenum selenide $(LiMo_3Se_3)_n$ dispersed in poly(vinylene carbonate). They were prepared by Cornell graduate student Josh H. Golden, who worked with the groups of both polymer chemist Jean M.J. Fréchet and of Francis J. DiSalvo, a solid-state chemist.

The metallopolymer $(LiMo_3Se_3)_n$ exists in the solid state as wires composed of lithium ions and long clusters of molybdenum selenide polyanions. In polar solvents, the lithium ions are highly solvated and the linear chains of polyanions separate from each other. The Cornell researchers capture that arrangement in their composite by dissolving the inorganic solid in vinylene carbonate, which they then rapidly polymerize in the presence of a cross-linking agent.

Single- and double-strand structures 6 to 20 Å in diameter and at least 50 to 100 mm long are formed in dilute solution. With more concentrated and viscous solutions, oriented multiwire "cables" 20 to 40 Å in diameter and up to 1,500 NM long are produced. The cables display both optical anisotropy and electrical conductivity, the researchers report.

The team obtained images of the composite materials using a technique called Z-contrast scanning transmission electron microscopy, where Z stands for atomic number. The imaging technique, carried out by physicist John Silcox, director of Cornell's Materials Science Center, clearly distinguishes the higher atomic number molybdenum selenide polyanions from the organic polymer matrix composed of lower atomic number atoms.

Noting that molybdenum selenide is "odd", Freshet says the Cornell researchers are now trying to establish how general their technique is. In addition to separating conducting wires, they are also applying the "site isolation" method to catalytic clusters. (Source: *Chemical and Engineering News*, 12 August 1996)

Thin films show laser potential

Over the past decade, scientists have shown that organic semiconducting polymers can replace inorganic materials as the active medium in a number of electronic and optoelectronic devices, such as light-emitting diodes. Now, three research groups have independently achieved another milestone, demonstrating that the same polymers, in the form of thin films, have potential as solid-state laser materials.

Benjamin J. Schwartz, a member of Alan J. Heeger's group at the University of California, Santa Barbara, reported introducing thin films of a dozen different conjugated polymers to emit light when stimulated by an optical laser. The emitted light showed some of the distinctive characteristics of laser light.

Physicist Richard H. Friend and co-workers at the Cavendish Laboratory of the University of Cambridge, England announced that poly (*p*-phenylenevinylene) (PPV), a well-known luminescent polymer, had been optically stimulated to emit light in a special device structure known as a microcavity. And a third group, led by physics professor Z. Valy Vardeny of the University of Utah, Salt Lake City, has shown similar stimulated emission of light using a PPV derivative.

To make a laser, the active material must emit light when stimulated, and the emission must be amplified so it exceeds the material's own light absorption. Previous researchers found clear evidence for stimulated emission from semiconducting polymers in solution or in dilute blends. But with neat films, they found absorption overwhelmed stimulated emission, leading to no net emission.

Absorption losses are thought to be due to interactions between the polymer chains. By changing the arrangement of the chains or attaching different side chains, the UCSB researchers were able to reduce those interactions, thus minimizing absorption losses.

The three groups made their polymers shine by "pumping" them with laser light. But to make a practical plastic laser, scientists will have to learn how to wring photons out of polymers by electrical stimulation. And it remains to be seen whether these materials can carry that much charge and perform well without degradation or other problems.

But some materials scientists think it is worth the effort, considering the big advantages of polymer-based lasers. Polymers allow the colour to be tuned easily and offer other capabilities that cannot be matched by conventional laser materials such as gallium arsenide, organic dyes, or gas mixtures. (Extracted from *Chemical & Engineering News*, 2 September 1996)

Lopsided modem boosts speed

Computers will soon be able to communicate across ordinary telephone lines more than 60 per cent faster than at present, thanks to new chips from Rockwell Semiconductor Systems of Newport Beach, CA. Rockwell already provides components for most of the world's modems.

Today's modems work at the same speed whether they are transmitting or receiving. The new technology uses a different "asymetrical" approach, in which chips in the consumer's modem will be able to receive data faster than they can send them. New chips will also be required for the "central site" modems commonly used by Internet service providers and large corporations.

When the upgraded central site modem recognizes that a consumer modem has the new chips, it will transmit information at up to 33,600 bits per second, which is as fast as some dedicated lines in the USA. Although they can receive at this speed, the consumer modems will only transmit at today's top speed of 36,000 bits per second. For browsing the World Wide Web or searching corporate data, however, the slower sending speed should not hold things up, because "surfers" spend most of their time receiving data and only send short requests for further information.

A far bigger drawback is that leased lines operate differently in Europe and the USA, so the new modems cannot get the extra speed on transatlantic links.

Products based on Rockwell's chips will be available from early 1997. (This first appeared in *New Scientist*, London, 19 October 1996, the weekly review of science and technology)

X-rays cut chips down to size

An X-ray lithography system from the Massachusetts Institute of Technology's Department of Electrical Engineering and Computer Science may help push back the limits of silicon chip technology. Not only should it allow the designers to build exceptionally small components of 25 nanometres—just a twentieth of the wavelength of green light—but is also much more flexible than conventional lithography, allowing chips to be customized more easily.

This flexibility arises because the system does away with conventional, fixed-pattern masks, which are the "stencils" that light passes through to etch patterns on the surface of the silicon wafer.

The system is designed to solve two of the most pressing problems in X-ray lithography—focusing the rays and making and maintaining a mask.

The X-rays are focused onto the silicon wafer through a computer-controlled array of hundreds of tiny mechanized windows. Each window has two components. The upper part is a lens to focus the X-rays, and the lower part is a micromechanical shutter to turn parts of the beam on and off during scanning.

The flat lens, known as a zone plate, is similar to a Fresnel lens. It is patterned with a series of transparent and opaque rings that focus the beam. By choosing the right X-ray source and designing the zone plates correctly, MIT's Henry Smith says that they should be able to focus the X-rays into a spot measuring just 25 nanometres across.

Each focused section of the beam will then be switched on or off by its own microshutter. The microshutters will be created using conventional lithography on a silicon wafer.

Each of the hundreds of windows in the array would be tens or hundreds of micrometres square. Given that the area to be etched is hundreds or thousands of times bigger than the focal spot on the silicon, the whole array must be scanned back and forth in order to fill in the entire area. Using existing X-ray sensitive materials, Smith calculates that a wafer could be written at a rate of 1 square centimetre per second.

This is no better than the rate at which wafers could be mass-produced optically 10 years ago, but the computer-controlled switches in the new system allow each new circuit to be different without the need for new masks, while the higher resolution of X-rays allows each square centimetre of chip to be much more complex.

The system eliminates the risk of damage to chips that comes with optical lithography, in which the mask must be held very close to the silicon. It also compares favourably with electron-beam lithography, which is at least ten times slower than the new system and has a lower resolution.

The only part of the MIT scheme that may require new technology stems from the proposed use of uranium to absorb X-rays in the zone plates. Gold rings on the zone plates would

only allow 10 per cent of the X-rays to be used for patterning. But spent uranium improves the efficiency to 31 per cent. The main disadvantage with uranium is that it spontaneously combusts in air, but Smith says that techniques for handling it have been developed in nuclear laboratories.

The quest to miniaturize silicon components makes X-ray lithography a hot topic. Other researchers are trying to design reflective lenses—based on the design of a lobster's eye—to focus the X-rays. (The first appeared in *New Scientist*, London, 19 October 1996, the weekly review of science and technology)

Counter-attack on counterfeiting

Rapid advances in new technology have made forgery easier than ever, and new security systems must keep pace to outwit the counterfeiter. Volodin *et al.* have developed a new system that uses a high-efficiency photorefractive polymer—a material whose refractive index can be modulated by light. Documents (such as credit cards) are first encoded with practically invisible "phase masks" (optical elements that encode information in the phase, rather than intensity, of the light). The photorefractive polymer then provides a means of "reading" the hidden information, and documents can be rapidly screened to verify their authenticity. (Source: *Nature*, Vol. 383, 5 September 1996)

Amorphous carbon proposed as interlayer dielectric

NEC researchers have proposed a new interlayer technology based on fluorinated amorphous carbon that provides a 50 per cent reduction in capacitance, while maintaining good process compatibility with current CMP-based multi-level metal processes. The amorphous carbon (a-C:F) layer, which has a dielectric constant of 2.3, is sandwiched between layers of HDPCVD SiO_2. Thin adhesion layers of silicon-rich SiO_2 and diamond-like carbon were used between the a-C:F and SiO_2 layers. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

New low temperature Al-Cu process demonstrated

A novel, low cost process capable of high quality aluminium via fill and metal layer planarization at temperatures around 400° C was recently developed by researchers at SEMATECH (Austin, Texas) and Varian Associates (Palo Alto, CA). The process, which uses low pressure Al-Cu sputtering combined with moderate heat applied to the wafers, has been successfully demonstrated on sub-half micron Al plugs of high aspect ratio (up to 4:1). Low via resistance (<1.2Ω for 0.35 μm vias), very high via chain yield (~100 per cent) and better via reliability were demonstrated at a wafer temperature of 380° C.

In a paper the researchers described how the use of low pressure sputtering enhanced direct aluminum deposition into the interconnect holes and reduced the amount of migrated Al atoms for complete hole fill and metal layer planarization. The low pressure deposition was a two-step process with high/low sputtering power in one process chamber. The typical deposition pressure and wafer temperature were 0.5 mTorr and 400° C, respectively. No collimator was used in the deposition. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Nitrogen profiling boosts gate dielectric performance

Researchers at Texas Instruments (TI) have come up with a way to improve the performance of ultra-thin gate dielectrics by doping them with nitrogen in such a way as to create a light nitridation at the bottom of the dielectric/silicon interface, and a relatively heavy nitridation at the top poly/dielectric interface. The light nitridation at the bottom provides improved reliability compared to other approaches to gate dielectric nitridation, while the nitrogen-rich top layer is more effective at suppressing boron diffusion.

The technique developed at TI to create this precise n-profile consists of nitriding a thermal oxide with a remote, high-density, helicon-based nitrogen discharge at room temperature for short durations of a few seconds. This is followed by a post-nitridation anneal. The researchers claim the advantages of such a process include:

- The use of (hydrogen-free) N_2.
- The ability to control the N concentration and its spatial distribution in ultra-thin dielectrics;
- Low thermal budget in comparison with other nitridation processes;
- Adapatibility/flexibility for integration with conventional oxide processing including cluster-tool processing; and
- Potential for scalability down to the 0.1 μm technology node.

With the new technique, the TI researchers were able to demonstrate high N concentrations (10-20 at. per cent) incorporated uniformly within ~0.7 NM of the oxide surface, little V_{fb}-shift and no significant variation in midgap-D (interface-trap density) from that of a control oxide, and suppression of boron penetration for high boron levels and for high thermal budgets, including a hydrogen ambient. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

New packaging concept: application specific material

Nitto Denko America Inc. (NDA) of San Jose, CA, has developed a new packaging concept called ASMAT (Application Specific Material) that employs a substrate with micro bumps for chip-scale packages (CSP). NDA said that traditional QFP-type (quad flat package) packages require a minimum chip size of at least 10 mm square and 1 mm thick, but chip-scale packages can be used up to 10 times more effectively.

A number of solutions to chip-size packages have been developed in the past. However, ultra-fine connection technology, large numbers of pins and chip surface protection remained troublesome issues, according to the company.

ASMAT uses a fine pattern processing technology for flexible circuits, a unique precision through-hole technology and a bump forming technology as a highly reliable substrate for CSPs.

Nitto Denko's ASMAT substrate features conductive metal layers coated with polyimide resin layers. The resin layers are themselves comprised of two layers, one a thermo-setting resin, the other a thermo-plastic resin. This allows surface protection to be carried out at the same time the connections are made in the chip mounting stage. (Reprinted with permission from *Semiconductor International Magazine*,

October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Large area image sensors developed

Researchers at the University of Surrey, UK, have developed an active matrix technology based on amorphous silicon that may lead to large area image sensors. The array is similar to an active matrix LCD working in reverse, according to Edward Morton, one of the developers of the technology. The array of display cells is replaced by photodiodes which drain the charge from the pixel capacitor. Although large area LDCs suffer from poor yields, the new type is far easier to produce.

If any pixel in a conventional LCD is defective or even dim, the display must be discarded. In the new sensor, any variation in the sensitivity of a pixel can be removed by post-processing. Morton said the technology is typically tolerant to 10 per cent of defective pixels, but the need to include the matrix transistor limits the minimum pixel dimension to 50 μm, thus setting the minimum size of the sensor for a given resolution.

The developers said the technology could be used in applications such as medical X-ray machines, where it could replace large sheets of photographic film. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Controlling oxide layers on $TiSi_2$

A very thin oxide layer typically forms on the surface of titanium silicide ($TiSi_2$) films after various wet and dry processes. Although some process engineers use this oxide as a convenient etch stop in subsequent etch contact processing, a new report from Hewlett-Packard and Colorado State University shows that it also poses risks to yield and reliability unless it is well controlled.

There are two challenges in trying to control this oxide: its thickness is difficult to measure with conventional single-wavelength ellipsometry and the composition of the oxide can vary depending on the type of process to which the silicide is exposed.

The challenge of measuring the oxide with single-wavelength ellipsometry is that the optical parameters of both the unknown top layer and the contiguous underlying silicide layer must be known, and they are usually not. The underlying silicide's optical properties are often unavailable, and the oxide grown on $TiSi_2$ is not a perfectly structured silicon dioxide, so optical values must be assumed. The HP/CSU researchers overcame this problem by using spectroscopic ellipsometry (SE), a technique most often seen in research environments. In a manufacturing environment, they suggest that the optical constants of the $TiSi_2$ film be pre-measured by the SE technique and assumed unchanged from run to run. Then one or two wafers per cassette can be monitored with conventional single-wavelength ellipsometry. The $TiSi_2$ constants should be checked every few weeks with SE to detect any changes in the $TiSi_2$ film properties.

An even greater problem is that different types of wet strips can lead to different types of oxide formation. In the HP/CSU study, researchers compared oxides left on $TiSi_2$ films after wet stripping using a H_2SO_4:H_2O_2:H_2O process versus those left using NH_4OH:H_2O_2:H_2O. They found that wafers processed in the H_2SO_4:H_2O_2:H_2O solutions had a "markedly higher" average standby current above the manufacturing specification limit.

Subsequent failure analysis revealed leakage between the gate and the source/drain on single transistors that employed this type of strip. The researchers believe that the H_2SO_4:H_2O_2:H_2O leaves leakage paths on the poly spacer caused by $TiSi_2$ "stringers". These stringers are bits of $TiSi_2$ that are left unstripped because the H_2SO_4:H_2O_2:H_2O forms a self-passivating oxide on the $TiSi_2$ during the strip process.

The solution? At the very least, strict control over this inadvertent oxide is crucial if contact resistance problems and current leakage issues are to be avoided. In the longer term, complete elimination of the oxide may be required. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA.)

Filler to improve thermal management

Responding to the need for packaging materials to handle heat more effectively, Dow Chemical Co. has developed a transfer moulding compound filter to replace fused silica. The silica coated aluminium nitride filler compound, called SCAN, has a greater thermal conductivity than fused silica and a comparable thermal expansion coefficient. Increasing the thermal conductivity of the moulding compound is expected to decrease junction-to-air (θ_{ja}) and junction-to-case (θ_{jc}) temperatures and therefore reduce device failures. SCAN-filled materials have a thermal conductivity two to seven times greater than those filled with fused silica, according to Dow.

Data taken from 208 lead plastic quad flat pack (PQFP) devices, moulded with an epoxy creol novolac compound at 3.4 W/mK compares θ_{jc} for devices using SCAN and fused silica, depicting a 40 per cent decrease with SCAN. The device using SCAN alone performs comparably with the device using fused silica and an exposed heat slug. Using SCAN may therefore eliminate or reduce the need for heat spreaders, reducing cost and complexity.

Reliability enhancements are also expected with SCAN. Eliminating the need for heat spreaders eliminates additional interfaces where delamination and cracking can occur. SCAN is not expected to add any thermal expansion problems. SCAN's adhesion properties may also enhance reliability. According to tests done by Toshiba Chemical, an epoxy moulding compound containing SCAN adhered to copper and palladium coated leadframes better than compounds containing silica fibres. Also, in reliability tests performed by Amkor Electronics Inc., 8-lead SOIC packages filled with SCAN achieved JEDEC level I reliability.

SCAN is expected to lower system costs. SCAN-filled compounds are similar to fused silica filled compounds in terms of formulation, glass transition temperature and flow length. Using it would require no special equipment and no reduction in the speed of the compounding process. Its thermal conductivity may allow reductions in catalyst use in thermosetting resins, reducing material cost. Also, cure times may decrease if there is no need for pre-heating, increasing throughput.

SCAN may provide a simple solution in overcoming device power limitations, improve reliability and reduce cost. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Lab-on-a-chip could simplify genetic testing

Researchers at the University of Michigan are one step closer to automating DNA screening and putting it on a chip. Currently, DNA analysis requires at least 10 individual procedures performed by highly skilled technicians in a complete molecular laboratory, and can take up to several days. Recently, however, the Michigan team moved small

DNA samples on a microchip through five separate processing steps, enough to handle DNA analysis.

The heart of the device is a thermo-capillary pump which uses surface tension, rather than valves or moving parts, to mix drops of pure DNA with an enzyme solution and drive it through five different components on the microchip. The DNA forms discrete drops with curved surfaces inside a series of narrow channels on the chip. It uses microscopic heaters built into the chip to heat just one side of a drop, reducing surface tension and increasing internal pressure on that side. Pressure differences push the drop through the channel in the direction of lower pressure.

Because the chip is fabricated with conventional photolithography and silicon micromachining techniques, researchers believe it should be inexpensive to produce in large quantities. Once perfected, its low cost should make possible single-use, disposable microchips. However, caution researchers, there are still significant technical problems to be solved that concern handling small samples and the interactions between the liquids and the chip. (Source: *Machine Design*, 26 September 1996)

Wiring technology developed using CuZi

A new wiring material and technology for 0.1 μm-class line width LSI fabrication has been developed by Oki Electric Industry. An alloy of copper and zirconium is used, providing a service life of 140 years or more, according to the company.

To provide LSI with higher speeds and integration levels, pattern lines must be thinner and denser than ever, and this raises a problem with durability. The key problem is electromigration, where the electron flow in the line causes the metal atoms to move, creating a fault and breaking the electrical connection. Atoms flow (diffuse) at sites like crystal boundaries and line surfaces, and if this flow can be restrained service life increases.

The crystal boundaries and line surfaces are covered with a material eluded from the wiring material to suppress diffusion, and the CuZi alloy is used as the wiring material. After the CuZi film is formed through sputtering, it is annealed at 400° C to provide a resistivity of only 1.9 $\mu\Omega$cm, which is significantly lower than the Al alloy commonly used in LSI today.

An estimate of wiring life for the conditions used in gigabit LSI show a service life about 35 times longer than pure Cu. ((Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Epitaxial growth leads to new CMOS FET

Oki Electric Industry has created a CMOS FET with a maximum drive line width in the 0.1 μm class, using the conventional single-gate structure and a small short channel effect.

When the gate length of the transistors is too short it causes the short channel effect, which makes it difficult to control the threshold voltage. This short channel effect can be controlled with the dual-gate structure, but this structure faces its own set of problems in increased process complexity.

Oki Electric formed a thin high-concentration boron doping layer in the nMOS FET and pMOS FET channel regions, and then epitaxially grew sequential dopant-free Si layers through a newly-developed two-layer epitaxial growth method. The new approach allows the threshold voltage to be controlled by the concentration and thickness of the boron doping layer, while the dopant-free Si layer offers little resistance to electron (nMOS FET) or hole (pMOS FET) mobility, making it possible to provide the MOS FET with high drive.

The pMOS FET uses only a thin epitaxial layer for hole motion, minimizing the short channel effect. The prototyped pMOS FET had about the same short channel effect as a dual-gate structure, but had a drive about 30 per cent higher. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL., USA)

Fijitsu develops ArF excimer resist

Fijitsu has developed a resist which can be exposed with ArF excimer laser light. A combination of the new resist with phase shift masks and annular illumination was used successfully in ArF excimer laser lithography to make a 0.12 μm line width. It was also successfully applied to a prototype memory cell with a 0.13 μm design rule and a cell area of 0.20 μm^2.

The wavelength of the ArF excimer laser is only 193 nm, making exposure of conventional polyvinyl phenol resin resists impossible. The cause of the problem was the absorption of the ArF light by the benzene rings in the phenol resin. The same benzene rings, however, are resistant to dry etching, and it was difficult to improve ArF transparency while maintaining resistance to dry etching.

Fujitsu resolved the problem with 2MAdMA-MLMA alicyclic resin. It has an adamantil base as a side chain, which provides dry etching resistance, and because it has no double bonds it is also easily penetrated by ArF excimer laser light. The new 2MAdMA-MLMA therefore combines both dry etching resistance with ArF excimer transparency.

MADMA-MLMA resist also has a high sensitivity of 4.7mJ/cm^2, and a 70 per cent transparency to ArF excimer light. Etching at 0.02 Torr for 5 minutes showed an etching rate of 1.2 for Ar polymer and 1.1 for CH_4 polymer, or essentially the same dry etching resistance as Novolak resin and i-line exposure.

The firm plans to license 2MAdMA-MLMA resist technology to multiple resist manufacturers. (Reprinted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL., USA)

Novel materials for data storage

New materials will enable tomorrow's compact disc to store data in stacks, like pages of a book, say researchers at New York's University of Buffalo (UB). Instead of storing data on surfaces, "these new materials could revolutionize data storage, because they allow data to be stored in the depth of a disc", says Paras N. Prasad, professor of chemistry, director of the UB Photonics Research Laboratory, and principal investigator. Novel dyes developed at UB are the key. Exhibiting strong two-photon absorption, as well as strong fluorescence emission, the dyes are blended with transparent plastics to form the storage medium. Data are stored by focusing a laser to alter the properties of the material. In a demonstration at a meeting of the American Chemical Society, Prasad showed a confocal microscope probing deep into the material to "read" (play back) a Bugs Bunny cartoon. Several seconds of the cartoon were stored in a cubic volume, each side of which was the thickness of a human hair. (Source: *Industry Week*, 7 October 1996)

Showing images in 3-D

In a piece of clear glass the size of a sugar cube, Stanford University graduate student Elizabeth Downing demonstrates a new way to the 3-D display of the future—without glasses, holograms, or virtual-reality gear. Instead, she has combined the cube with lasers, scanners and other equipment to produce 3-D images by creating actual three-dimensional colour images inside a solid cube of fluorescent glass. The emissive, transparent images are produced by infrared lasers crossing in a matrix doped with rare earths. In product development, engineers could use it to view solid models *as solid models*. Air-traffic controllers might use it to track aircraft positions in three dimensions. And physicians could use the technology to depict 3-D data from such medical procedures as MRI, CAT scan and ultrasound. In all those applications, there are few restrictions on the viewing angle and a number of people can view the image together. (Source: *Industry Week*, 7 October 1996)

D. MARKET TRENDS AND COMPANY NEWS

Market Trends

Digital signal processing comes of age

Within the past few years, various semiconductor devices and software tools have conjoined to make digital signal processing not just cost-effective for commercial and consumer applications, but so attractive as to have inspired a hundred new uses.

Today, digital signal processor (DSP) chips are central to products ranging from cellular phones, modems, and personal digital assistants to disk drives and security and identification systems. The devices even show up in automotive systems, like active suspensions and noise cancellers.

So rapidly have these applications grown, some might assume that their key enabler—the single-chip digital signal processor—was invented only yesterday. In fact, it has been around for almost 15 years. For most of that time, however, a lack of software support and a marginal price/performance ratio limited its acceptance. Even today many potential users are loath to embrace the technology because of its "difficult" reputation.

While that reputation may have been deserved in the past, recent developments have changed the picture substantially. Advances have been made both in the devices themselves (including their prices) and in the software tools that support them. Thanks to these advances, the DSP market is currently growing at three times the rate of the rest of the semiconductor industry.

The advent of single-chip DSPs in macrocell form and very dense, cell-based semicustom ICs has changed the role of application-specific devices. These developments have allowed Texas Instruments Inc., Dallas, for example, to create dozens of unique devices for its customers without giving up the cost-effectiveness of a highly targeted application-specific IC or the flexibility of a programmable DSP. More recently, the capability to create customized DSP chips by embedding a DSP core in an ASIC has been made available to customers by companies like TI and DSP Group, Santa Clara, CA.

Although the main factor behind the broad and growing acceptance of one-chip DSPs has been the price-performance ratios of the chips themselves, they could hardly have succeeded without a variety of software development tools, which are available from many vendors. As both the chips and the problems they address have become more complex, those tools have advanced from simple assembler-linker combinations to compilers for high-level languages and other increasingly sophisticated aids. In fact, some of today's tools can complete several design tasks concurrently—even before a target system exists. The software tools in question fall into two main categories: code-generation tools, and tools for system integration and debugging. In the early days, the only way to program a DSP was in assembly language, which was converted into executable code by an assembler-linker.

More recently, as compilers have improved and applications have become more complex, the code-quality gap has narrowed appreciably, and high-level languages are much more widely used. The main benefits of those languages are increased productivity—in both writing the code and maintaining it—and the ability to run code on various platforms.

While code-generation tools have eased programming by making the complex inner workings of DSPs transparent to the user, other tools have simplified the task of integrating hardware and software in new designs; and still others help in pin-pointing problems in the software-hardware interface. Improvements in three areas—software simulators, hardware emulators, and system evaluation tools—have streamlined the simultaneous development of hardware and software, thus shortening development time overall.

Software simulators are programs that mimic the behaviour of a DSP in executing code. They run on a host computer, such as a PC or workstation, and allow software engineers to verify program operation before the actual system hardware is available for use as a test bed.

These tools make use of specific I/O files to simulate the way the software interacts with I/O ports. Engineers can customize these files to improve the accuracy of the hardware port emulation. Software simulators also have internal clock counters that designers can use to verify the operation of time-critical code.

Widely useful today, DSP will become even more so as it continues to evolve. Performance will climb, prices will fall, and design will become even smoother, so that DSPs will become the driver for many new high-volume applications. Within those general trends, several more specific currents may be discerned.

First, realizing that many future applications will need the power of multiple processing elements operating in parallel, DSP chip makers are developing extremely complex, high-performance devices containing upwards of four million transistors. These systems-on-a-chip will actually integrate multiple *user-customizable* processing elements on a single piece of silicon.

Second, software tools in general, and compilers in particular, will improve to the point where high-level languages will yield tighter code than handcrafted programs. At the same time, true object-oriented design techniques, with all their associated benefits, will become feasible.

Third, development environments will get friendlier as they acquire the ability to visualize systems at whatever level the designer desires—from transistor to chip, board, subsystem, and even system level.

Finally, heterogeneous systems—those that can accommodate processors of different types—will become more practical. Standardized parallel operating systems will ease the development tasks associated with such complex systems. (Source: *IEEE Spectrum*, May 1996)

Cable modems touted as fast alternative to phone modems

US market researcher Forrester Research estimates that by 2000, there will be almost seven million cable modem users in the USA compared with about 6.7 million ISDN users. By 2000, the value of the cable modem market should be worth about $1.33 billion compared with $503 million in 1998.

The size of the market is attracting some major companies including Motorola, Hewlett-Packard, Zenith Data Systems, Intel, Hybrid Networks and Com21. There are already several major pilot programs in the USA, testing out

cable modem networks. The most significant trial is being conducted by @Home Networks which is backed by several major TV cable companies.

@Home realizes that simply connecting a cable modem to a cable TV network with Internet access will not solve the band-width problem. In addition, only about 20 per cent of US cable TV networks are capable of being converted to two way transmissions, essential for cable modem users. Fortunately for @Home, cable TV companies have to upgrade their networks anyway, to offer more cable TV channels if they hope to compete with the direct satellite TV companies. This means that they can more easily be adapted for Internet content delivery.

The cable modems themselves are not as straightforward as analogue telephone line modems. They are essentially small computers with micro-processors, memory systems and an operating system and can cost several thousand dollars each. The goal is that manufacturing economies of scale will drive their cost down below the crucial $500 mark.

Cable modems also suffer from interference from line noise caused by electrical devices within the home or business, and line noise picked up along the cable TV network. This line noise can drastically affect performance and the cable modem will stop functioning if line noise gets too bad. This problem especially affects the upstream communications channel and so some companies are working on cable modems that combine an analogue phone modem to handle the upstream communications path. (Extracted from: *Electronics Weekly*, 23 October 1996)

ERP vendors join rush to the Internet

As a rule, manufacturing companies are a conservative lot. Concerned about data security and issues related to the speed and reliability of transmissions, most are not yet ready to plunge into full-blown electronic commerce over the Internet, but vendors in the enterprise resource-planning (ERP) software field seem convinced it is merely a short-term obstacle.

"By the year 2000", asserts Michael G. Ker, president and CEO of Enterprise Planning Systems, a Kanata, Ontario, firm that offers an advanced simulation and "collaborative planning" package, "all software will be Internet-enabled, Intranet-enabled and Web-based. Everyone will be taking advantage of this lower-cost, better medium of communication called the Internet. It will become a standard. It will be expected, just like a Windows interface is expected today on software".

In the short term, companies are more likely to deploy limited Internet/ERP linkages—for example, to expand their marketing reach or facilitate planning and scheduling. One of the newer wrinkles in the scheduling arena is "order promising".

The approach: A user connects to a Web page, then clicks on order entry, then order configuration, and requests a shipment date—and receives an "instant" reply as to whether the order can be fulfilled by the requested date.

More likely, the analysis of the factory's ability to produce and ship an order by a given date would occur in response to a query from a dealer or a salesman in the field, but ultimately, the customer could bypass sales.

While the OptiMax product is designed to supplement ERP systems, some vendors of broad-based packages are talking about offering sophisticated Internet-compatible scheduling systems as integral parts of their ERP software.

The marriage of ERP with Internet capability represents "another paradigm shift, a rethinking of how we want to do business", observes a spokesman of a company that is one of the pioneers of finite-capacity scheduling systems. "It will enable small to medium-size organizations to now participate in global markets—by making their product information available on the Web, enabling customers to place order, and then follow up on those orders".

The potential is enormous considering the statistical projections for global access to the Internet. In 1995 some 40 million people worldwide were connected. By the year 2000 there will be 700 million people surfing the Web.

That "universal and pervasive" connectivity—coupled with shrinkage of the time that people spend shopping (in the USA it has dropped from 12 hours to just three hours a week)—suggests some serious implications, especially for makers of consumer goods. Technology strategists in such businesses, Clayton R. Parnell (manager with Kurt Salmon Associates) emphasizes, face the challenge of designing IT systems that can handle rapid change through faster application development, and they will have to rethink their business processes, so they will mesh with the way consumers will be using information systems.

Certainly, the ERP vendors have been doing a lot of rethinking—and now they are eagerly describing their visions of the future.

Ker also predicts that eventually Internet browsers—the front-end software—"will probably be doing encryptions automatically" to prevent data from being intercepted by unauthorized people. And to facilitate global commerce, browsers "will do translations automatically for currency, for language, and for units of measure". (Extracted from *Industry Week*, 18 November 1996)

Explosive growth of sci/tech on the Web

In 1996, the big development in sci/tech information has been Web-based access. US federal government information began a wholesale migration to the Web in 1995. Although they were early Web developers, universities have not lived up to earlier promises of adding content due to a lack of economically feasible conversion methodologies and roadblocks created by antiquated copyright laws. Leading universities are focusing on the development of Internet technologies, while companies like Netscape and IBM have a vested interest in the growth of digital information. There are currently a surfeit of sci-tech databases and full-text journals available through the Web. In 1995, database producers and providers began to provide Web interfaces to bibliographic databases and this has increased during 1996.

While traditional journal publishing will probably not migrate to the Web, the Internet is ideal for the rapid communication that marks the scientific frontier. It is expected that traditional sci/tech literature will exist to formalize discovery rather than communicate it. Technical information may be driven onto the Web because of the inherent multidimensionality of the medium. In the patent field, Derwent has reinforced its position as the high quality provider of patent information by increasing coverage of the Japanese (Kokai) patent applications to 100 per cent. Derwent Patent Status File and LitAlert databases offer increased timeliness and coverage, while Questel Orbit offers full-text coverage of the US patent literature on the Web. To summarize 1996 developments, databanks, database producers and publishers are rushing to embrace the Web. The emphasis is placed on the provision of additional access options for existing databases being exceeded by the creation of new files. This trend indicates a maturing information industry. Intelligent players are now examining what unique services they bring to the marketplace to build on their strengths. (Source: *Database*, 19(6) December 1996)

The impact of the Web on the information business

Pressure points in the on-line business may arise where none were felt before. In a very real sense the traditional database services have seen a marked erosion in the quality and value of the products they sell over the last few years. Prices for their services have escalated sharply while the quality of those products continue to plummet.

The fact is that every day more and more database customers, end users and professional searchers become accustomed to Web sources and Web prices. Also, every day more publishers and research centres and other professional organizations open and enhance their Web sites. As this phenomenon continues to grow, Web users become accustomed to the rich, integrated hyperlinks, the attractive desktop publishing quality of output and free or low prices. In comparison, the prices and products put out by the traditional database industry seem to worsen.

One example is Web based newspaper sites that have begun offering archive services. This wonderful Internet world of free news with articles filled with pictures and audio clips, all accompanied by links to past articles and other key Web sites, has given the Web versions of newspapers a keen advantage over print versions. However, for a professional searcher who had found a dozen or more articles, LEXIS-NEXIS' policy of charging once for a search statement but then allowing low prices for on-line downloading of any number of full text articles could be the better deal. (Source: *Information Today*, November 1996)

Beating the information budget

Demand for new IT services within a company can be erratic, driven by market changes, internal restructuring or rapid changes in technology. The IT budget, however, is often fixed, creating a problem if projects are to be implemented. Innovative approaches to financing become necessary.

A company does not have to own the equipment it uses, for example. Although at present 76 per cent of companies buy their hardware, software and networking products, according to Benchmark Research, 61 per cent would consider leasing in the future. Rapid innovation and ever shorter lifecycles mean that outright ownership of PC networks, in particular, is less attractive than formerly. According to the Gartner Group, buying a PC network may cost up to 10 per cent more than leasing. Not only can a company reduce its costs by embracing leasing, it can also gain greater control over its investment by agreeing in advance exactly how much will be paid, when and how.

Financing is an integral part of many outsourcing deals. The prospect of gaining lucrative, long-term revenue streams has prompted some suppliers to offer highly advantageous terms. Sema Group, for example, waived its normal requirement for a large, upfront payment in order to secure a £100 million contract to supply submarine command and control systems to the UK Ministry of Defence.

The finance market comprises a few large players with the resources to fund additional services, and a number of smaller, niche companies. To date, however, merchant banks have tended not to involve themselves in computer projects. The exceptions, such as Kleinwort Benson, have been encouraged to do so through partnerships with IT suppliers. (Source: *Information Strategy*, 1(1) October 1996)

World chip market growth

After a turbulent 1996 that saw sales decline by 10.5 per cent, the global semiconductor market should grow 7.4 per cent in 1997 to $138.8 billion, then return to strong double-digit growth in 1998 and 1999, according to the Semiconductor Industry Association.

According to the multi-year forecast prepared by the World Semiconductor Trade Statistics (WSTS), global chip sales will increase in 1998 by 17.1 per cent to $162.6 billion, and climb 21.6 per cent in 1999 to $197.6 billion. Just two years ago (1994), the global chip market was only at $101.8 billion. In 1990, the world market was $50.5 billion.

These growth rates overshadow the downturn the industry witnessed during 1996.

Long-term prospects for the chip industry are still excellent because the world has a ravenous appetite for the electronic equipment that relies on semiconductors. Over time, chips will become even more critical parts of the world economy than they are today.

In 1997, the WSTS predicts that total sales revenue for DRAMs will decline an additional 13.9 per cent to $21.1 billion. The downward trend will reverse course in 1998 and 1999, when DRAM sales are expected to increase by 29.1 per cent and 41.2 per cent, respectively. The WSTS forecasts DRAM sales of $27.3 billion in 1998 and $38.6 billion in 1999. (Extracted with permission from *Semiconductor International Magazine*, December 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Memory for 1997

Memory for PCs will start to be dominated by synchronous DRAM rather than the EDO devices used today. Graphics systems will also make more use of SDRAM's graphics counterpart, SGRAM.

Forecasts for prices and growth vary considerably, but even the best prediction shows a flat year for memory sales.

The year 1997 will also see the start of volume production of 64 Mbit DRAM chips, mainly for the workstation market, while the fourth quarter could even bring 256 Mbit devices. 1997 could also see the first SyncLink devices, the challenger to Rambus for the PC main memory aimed at the decade's end. SRAM will continue to be produced because of its overall speed advantages. (Source: *Electronics Weekly*, 11 December 1996)

Displays for 1997

CRTs are not going to die for awhile yet. LCDs bigger than 300 mm will become cheaper as factories install equipment to handle bigger glass. Reflective LCDs will appear in laptop PCs for the first time.

Light emitting polymer displays will also be in production in some form or other. Field emission displays based on micro-tips rather than diamond film can be expected in products next year. Texas Instruments' micro-mirror plans took a blow when Nokia pulled out of TV, but the device is emerging in several commercial systems. (Source: *Electronics Weekly*, 11 December 1996)

Embedded for 1997

Systems-on-a-chip will grow as semiconductor companies enter more specialized markets. This has become evident with GSM handsets and is now being seen with set-top boxes, although single-chip digital ICs for set-top boxes will be in 1998 rather than 1997.

Engineers will increasingly go to ASIC vendors for custom chips, choosing from the growing number of licensed CPU cores and functional blocks (the intellectual property) owned by ASIC houses. Software transportability, driven by the universal use of C, will make the processor choice less an

issue of legacy, rather one of cost. ASICs and microcontrollers with more on-chip flash and even DRAM can also be expected. (Source: *Electronics Weekly*, 11 December 1996)

Increase in equipment revenues for first half of 1996

World-wide semiconductor capital equipment revenues totalled $14.4 billion for the first six months of 1996, a 33 per cent increase over the same period last year when world-wide sales reached $10.9 billion, SEMI reported. Expectations and early trend indicators show a slower rate for semiconductor capital equipment shipments for the second half of 1996, which is still expected to result in an estimated overall annual sales growth of approximately 20 per cent worldwide.

According to data compiled by SEMI's Executive Market Data Service, orders for new equipment during the first six months of 1996 totaled $14.8 billion, a 14 per cent increase over the first half of 1995. Nearly 20 per cent of these new orders were placed for semiconductor fabrication facilities in Taiwan and the ROW region. About one-fourth of the orders placed came from the North American market, while the European and Korean markets each accounted for about one-eighth of equipment orders placed, and the Japanese market took the remaining 30 per cent. (Extracted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Chip card market to quadruple in five years

As consumers try to simplify their lives with one card to handle their banking and shopping needs, the world-wide chip card market is expected to thrive with shipments growing from 774 million units in 1996 to 3.4 billion units by 2001, according to Dataquest, a San Jose-based market research firm. The top-selling region for chip cards is Europe, which accounted for 90 per cent of chip card sales in 1995. Dataquest analysts expect other regions to offer more of these cards this year.

"Although some standards issues, infrastructure issues and software issues remain to be resolved, chip cards hold the promise of being one of the world's highest-volume markets for semiconductors", said Jonathan Cassell, industry analyst in Dataquest's Semiconductor Application Markets Worldwide programme. "They can perform the duties of pocket change, paper money, and debit and credit cards, acting as a means of identification, access or payment. Thus, chip cards insert semiconductor technologies into areas where they have never been before, providing a new frontier of growth for IC makers".

The market is currently dominated by low-cost EEPROM and EPROM-based memory cards, but the fastest-growing area is in microcontroller-equipped smart cards. The smart card market reached 84 million units in 1995, and it is forecast to reach 1.2 billion units in 2001.

A chip card is a flat, plastic card, the size of a credit card, that has one or more integrated circuits on board. A smart card is a chip card that has a microprocessor or microcontroller on board. Memory cards do not have a microprocessor or microcontroller but may include other types of logic on board, such as security or cryptography functions. (Extracted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Consumer spending on durable goods will stabilize microcontroller market

World-wide sales of microcontrollers have been extremely robust over the past two years reflecting the strong demand in consumer products and household appliances. However, sales have declined steeply in the last six months, despite the omnipresence of microcontrollers in appliances, automobiles and consumer electronics. The outlook for the microcontroller market remains very good, with housing starts advancing at a record pace and consumer spending on durable goods moving at a healthy level.

Annualized growth rates peaked in August 1995, with a 34.2 per cent growth rate totaling $10.1 billion. Unit sales and average sales prices peaked as well. However, current sales have tapered off. Year-to-date sales grew by 6.5 per cent in the first eight months of 1996 and average sales prices declined by 3.8 per cent while unit sales grew by 10.7 per cent. Sales of microcontrollers are expected to grow to $11.5 billion at year-end 1996, representing a 7.2 per cent annual increase. Most of the growth is expected to occur in the 16-bit microcontroller segment. A whole host of products will utilize these chips (i.e. digital versatile disk players, digital cameras, video games, and advanced "smart" household appliances). $12.9 billion sales growth is anticipated by the close of 1997, reflecting a 12 per cent annual growth rate. (Extracted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Users interested in open CNCs

PC-based open CNCs (computer numerical control) will change the market structure of that control-industry segment, says Automation Research Corp., Dedham, MA. To support that conclusion from its recent market study, it cites the strong open-systems interest among end users attending the 1996 International Manufacturing Technology Show. It says that new concepts such as agile manufacturing, FMS, and flexible plant-information systems are driving the need for PC-based open CNC. It says that the technological advances in PCs, coupled with declining hardware prices, are forcing suppliers to consider the move to open systems via PCs and Windows. (Source: *Industry Week*, 4 November 1996)

SIA chip sales prediction

The US Semiconductor Industry Association (SIA) predicts that chip sales will grow by 7.4 per cent in 1997 and resume double digit growth rates in 1998.

The SIA says that 1996 sales will be about 10.5 per cent below 1995, when the market grew by 42 per cent. The upturn in sales should manifest itself before the end of 1996 and should last well into 1999.

Chip sales are predicted to reach $139 billion in 1997 and increase by 17.1 per cent in 1998 to $163 billion. Chip sales will be helped by growth in PC sales. US market research firm Dataquest says that the PC market will grow by almost 20 per cent in 1996, but market research firm Context says that European PC growth will not be as robust and it predicts growth of about 11 per cent. (Source: *Electronics Weekly*, 6 November 1996)

Dataquest revised chip forecast

Dataquest, the US market research firm, claims the world-wide chip market will be much smaller this year, revising its earlier forecast downwards.

Instead of expecting growth of 7.6 per cent in 1996 compared with 37 per cent growth last year, Dataquest now says the market will shrink by 9 per cent.

In spite of the downturn being much worse than expected, the firm believes there are encouraging signs that the market may get better. (Source: *Electronics Weekly*, 23 October 1996)

Five years for FRAM

It will be another five years before ferroelectric RAM (FRAM) will be cost-competitive with SRAM, according to Dr. Tsugio Makimoto, executive managing director of Hitachi.

He reckoned that FRAM would achieve twice the device density of SRAM (half that of DRAM and flash) and would have 150 ns rewrite speed compared to 50 ns for DRAM, 5 ns for the fastest SRAMs, 10 ms for E^2PROM and 10 μm for the fastest flash.

Makimoto also said that the read/write cycle endurance of FRAM would be in the 10^{10} to 10^{13} region compared to the 10^5 to 10^6 endurance of E^2PROM to 10^{13} flash.

Hitachi has just completed development of a 256 kbit FRAM, said Makimoto. The first applications for FRAMs would be in organizers and in wireless IC cards because of the technology's very low power characteristics. (Source: *Electronics Weekly*, 23 October 1996)

Technology falls short in attracting investors

High technology is failing to attract investment into UK small businesses, according to a Bank of England report.

An investigation into the financing of technology-based companies found that despite the UK venture capital industry being the most developed in Europe, only 23 per cent of total investments are made in technology-based firms. In the USA, 65 per cent of all venture capital goes into the technology sector.

Only 6 per cent of loans made under the DTI's Small Firms Loan Guarantee Scheme go to technology-based firms.

The Bank found that there are three main barriers to the financing of small high technology firms—finance providers' lack of familiarity with the technologies concerned; the high costs of monitoring relative to the size of the investment involved; and the lack of management, particularly financial management expertise, in early-stage technology firms.

The Bank recommended that banks should be encouraged to develop packaged finance for technology-based firms and the enhancement of management skills of technology entrepreneurs. (Source: *Electronics Weekly*, 30 October 1996)

US venture capital investment surges

While high technology companies recently experienced turbulence on Wall Street, they led 1996 second quarter venture capital investments across the USA to a two-year high and put activity on a pace to far exceed 1995 levels, according to a Price Waterhouse LLP National Venture Capital Survey.

Furthering a two-year trend, high-technology companies—particularly those in software and information communications industries—again were the favoured venture capital investor target, accounting for more than two-thirds of all companies receiving venture backing and for nearly 60 per cent of all dollars invested.

Silicon Valley far outdistanced all other US regions, with 160 companies receiving funds 28 per cent of all companies nationwide. (Extracted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Worldwide equipment market continues to grow

The worldwide equipment market continues to grow despite recent announcements of fab facility cancellations, curtailment of capital spending plans and layoffs. The slowdown in the semiconductor market has many chip manufacturers reassessing their capital equipment plans. Semiconductor equipment manufacturers, particularly in North America, have had to cut production in the face of slowing orders. However, some industry executives argue that reducing capital spending for new equipment will leave domestic chip makers at a competitive disadvantage. Growth in sales will continue to be very good in some overseas markets. Worldwide sales could continue to grow albeit at a slower pace.

According to data from the Semiconductor Equipment and Materials International (SEMI), worldwide sales of all types of semiconductor equipment totalled $27.1 billion in May 1996. This represents an amazing 35 per cent year-to-date growth in sales. The growth in sales is exceedingly vigorous but it is below the stratospheric growth rates at the close of 1995.

However, semiconductor equipment sales by North American manufacturers have slowed markedly. (Extracted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Consumer semiconductor market

Semiconductor manufacturers are reaping the benefits as the world-wide consumer electronics semiconductor market continues to grow, reaching $24.6 billion in 1995, according to Dataquest, a San Jose-based market research firm. Toshiba was the top vendor in 1995 with revenue of nearly $3.3 billion.

Dataquest analysts attribute Toshiba's success to its substantial line of ICs targeted at the consumer market. Dataquest expects other vendors to pursue aggressive marketing efforts into this market in 1996.

Reflecting the fact that the Japanese and Asian regions are the world's largest for consumer electronics equipment production, Japan-based companies dominate the list of top-ranking semiconductor suppliers in this area. Four of the top five suppliers of semiconductors for consumer electronics applications are Japanese companies. (Extracted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Scanners for everyone

Scanners are evolving rapidly from a niche product to an essential, affordable peripheral. An entry-level flatbed—24-bit, 300-by 600-dots per inch colour unit—will cost US$ 250 by the middle of 1997, down from US$ 600 two years ago. Some companies are developing a colour keyboard scanner which should be available in 1997. Scanners are also being bundled with more software such as OCR application; image editing; e-mail; and fax. There are also improved components such as faster PC hardware, software integration, and next-generation I/O buses such as the Universal Serial Bus (USB) and FireWire. Generally, entry-level flatbeds and sheetfeeds are supplied in 24-bit configuration with a 300- or 600-dpi resolution. A 24-bit colour scanner can sample eight bits per pixel for three major colour channels for a total

of 16.7 million colours. Scanners using professional desktop publishing are also becoming more powerful and more affordable with prices ranging from US$ 1,000 to more than $5,000. The Taiwanese are the market leaders with a 64 per cent market share.

Other factors such as cheaper components, different lamp sources, and new PC connections are reducing the cost of scanners. More importantly, the price of the charge-coupled device (CCD)—the light sensing element that determines optical resolution is also falling. Scanners aimed at graphics professionals with colour CCDs with 600- and 800-dpi remain high and they are not expected to drop. The most critical scanning factor is memory, and falling prices here are good news for scanner makers. Many image editing packages require a system's memory to be three to five times the total file size. Another factor that is pushing scanners into the mainstream is that they are becoming much easier to use. Many Taiwanese companies are trying to move in the direction of Visioneer whose keyboard scanner software supports OCR, image enhancement, business card scanning, copying, e-mail, fax, and a link to the Internet via Netscape's Navigator. The paperless office is not going to become a reality in the near future, so scanners help bridge the gap between the hard image and the digital world and are becoming essential office components. (Source: *Byte 40*, December 1996)

Backup tapes

The tape backup industry has changed dramatically in the last two years, with the major players consolidating and re-grouping. Hewlett-Packard (HP) bought Colorado Memory Systems, while Seagate purchased Palindrome. Amongst all the changes, however, some associations remained. HP continued to be primarily associated with 4 mm DAT, and Exabyte remained the brand leader as regards 8 mm cartridge backup.

Exabyte was one of the early players in the market for mid-range systems. Their products were based on Sony's Hi-8 video camera mechanism, and the early drives were adapted from those used in the consumer video market. DAT also represents an adaptation from the consumer market—but using a smaller, 1.5 x 2 inch cartridge of 4 mm tape—which first appeared in 1988.

In 1991, the original Digital Data Storage (DDS) standard for DAT was extended to allow for data compression, and tapes of 90 metres were employed. The new format (DDS-DC) increased the total capacity per cassette to 2 Gb, or twice that if compression is used. The standard was extended again in 1993 (DDS-2) and yet again in the form of the latest version, DDS-3, which offers 12 Gb per cassette.

Digital linear tape (DLT) has also seen rapid growth in the past eighteen months. This represents a return to the original, simpler, non-rotating head design of tape device. It is claimed that stationary heads help increase the longevity of both the tape and the device. Using 2:1 compression, a conventional DLT device can transfer data at up to 5 Mbps. DLT products also score well as regards capacity: Quantum's DLT7000, for example, has a capacity of 35 Gb on a cartridge holding 1,800 feet of tape. (Source: *MicroScope*, (15(44) 6 November 1996)

Company News

WAN gear (carrier services)

Standard communications links are no longer deemed sufficient by many users, who want to match services to the specific application. Service providers are responding by offering frame relay, ISDN and ATM. New products and services are appearing which promise to reduce costs.

RFC (Request for Comment) 1490 gives net managers a means of moving legacy traffic from leased lines to less expensive frame connections. Motorola Information Systems and Netlink are offering FRADs (frame relay access devices) which transport various legacy protocols via frame relay.

So-called central office FRADs are multiport units encapsulating frames at the central site, eliminating the need to deploy FRADs at each branch office. Integrated access device (IAD) suppliers such as Premisys Communications and Verilink are selling slot-in frame relay modules.

Growth in frame relay is likely to stimulate demand for ATM. Several manufacturers have introduced ATM concentrators which can aggregate voice, data and video connections within a single ATM link. ATM switches are also being fitted with modules for a variety of WAN links. The B-STDX 8000 and 9000 from Cascade Communications, for example, can be configured to accept ATM, frame relay, ISDN and SMDS (switched multi-megabit data service).

ISDN is also gaining in popularity, providing remote LAN access, teleworking and LAN interconnect services (when usage is for fewer than six hours a day). Nearly every router supplier now offers ISDN BRI (basic rate interface) connections on its branch office units.

Separate sections cover topics including backbone packet and cell switches, ATM concentrators and converters, broadband signalling software, X.25 equipment, integrated WAN access, CSU/DSUs, multiplexers, data compression devices and satellite equipment. (Source: *Data Communications*, 21 August 1996)

Microsoft Windows NT decision trips up MIPS

Microsoft says it has stopped developing future versions of the Windows NT operating system for the MIPS microprocessor following NEC's decision to phase out MIPS-based workstations, focusing on Pentium Pro workstations instead.

The move spells the end of MIPS' challenge to workstations running Windows NT instead of Unix and cedes the market to Pentium Pro, Digital Equipment's Alpha and PowerPC based workstations. The Windows NT market is the fastest growing segment of the workstation market and has resulted in new NT based workstations from Hewlett-Packard and Digital, plus forthcoming models from Compaq Computer.

Microsoft said its decision was based on "decreasing demand for MIPS-based systems from its customers and original equipment manufacturers (OEMs)."

The move should not harm Silicon Graphics MIPS architecture which has two large volume customers, Sony and Nintendo, using it in video game consoles.

Five years ago, MIPS was considered a strong competitor to Intel architecture microprocessors and a consortium of computer companies pledged to develop a wide range of computer models and software. The consortium fell apart after failing to agree on basic standards for the MIPS machines. (Source: *Electronics Week*, 23 October 1996)

Microelectronics research house spawns successful spin-offs

Imitation being the sincerest form of flattery, IMEC should be feeling pretty pleased with itself as the Singaporeans, the Thais, the Malaysians and the British each try to set up IMEC clones.

IMEC (which stands for Inter-University Microelectronics Centre) is the most successful independent micro-

electronics research house in Europe and one of the largest in the world with 630 people and a research budget of $70 million a year.

But as well as attracting imitators, Belgium's IMEC can take satisfaction from another measure of success in the microelectronics business—its increasingly large number of spin-offs. Institutions which create good technology tend to spawn entrepreneurial start-up companies setting out to commercialize new ideas.

IMEC has spawned one start-up a year in its 12-year existence and spin-off activity is snowballing.

A catalytic new factor for IMEC is that the US venture capitalists—the smartest and most aggressive high-tech VCs in the world—are starting to take an interest in IMEC's talented fledglings.

Among the most successful of IMEC's technological brood are Easics, a VHDL design house and Destin, developers of a reliability test technique based on ageing kinetics to test for the lifetime reliability of components.

The most recent are the class of 1996—Sirius, Madgic, C-Cam, Co-Ware and Target.

Past successes among IMEC alumni have been Alphabit—which developed software for simulating microwave circuits—now part of Hewlett-Packard; UCB Electronics—which developed a special photo-resist—now part of the Japanese company JSR Electronics; and EDC—which developed a top-down system for DSP design in a joint venture with Mentor Graphics; and CoBrain—developer of dry etch equipment in a joint venture with Matrix of the USA.

Despite the spin-offs, IMEC still has plenty of ideas left fermenting in-house.

Another of IMEC's interests is non-volatile memories. Dr. Herman Maes said they had developed a demonstrator 64 kbit—4 sq.mm—flash memory chip. IMEC's flash technology uses a split gate cell and is suited for embedded, though not for standalone, flash memory chips.

Also being pursued are multi-level storage technology, ferroelectric memories and micromachining. (Extracted from *Electronics Weekly*, 27 November 1996)

DuPont in outsourcing pact

After studying and rejecting a plan to outsource part of its information technology (IT) operations, DuPont announced it will award one of the biggest IT outsourcing contracts ever to Computer Sciences Corp. (CSC) and Andersen Consulting. Under the terms of the agreement, CSC will operate DuPont's global IT and computer infrastructure and Andersen will provide IT applications and consulting for DuPont and Conoco.

Outsourcing was a preferable alternative to a massive hiring for and investment in IT. The earlier evaluation of outsourcing focused on system applications, distributed computing, and personnel issues and resulted in DuPont hiring Andersen to train staff but not to provide system applications. (Extracted from *Chemical Week*, 18/25 December 1996)

Business information: what is it really worth?

Most companies, it is claimed, neglect one of the more important assets they employ—information. Information comprises essential intelligence about suppliers and customers, specialist product knowledge and the operational information which gives a company its peculiar identity within the market. Failure to recognize its strategic importance can be potentially disastrous. This is illustrated by the collapse of Barings Bank: information which would have saved the firm was either unavailable or was ignored.

The value of intangibles, including information, is often only revealed when businesses change hands. When IBM purchased Lotus, for example, it paid $3,500 million for a company with a book value of $500 million. The share price rose as investors realized that the knowledge residing within Lotus could be converted by IBM into added value and profit. When Nestlé acquired Rowntree Mackintosh, a single brand, KitKat, was valued at $160 million: this figure far exceeded actual sales of the product.

The more aware companies are now seeking ways of ascribing values to information assets, as an essential pre-requisite to managing them effectively. This, however, is no straightforward task. There are many types of information, derived from different sources. Some items have only ephemeral value, some are more important than others, and some have no value until changing circumstances make them so.

A variety of approaches are being adopted, and ultimately, companies must construct their own yardsticks. Whatever measures are applied, however, they must be used consistently, so as to determine how best to derive value from information assets. (Source: *Information Strategy*, 1 October 1996)

Intel will carry out network PC plan after all

Intel says it will make a network-styled computer, reversing earlier views that the PC architecture is the only platform for future computing applications.

Speaking at a recent computer conference, Intel officials said that the company is working on a "sealed case" design suited to Internet and Intranet applications which borrows many of the concepts of the network computer (NC) being promoted by Sun Microsystems and Oracle.

Intel said that it is working on a PC design that would be based on a powerful MMX enabled Pentium Pro microprocessor, have a relatively small hard drive but no floppy drive, and will run Microsoft's Windows 95 or a smaller version of Windows NT.

Intel said that the PC design is not exactly the same as the NC, which has no local data storage, and will come with just 8 Mbytes of DRAM and an Ethernet card or a modem.

Intel envisages a line of basic PC designs including models with the ability to connect to data storage devices and have support for Universal Serial Bus peripherals.

Intel says several large PC manufacturers are interested in manufacturing PCS based on its design and the first such computers will be available in mid 1997. (Source: *Electronics Weekly*, 2 October 1996)

Israeli firm shifts focus from VOD to Internet

Orckit, the Israeli-based communications firm, is shifting its focus from concentrating on video-on-demand (VOD) to using its technology to address the fast-moving Internet market.

Although Orckit's ADSL/HDSL (asymmetrical digital subscriber line/high bit-rate digital subscriber line) systems are well-suited to the VOD market, Orckit believes it would not capitalize on the market quickly enough following a lack of consumer interest.

Orckit is proposing the use of its second generation ADSL modem for use with the Internet. It allows down-link data rates of 8.5 Mbit/s and up-link rates of 640 kbit/s. Orckit is offering telecommunications and cable companies a complete system, dubbed FastInternet, that begins at the telephone exchange or the head-end and carries to the consumer home or the modem through existing copper wires.

The modem, which houses the bridge routers and some of the splitters typically used in the head-end, will act as the central hub for a home Intranet or a small office LAN.

Although some of the components may make the modem more expensive, Orckit believes that its use will be very much in tune with what is currently happening in the mobile communications industry. Orckit expects to start shipping FastInternet in volume in early 1997. (Source: *Electronics Weekly*, 2 October 1996)

Firms link up to "reinvent design"

SGS-Thomson Microelectronics, Cadence, Magneti Marelli and the Italian National Research Council (CNR) are seeking to revolutionize the way electronic systems are designed in a new collaborative effort.

According to Professor Alberto Sangiovanni-Vincentelli, the current design techniques including the verification and validation of designs are riddled with problems. These range from being too complex to benefit commercial systems design through to making it difficult to modify such a design.

The collaboration will focus on developing electronic systems and components mainly for the three most thriving areas: automotive, consumer and telecommunications. The research will start with a project dubbed Parades (Project of Advanced Research of Architectures and Design of Electronic Systems) for the automotive industry.

Techniques making use of multi-processor distributed architectures will be used to design an engine management control system. (Source: *Electronics Weekly*, 2 October 1996)

IBM pulls plug on plans for FPGAs

IBM Microelectronics has abandoned its efforts to get into the programmable logic market. "Programmable logic represents a significant business opportunity, but appears to be very much a specialist market", said a company spokesperson.

Although programmable logic is a $2 billion market which grew 50 per cent in 1995 and 30 per cent in 1996, it has been a graveyard product area for established companies including Intel, Toshiba, SGS-Thomson and Texas Instruments.

IBM had aimed at developing an FPGA with technology licensed from Atmel. IBM had licensed the fine-grained SRAM-based technology of Concurrent before Atmel took it over. The licence survived the acquisition. (Source: *Electronics Weekly*, 2 October 1996)

LG semicon plans 64M RAMBUS

LG Semicon Co. has initiated a plan to develop 64M RAMBUS DRAMs. A spokesman for LG Semicon said the company, in conjunction with Rambus Co. of the USA, would develop the 64M RAMBUS chips, which will be capable of transmitting data at a speed of 1.6 gigabytes per second.

LG Semicon is the first company among the eight companies specializing in the development of RAMBUS DRAMs, including NEC, Toshiba and Hitachi of Japan, to develop a three-fold speed RAMBUS DRAM. (Source: *Korean Business Review*, November 1996)

LG plans non-memory products

LG Semicon is set to focus on developing non-memory semiconductors, a major element for multi-media. With the new investment plan, LG Semicon expects non-memory chip sales to reach as much as US$ 3 billion, 25 per cent of the total estimated sales in 2000.

The company will mass-produce the MPACT chip which was jointly developed with Chromatic Co. of the USA in 1995. LG Semicon will also produce Java-processors later in 1997 under a joint development programme with Sun Microsystem Co. of the USA. The MPACT chip is called "System on a Chip" since it combines seven multi-media capabilities, including graphics, moving pictures, fax and modem systems. Meanwhile, the Java-processor is a chip which translates the Java language, a language for developing Internet programs, into ordinary computer languages.

LG Semicon has simultaneously set up long-term plans to manufacture new products, combining media-processor and CPU (central processing unit) functions by combining the design and processing capabilities of 0.35 and 0.25 micron ASIC (application specific integrated circuit) chips and logic with DSP (digital signal processor) and RISC (reduced instruction set computer) capabilities. (Source: *Korean Business Review*, November 1996)

Anam acquires TI technology

Korea's Anam group, the world's largest assembler of semiconductors, announced that it will invest US$ 3 billion in its entry into the non-memory semiconductor market. Anam will initially import the technology to produce CMO (complementary metal oxide) decision element semiconductors using 0.35 micron technology from Texas Instruments (TI). TI will gradually transfer more non-memory semiconductor technology to Anam.

"This is the first time that Korea is receiving the technology to manufacture 0.35 micron technology chips", said an Anam spokesperson, adding, "0.25, 0.18 and 0.13 micron technology also will be transferred to Anam from Texas Instruments".

The non-memory 0.35 micron technology is currently utilized in producing Intel's Pentium P and Sun Microsystem's Spark microchips. Until now, Korean microchips have utilized only 0.5 micron technology. Through the transfer of this technology, Anam will possess the capability to produce integrated semiconductors in addition to its original capability to produce semiconductor components and assembly machinery. (Source: *Korean Business Review*, November 1996)

Mitsubishi and MOTOROLA to exchange technologies

Mitsubishi Electric Corp. and Motorola Semiconductor Products Sector's Imaging and Storage Division have agreed in principle to exchange Mitsubishi's embedded DRAM design and process technologies and M32R micro-processor technology for MOTOROLA's ColdFire and 68EC000 microprocessor technologies. The technology exchange will enable the two companies to provide system solutions incorporating processor and DRAM memory functions on a single chip and to create open, synthesizable embedded processor and embedded DRAM cores that can be implemented with standard hardware and software development tools. (Reprinted with permission from *Semiconductor International Magazine*, November 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Serving a site

Siemens Stromberg-Carlson is setting up a special business unit to provide Internet-specific network solutions for corporations. Expected to achieve cumulative sales of $1.2 billion by 2000, the new business unit will target telecommunications network and service providers as well as

cable network operators. Combining both existing and new technologies, the first products are scheduled to hit the market this year. Among a number of projects, the business unit intends to focus on improving telephony over the Internet as well as Internet access. The business unit has already signed its first contract under which it will provide complete Internet service solutions to the Kalona Cooperative Telephone Company, in Iowa, USA. (Source: *Siemens Review*, March-April 1996)

No contact as chip firms join low-power smartcard challenge

Chip makers are now collaborating with smartcard companies to develop low-power contactless smartcards that are powerful enough to execute complex security cryptographic calculations.

MOTOROLA has announced an R&D agreement with Gemplus for contactless products. First results from the collaboration are expected in mid-1997 with volume production occurring in autumn. The collaboration is expected to drive the price of contactless chips below $3, compared to the present average of $8.

The low power devices will have enough memory and processing performance to enable contactless mode applications including financial transactions.

In turn, SGS-Thomson has announced a collaborative agreement for contactless smartcards with Innovation Industries, the company founded by the smartcard inventor Roland Moreno.

The main problem to date has been powering a contactless smartcard that features a microprocessor and a maths coprocessor. However, Siemens and Mikron, the Austrian company owned by Philips, expect to reduce power consumption sufficiently to introduce such devices by early next year.

The gap between the omnipotent contact cards and the contactless equivalent is currently being bridged with the combinational, or "combi", cards based on chips such as Mikron's Mifare plus, Siemen's SLE44R42S with a Mifare circuit on board and SGS-Thomson ST16RF42. (Source: *Electronics Weekly*, 6 November 1996)

SEMI lobbies for UK chip fab R&D centre

Semiconductor Equipment and Materials International (SEMI) is putting its weight behind the establishment of a strong, publicly-funded National Microelectronics Institute (NMI), along the lines of IMEC in Leuven, Belgium.

The international trade association is also showing its commitment to the UK by running a two-day conference in London for US investors looking for suitable UK semiconductor investments.

The establishment of an effective NMI could persuade more inward investors to set up their operations in Britain. At present, the role of the NMI is seen as one of training. Success would also enable SEMI to appear as a particularly proactive organization in the eyes of its UK members. (Extracted from *Electronics Weekly*, 4 December 1996)

E. APPLICATIONS

Cheaper PCBs

French company Bree Industrie has devised an inexpensive method of manufacturing double-sided printed circuit boards using silver polymer holes technology, instead of the more costly alternative using chemical techniques, to make plated through-holes with copper. The process involves using a conductive polymer paste which is applied by an automatic screening technique. The holes filled with the paste form highly reliable connections between the two sides of the PCB. The technique is described as particularly suitable for applications involving surface mount components where the holes only ensure electrical connections between the two faces of the board.

Bree says the technology can be combined with the use of low-cost base materials and direct etching processes, which greatly reduces the number of production steps. The silver polymer holes have a resistance of 25 mO and can carry a current of up to 500 mA in normal use. (Source: *Engineering*, November, 1996)

Applying nanotechnology for the benefit of mankind

Nanotechnology is being hailed as a future saviour of Mankind. Micromachines that travel around bodies repairing cells on a molecular scale and "universal assemblers" that can build anything you want from raw atomic feed stock (air and soil) will be just two of the consequences of nanotechnology, according to some very imaginative minds.

Back in the real world, of course, such applications are a very long way off. For now, quantum physicists and engineers, around the world, are looking at ways of applying nanotechnology for beneficial purposes in the near future. The Japanese Ministry for International Trade and Industry (MITI) is cooperating with Japanese industry in a 10 year $250 million research and development project focused on its Joint Research Centre for Atom Technology (JRCAT).

Birmingham University's Nanoscale Physics Research Laboratory has been involved with JRCAT in fabricating 100 nm tall pillars of silicon with diameters of 10 nm. This process is seen as a precursor to developing small-scale silicon structures that can emit visible light.

Richard De La Rue, Professor of Optoelectronics at Glasgow University, and colleagues are working with aluminium gallium arsenide (A1GaAs) crystals to develop a structure that will allow the direction of optical waves to be controlled in all three dimensions of space; something that has not yet been achieved. "This is potentially a way of making far more efficient optoelectronic devices", says De La Rue.

So far they have been working on two-dimensional structures. By punching 100 nm holes into a crystal of A1GaAs, the Glasgow physicists have found that they can produce a crystal with a "photonic bandgap" between 800 and 900 nm, so that optical radiation at these wavelengths can be directed by the crystal structure. This could lead to such devices as lasers with reduced noise or highly efficient light emitting diodes.

One area of nanoelectronics that may have important consequences for computer memories is that of "single electronics". The effort here is to eventually create a "quantum dot" that either holds an electron or does not, so creating the ultimate binary memory. Achieving memories at this level, according to Dr. John Williamson of Glasgow University's Nanoelectronics Research Centre, will take about another 10 years.

Plenty more research is going on into nanoscale fabrication, nanoelectronics and other areas of nanotechnology, both at the research centres mentioned and elsewhere in the UK. Whether there is enough money going into nanotechnological research is debatable. But what is clear, from the realistic applications already envisaged, is that it will become an important area of research early in the next century. (Extracted from *Electronics Weekly*, 20 November 1996)

Private networks

Siemens has just introduced the Gigaset 1054isdn—a telephone that enables cordless ISDN connection at home or in the office. The ISDN base station is equipped with a multicell capability based on DECT technology, and can operate up to eight mobile units. Two telecommunications connection sockets can also link the Gigaset 1054isdn to analog devices such as telephone answering machines, fax units or PC modems. However, via the Gigaset 1000TAE, the Gigaset 1054isdn base station can maintain a cordless link to these analog devices as well.

Like other new Gigaset components, the Gigaset 1054isdn adheres to the international Generic Access Profile (GAP) air interface standard, but this latest system provides a higher calibre of protection against eavesdropping by encrypting messages for each specific base station. Extremely versatile, this latest in the line of Gigaset systems can maintain two external and three internal links simultaneously, transfer calls between any mobile units, set up three-party conferences, prioritize calls, bar specific call numbers, and electronically block individual mobile units. (Source: *Siemens Review* 3-4 1996)

New computers

Barely a day goes by without some computer company claiming that it is releasing a "breakthrough" product related to the Internet. Sun Microsystems' new JavaStation, which was unveiled on 29 October, should have been closer to meeting that description than most. The JavaStation is the first of the Californian firm's vaunted network computers (NC). Such machines, argues Sun, will oust the personal computer (PC), just as the PC toppled the mainframe. Unfortunately—but perhaps predictably—Microsoft and Intel, the two firms that have gained the most from the PC, are trying to spoil the party.

The JavaStation is not the first NC. A handful of other firms have already shown off their own versions. However, it is the first product aimed clearly at business users. Similarly, although the network computer is often associated with Oracle, another Californian software company, Sun is the firm that could gain most from the device, partly because NCs all use Java, Sun's Internet programming language. This is one reason why Sun's shares have recently outperformed even Microsoft's.

Sun's sales pitch for the NC is simple: PCs cost too much to run. By using centralized servers to store a PC's

programs, rather than a local hard disk, NCs get rid of running costs (such as systems staff having to update software on every PC each time a new version comes out). According to most independent experts, NCs might cost less than half as much as PCs to maintain (see table). That is not quite "zero-administration", but it is still enough to tempt companies to reject PCs in favour of NCs.

The lure of Java

Desktop computer costs

Cost of purchasing and running a single desktop computer, $

	PC	NC
Initial hardware cost	2,000	1,200
Annual average running cost	6,400	2,500

Microsoft and Intel, supported by most of the biggest PC makers, have announced the NetPC—an alternative answer to the problem of reducing the cost of running computer systems. Even though the details of the NetPC are still a little fuzzy, it will basically look like a cheap, ordinary PC. Its brains will be a less expensive (and slower) version of Intel's Pentium processor. Unlike the NC, it will have its own hard disk. But it will also have some clever software that will allow systems staff to control a number of computers from one place.

A basic JavaStation costs $1,200 (including the screen and keyboard), $800 less than the price of a normal PC with goodies, such as a CD-ROM drive and sound system. The new NetPC is likely to cost around $1,500. It will be able to run Microsoft's Windows operating system—and hence the thousands of other programs that use it. Sun's JavaStation, by contrast, will depend on Java. (Extracted from *The Economist*, 2 November 1996)

Potential in magnetic separators

Papermaking, high-volume water-purification systems, and on-site remediation of contaminated soils are some of the applications that can become more cost-effective with magnetic separators using high-temperature superconductors, says researcher Mark Daugherty, Los Alamos National Laboratory, Los Alamos, NM. "Since large superconducting magnets can produce much greater magnetic fields than conventional magnets, you can move a much larger volume of material through the separator at a much faster rate and still achieve the same degree of separation", he adds. Also, the simplicity of the cooling systems for high-temperature superconductivity enhances portability. (Source: *Industry Week*, 7 October 1996)

Off-peak energy storage

Does sodium-sulphur battery technology hold the key to the cost savings of off-peak energy storage? Tokyo Electric Power Co.'s optimism is based on its observation that this type of battery has three times the capacity of the familiar lead-acid type and its hopes extend to prospects of using them in any location, even small commercial buildings or private homes. Supporting that dream is the expectation that the high cost—$30,000 per kilowatt-hour of capacity—will fall by 90 per cent to less than $3,000. The batteries typically last for 15 years, reducing annual costs to as little as $200 per kilowatt-hour of capacity. A 500 kilowatt-hour battery now being used experimentally at a substation near Tokyo measures 5.7 metres wide, 3.6 metres deep, and 2.5 metres high, says Wataru Nishimoto, deputy head of Tokyo Electric's energy storage department. Smaller versions could be used with solar energy. (Source: *Industry Week*, 7 October 1996)

Tiny memory card strikes a chord

Music-loving joggers could soon be free of bulky personal stereos that bounce around on their belts. The replacement device is as tiny as a pager, and plays music from a solid state memory chip. The same development could also come in handy for people who want their pagers to record a spoken message, instead of just text. It could even come to the rescue of people who wish their portable phones could record incoming calls while switched off. All these devices will soon be available, thanks to standards for a digital memory format agreed by the electronics industry.

Today's portable computers have a slot for a card the size of a credit card, which can function as extra memory, a modem or even tiny hard disc. To make computers even more compact, manufacturers need a card the size of a postage stamp. Earlier this year the Miniature Card Implementers Forum (MCIF), based in Folsom, California, defined a new card format measuring 38 millimetres by 33 millimetres. Four companies, AMD, Intel, Fujitsu and Sharp have each come up with cards of this size which can store up to 64 megabytes in flash memory. Unlike RAM, flash memory is non-volatile, which means it stores data without the need for backup power.

The MCIF, which includes Sony, Kodak, Hewlett-Packard and Compaq, also agreed a common standard for packaging data sorted on a miniature card. So when text, images or sound are captured by a pocket computer, camera or recorder, the data can be retrieved by another computer.

The International Voice Association, which represents the big three companies in office dictation and phone recording machines, has also adopted the new card. The IVA, based in Vienna, was formed after Philips, Grundig and Olympus developed incompatible miniature tape cassettes for dictation and phone recording. None of the three companies was willing to climb down, which is why office staff from different companies often cannot exchange tapes for transcription. The big three will now switch to the miniature memory card instead of tape.

If history repeats itself the miniature card will soon carry high quality music. When Philips launched the first analogue tape cassette, 30 years ago, it was intended for mono dictation but was quickly adapted for hi-fi recording. Bell Labs in the US, and NEC in Japan, are already developing personal stereos that play music from chips. Their prototypes rely on digital compression to reduce the memory requirement. A data rate of 128 kilobits per second—less than one tenth that needed for CDs—can now deliver acceptable stereo. (This first appeared in *New Scientist*, London, 19 October 1996, the weekly review of science and technology).

Skinny speakers break all the rules

Intelligible public address systems, talking billboards and hi-fi systems with superslim speakers could all result from a chance discovery by the British military.

The distributed mode loudspeaker (DML) breaks all the rules of speaker design by delivering loud, high-quality sound from a panel just a few millimetres thick. The Verity Group, which owns hi-fi specialist companies Mission and Quad, has now set up a company, NXT, to license the technology.

The DML panel is very stiff, and is clamped to stop it moving like a piston. Instead it is bent by an electromagnetic or piezoelectric transducer. As the panel flexes it creates a complex pattern of resonances over its surface, with different points vibrating at different frequencies. These resonances combine to generate a range of frequencies covering two and a half octaves.

The signal from the transducer is an ordinary audio signal. The ability of the panel to translate it accurately into sound depends on the precise arrangement of the clamps and the transducer, along with the shape, density and stiffness of the panel material. The wave patterns from the front and rear are not in opposite phase, so they do not cancel each other out. (This first appeared in *New Scientist*, London, 12 October 1996, the weekly review of science and technology).

Fibres are a printer's best friend

Polaroid has developed optical fibre lasers that can generate up to 23 watts of light—many times the power generated by the fibre lasers used in telecommunications.

Although there have already been experimental systems that generate several watts, this is the first fibre that is efficient and reliable enough to be used commercially. Printers will be able to use a 9-watt fibre laser to generate colour proofs with the same resolution as printing plates, without the need for wet chemicals.

In order to design a system that uses both fibre and semiconductor lasers, the wavelengths at which the fibres absorb pump light must be matched with those of high-power semiconductor lasers. Polaroid doped its fibres with ytterbium ions, which absorb at 915 nanometres, matching the output of semiconductor lasers that were designed for the purpose.

The next challenge was to find a way to collect the pump light efficiently. The semiconductor laser emits light from an area 730 by 335 micrometres, which is much larger than the 8-micrometre core of the fibre. Polaroid solved the problem by surrounding the tiny core with a thick rectangular cladding of pure silica measuring 330 by 170 micrometres. In turn, the silica was wrapped in an outer plastic cladding, forming a round fibre with a diameter of 650 micrometres.

External optics focus the pump beam onto the rectangular area at the end of the fibre. Total internal reflection traps the pump light in the silica layer, and the rectangular shape of the cladding ensures that the pump light bounces through the ytterbium-doped core to excite the fibre laser. Other researchers have tried trapping pump light with circular cladding and found that a lot of the light never passes through the core. Bennett Rockney, Polaroid's manager of fibre-optics research, says only 20 to 50 per cent is absorbed in such systems.

Thanks to its rectangular design, Polaroid's system can generate 9 watts of laser light from a 50-metre fibre and a 17-watt semiconductor laser. The pump laser requires cooling, but the fibre laser does not heat up. To find the maximum power output of their new setup, Polaroid engineers hooked up pump lasers at both ends of a fibre laser, obtaining 23 watts.

The fibre laser is the key to the print proofing system Polaroid plans to introduce in 1997. Currently, printers can generate printing plates directly from their computers, but these are not good enough for checking the quality of the images before the presses roll. So printers must use wet chemical processes to generate proofs.

The fibre laser, on the other hand, can create the 10-micrometre dots needed to match the resolution of printing presses. (This first appeared in *New Scientist*, London, 5 October 1996, the weekly review of science and technology).

Virtual "tour" could prevent colon cancer

A radiologist at the Bowman Gray School of Medicine in Winston-Salem, North Carolina, is using CT scans and virtual reality to spot polyps in the colon before they grow into cancerous tumours. David Vining says that the new method is far more acceptable to patients than internal examinations, and cheaper.

Vining's procedure demands expensive computing resources but has significant advantages. It relies on a helical CT scan, in which the patient is moved through a rotating beam of X-rays. "The result is a continuous helix of data, rather than the slice-by-slice images collected by the usual CT scan", says Vining. "After the scan, which takes less than one minute, the data is processed to create a virtual-reality "tour" of the colon. We can produce a 3-D movie in which the physician can fly through the intestine, looking at the wall—mimicking a colonoscopy". Because the image is on a computer, it is possible to enhance important features.

Only a handful of medical centres in the USA have the computer equipment needed to create such 3-D images. The hardware costs up to $300,000, but Vining believes that virtual reality could save money. "Conventional colonoscopies require sedation, involve a slight risk of bowel perforation, and cost $900 to $1,500. A VR scan may soon cost as little as $500", he says. "But the most important thing is that this noninvasive, painless test could be used for screening people who would never come in for a colonoscopy. That would mean catching cancerous and precancerous lesions in time for treatment". (This first appeared in *New Scientist*, London, 5 October 1996, the weekly review of science and technology).

Sample shipments of 256 Mbit SDRAMs

NEC Corp. has commenced sample shipments of 256 Mbit synchronous random-access memories (SDRAMs). The SDRAM was developed using 0.25-micron photolithography. It has memory capacity capable of storing 570 million devices, such as transistors, on one chip. The SDRAM significantly improves display and data processing functions, making it suitable for multimedia equipment.

Fast page mode DRAMs and EDO DRAMs are commonly used for main memories in personal computers. However, as application software advances and microprocessors speed up, larger-capacity, higher-speed memories are needed for personal computers, workstations and servers.

The new SDRAM can provide small, stable memory cells, achieved through NEC's hemispherical-grained polycrystaline silicon (HSG) capacitor technology. Prefetched pipeline scheme has been adopted to facilitate multiple parallel processing, which enables the world's highest clock frequency of 200 MHz and a data transfer rate of 400 MB/second. The Synchronous Mirror Delay circuit reduces power consumption in sleep mode to 3mA, without sacrificing data transfer rate. Miniaturization was attained through an arrangement drive circuits.

The new product is available in two configurations: 16 M x 16 bit and 8 M word x 32 bit. Mass production of 10,000 units will commence during the latter half of 1998.

Further details from NEC Corporation, Public Relations Division, 5-7-1, Shiba, Minato-ku, Tokyo 108-01. Tel.: +81-3-3798-6511; Fax: +81-3-3457-7249. (Source: *JETRO*, October 1996)

Memory interface board incorporating high-speed serial board

Midori Electronics Co. Ltd. has produced a superhigh-speed transfer device called Ultra MD Bus Master Transfer Device (MDC-926Rs) that consists of a memory interface board SCSI-2 incorporating a high-speed communications serial board.

The data transfer speed has been improved considerably, as the write-in and readout speed is improved compared with existing counterparts. In addition, an NIM function is incorporated that eliminates the need for setting the plug-and-play operation or cumbersome interrupt processing number. The selling price is also lower, about 30 per cent less than its predecessor. The board is compatible with NEC's PC-98 series and Epson's PC series computers.

The new interface board is a fully tuned-up version of the conventional MD bus master transfer system and enables data transfer at high speed. In addition, the high-speed serial board is compatible with ISDN terminal adapters, so high-speed communications can be used immediately with present personal computers and modems. Further details from Midori Electronics Co. Ltd., 559, Shimo-Asao, Asao-ku, Kawasaki City, Kanagawa Pref. 215, Tel.: +81-44-989-7632; Fax: +81-44-989-7624. (Source: *JETRO*, October 1996)

Nematic type liquid crystal display

Kyocera Corp. has started distributing samples of a newly developed 12.1 inch colour supertwisted nematic (STN) type liquid crystal display (LCD) KCB8060HSTT-X2 with a response speed as fast as 150 ms, double the speed of conventional types of similar LCDs.

The response speed was improved by introducing the cursor shift effect. The company plans to market the new LCD for use in word processors and notebook type personal computers. Improving the LCD materials has increased the speed of switching the crystal direction when switching the voltage on and off. Conventional LCDs are the SVGA type, with a response speed of 330 ms, and resolution of 800 pixels horizontally and 600 vertically. The new LCD is 27.55 cm x 20.6 cm, and has a thickness of 1 cm.

Further details from Kyocera Corporation, Corporate Communications, 5-22, Higashino-kita-inoue, Yamashina-ku, Kyoto 607, Tel.: +81-75-592-3851; Fax: +81-75-501-2766. (Source: *JETRO*, October 1996)

System for engraving tracks into superminiature hard disks

Notebook type personal computers are certain to be incorporated soon with hard disk drive systems of 1 gbyte, in which case the track density of hard disks will be doubled compared with now, making it indispensable to use systems for engraving information storage tracks in high density.

Kyodo Denshi System Co. Ltd. has developed a system for engraving information storage tracks into superminiature hard disks (HD) for notebook type personal computers.

The data write-in system mounts a compact rotary encoder using a laser as its positioning sensor, by which the track width readout accuracy has been considerably improved making it compatible with next-generation. HDs with track densities of 10,000 tpi, double that of existing HDs. For example, with 1.8-inch HDs, the resolution is 1 nm, an improvement of more than eight times when compared with conventional types of systems using laser length measuring devices. Even with 3.5-in. HDs, the resolution is 2 nm, double that of conventional systems.

A single system is capable of treating up to a maximum of four HDs, and a distinct sales point lies in its simple maintenance. The company plans to sell the track write-in system primarily to hard disk drive system manufacturers.

Further details from Kyodo Denshi System Co. Ltd., 2-13-6, Shin-Yokohama, Kohoku-ku, Yokohama City, Kanagawa Pref. 222, Tel.: +81-45-474-2480; Fax: +81-45-474-0926. (Source: *JETRO*, October 1996)

Transistor package

Motorola is about to launch a space saving plastic moulded package for its discrete transistors, which will fit in standard chip component pick and place machines.

The first device in the new μSurf package will be a small signal transistor. The package is commercially viable because it combines silicon processing and plastic body moulding in the one manufacturing operation. According to the company, it is inexpensive to produce. It also fits on the same footprint as a standard 0402 chip resistor or capacitor surface mount component so that it can be dispensed in standard surface mount pick and place machines.

The first μSurf packaged devices will be small signal transistors in a single three-pad package. However, Motorola says it is not limited to single devices and multi-transistor versions are also planned. The intention is to retain the SMD compatibility, so larger packages will be on standard footprints such as 0603. (Source: *Electronics Weekly*, 30 October 1996)

Single chip mobile phone design

A single chip mobile phone design with programmable baseband signal processing which will work with more than one network standard has been announced by Texas Instruments (TI). Samples of the device, which could potentially be the first volume product based on the ARM7 Thumb core, have been shipped to customers including Nokia for several months.

The chip combines the wireless optimized TMS320C54x digital signal processor (DSP) with a c470 microcontroller and working memory for the DSP. The c470 is based upon the ARM7 Thumb core.

Multiple standards can be implemented on the chip such as GSM, PCS1900, DCS1800 and IS95. GSM-wise, the chip can be programmed for full, half or enhanced full rate.

All the digital baseband functions such as speech decode, error correction, equalization, demodulation and encryption are carried out by the DSP. General controls including the user display and keyboard interfaces are handled by the microcontroller.

During 1997, the chip will be produced on TI's 0.25 μm process. The end of next year should see a port to the 0.18 μm Timeline process, reducing cost, voltage and power consumption. (Extracted from *Electronics Weekly*, 30 October 1996)

Fujitsu MicroLens makes flat panels

A machine incorporating a new way of manufacturing flat panel displays or large silicon substrates like those used in MCMs (multi-chip modules) is to be delivered to Fujitsu in the next couple of months.

The machine works in conjunction with a reactive ion etcher from Oxford Instruments. The etcher determines the size of the substrate that can be used, but the Hugle machine can be adapted to handle any size of substrate.

The machine, called MicroLens, uses an array of millions of tiny lenses as small as 190 microns diameter, which focus a single UV light source projected through a mask onto a silicon substrate. (Extracted from *Electronics Weekly*, 30 October 1996)

Hitachi takes flash to 64Mbit

Hitachi's semiconductor division has started manufacturing a new level of density of flash memory chips—64 Mbit—and is marketing them in the form of cards as a replacement for low-density hard disks in portable applications.

Hitachi is not intending to sell the chips at the device level. They are being marketed as memory cards with up to 75 Mbytes of storage capacity.

The cards will supply removable non-volatile storage for laptop computers, PDAs, organizers, pocket computers and the like. Packaging variations could allow them to be used in voice digitizers, digital cameras and many other applications.

The chips themselves are made utilizing the proprietary AND-type flash architecture which Hitachi developed, and for which they have a joint venture with Mitsubishi.

As well as using the AND flash technology for memory cards, Hitachi will be combining it with the company's SH series of microprocessors to provide field programmable microprocessors.

Hitachi's AND architecture is similar to the NOR architecture pioneered by Toshiba and adopted by market leaders Intel, AMD and Fujitsu. (Source: *Electronics Weekly*, 30 October 1996)

A chip you cannot outwit

Automakers have a new weapon in the battle against car thieves—a tiny chip from Exel Microelectronics that controls door locks, ignition switches, and a raft of driver-related functions. The new ICs actually work in pairs; one chip goes in the vehicle, the other in an ordinary-looking key.

Unlike other access-verification chips, Exel "SureLok" ICs are inexpensive, costing around 90 cents, and virtually impossible to defeat. The encryption system employs a sophisticated variable-code "challenge-and-response" protocol that changes its 32-bit password after each authentication. According to Richard Downing, an applications engineer at the San Jose-based firm, it would take approximately 4 billion attempts, or about 13 years, to outwit just one chip and match the code.

Another major advantage is that the ICs are truly stand-alone components, requiring only a three-wire interface—power, ground, and a bidirectional data line.

SureLok ICs come in a variety of packaging styles, including surface-mount SOICs and bare die. An eight-pin SOIC, available in tape-and-reel, would ordinarily mount on a circuit board inside the vehicle. The mating chip, typically a bare die, would be embedded somewhere within the key. Protected by a sealed plastic cover, the die could be bump or wire bonded to circuit traces extending the length of the shaft.

Despite the chip's small size (2.7 x 2.1 mm) and its computationally intensive encryption engine, Exel engineers managed to squeeze 512 bits of general-purpose E^2 prom onto the IC. The programmable memory typically contains instructions that customize products for individual users or specific environments.

The preprogrammed key would tell the car for example, not to exceed, say, 50 mph, and could just as easily impose limits on acceleration rates, trip distances, and time of use.

Besides keys, SureLok chips are also well suited for electronic equipment—particularly cellular telephones and workstations—where there is a need to lock out unlicensed accessories such as third-party batteries, video cards, and networking hardware. (Extracted from *Machine Design*, 26 September 1996)

Plug-and-play comes to power modules

Most engineers who design low-cost electronic products get tangled up at some point modifying general-purpose power supplies to fit their specific needs. Historically, the alternative to this time-consuming process is ordering a supply designed and built to specifications—which not only squeezes the engineering budget but wastes even more time. All that is about to change, however.

TB Wood's Inc., Chambersburg, PA, has introduced a family of low-cost plug-and-play power modules aimed at helping OEMs bring a wide variety of products to market faster. Flexible and reliable, the PowerMod controllers are suited for everything from simple inverters to uninterruptible power supplies (UPS). With additional power-switching modules, they can also serve as full-featured flux vector controllers and servo amplifiers. The switching devices use second-generation IG-BTs mounted on insulated, metallized substrates, producing the smallest power packages available today. (Source: *Machine Design*, 26 September 1996)

The office afloat

Ocean going and coastal vessels as fully featured floating offices, equipped with integrated onboard computer and communications networks, inter-connected into corporate, regulatory and associated land-based office systems are not an option, they are destined to become a necessary fact of shipping life. The current and emerging commercial and legislative pressures strengthening hold within the industry compound to make this a safe prediction, for the near future.

Perhaps less obvious is the strategic role that ship/shore communications will play in the final solution. The concept of the floating office will, in fact, stand or fall on the quality of the ship/shore communications infrastructure, it is that significant. This development will happen as the role of communications extends beyond simple message and data transmission to become an essential "enabling" technology. This is the Managed Ship/Shore Communications Infrastructure (MSSCI), the means of unlocking a vast array of cost effective applications, addressing the long term issue of compliance and providing a vital management tool.

A major strategic influence is the potential benefit of computers used for onboard ship management applications. Whether by the personal initiative of the seafarers themselves, or from a legacy of ship building, or by corporate policy, the PC is proliferating on board. Word processing, spreadsheets and databases are now typical informal functions personally adopted by the master and senior officers, if not already part of a corporate computer plan. PC based systems for shipboard data display and analysis, condition monitoring, cargo control/handling, vessel management, messaging and many other on board applications are freely available and can be individually cost justified.

Urged on by improving PC literacy, increased control and reduced operating resources, vessels are already showing the natural evolutionary pattern of creeping computerization. This is totally consistent with the need to improve quality and management standards on board whilst maintaining or reducing manpower skills numbers and associated costs, but it is a dangerous cul-de-sac. Computer assisted support for individual shipboard functions may be the operational and financial solution but there are management considerations. Separate PCs and applications may be the natural

evolutionary process but they are certainly not the final answer for the floating office.

All onboard applications will have common elements such as data collection, systems administration, support and communications, but they are unlikely to originate from the same supplier and, as a consequence, adhere to common standards. Individual and separate implementations may provide a tactical gain, but collectively create a strategic nightmare. An integrated and standardized approach to on-board PCs is essential making systems simpler to install and manageable. As PC proliferation onboard increases the use of an industry standard to bind them together becomes the critical success factor.

The key functionality of the ship/shore communications infrastructure covers three areas:

(1) Optimization of the communications facilities;
(2) Inter-connectivity with corporate and industry networks;
(3) Management of the ship/shore communications.

(Source: *Ocean Voice*, October 1996)

Mitsubishi in deal to ease Web access

Mitsubishi Electric America has joined with the Internet startup firm, Diba, to make it easier and cheaper to create information appliances that access the Internet such as Web TVS and e-mail phones.

Mitsubishi says the collaboration will allow companies to build information appliances based on Diba's technology using just two chips instead of 12. The devices will be ready by the second quarter of 1997.

The main device will be Mitsubishi's M32R/D, which combines a Risc processor core with 16 Mbit of DRAM. The second device will be an Asic supporting video, audio and infra-red communications.

Diba has produced hardware and software reference designs which it licenses to other companies. The software includes a compact operating system and Web browsers which allow users to access information over the Internet or other network connections. Diba has already announced relationships with NEC, Samsung and Zenith Electronics. (Source: *Electronics Weekly*, 4 December 1996)

Digital images replace hammer and chisel

It took Italian, German and French master builders more than five centuries to complete Milan Cathedral. Industry and motor traffic now threaten to destroy it in a matter of years. Exhaust emissions and acid rain are eating away at its unique marble facade. Because it takes a sculptor over a year to reproduce a life-size statue using hammer and chisel, the restorers have turned to the very latest technology. The figures are scanned with the help of digital cameras produced by the Jena-based Carl Zeiss optical equipment company. The system records approximately 50 measuring points per second, which are then used to programme the cutting machines. This makes it possible to produce a complete sculpture in only eight weeks. This represents an enormous timesaving. Nevertheless, human sculptors continue to produce the fine details of the figures better by using their hands. (Source: *Deutschland*, No. 6, December 1996)

Computer duo improve PC speech recognition

Fonix and Motorola have separately announced advances in speech recognition technologies that will improve the performance of PCs in responding to spoken commands and in transcribing speech.

Fonix said it has produced an improved version of the format tracking algorithm that can identify key formats—vowels and other speech characteristics. Fonix says it has tested its algorithm with human voices of both sexes, across a range of ages and accents. Fonix added that it will license its technology to other companies and will continue to work on new speech recognition technologies.

Motorola, meanwhile, said it had achieved a break-through in creating a speech recognition system that can identify continuous Chinese speech running on a standard PC. Motorola's system, which use special software and a DSP on an add-on board, can recognize about 10,000 Chinese words.

Although other companies have been working on English speech recognition, Motorola says that what it has done is more challenging. (Source: *Electronics Weekly*, 20 November 1996)

256QAM gets first cable TV showing

What is claimed to be the first demonstration of the 256 QAM broadband video transmission technology has taken place in Canada as part of a cable TV network trial.

According to General Instrument, which supplied the transmission system, its efficient use of the network's coaxial cabling enables two high definition TV channels to be carried in 6 MHz of cable bandwidth.

The quadrature amplitude modulation (QAM) system, was the basis of the North America's Grand Alliance HDTV trials and is also the basis of the European DVB terrestrial digital TV standard.

An advantage of 256 QAM is the relatively large number of phase and amplitude states 256, used to represent the digital TV signal. (Source: *Electronics Weekly*, 6 November 1996)

Versatile power meter

Siemen's Automation Group has unveiled a new optical active-power meter designed to measure emissivity levels of up to 100 mW. The K2701-OXN1—a versatile, handheld meter—is invaluable during the installation, troubleshooting and maintenance of fibre-optic systems. it was specially developed for use in cable TV and telecommunication networks, which employ analogue transmission techniques.

Analogue systems contain high-powered lasers that cannot be measured using standard detectors. However, thanks to its special indium gallium arsenide (InGaAs) detector, the K2701-OXN1 is able to measure emission levels of up to 100 mW (+20dBm). The low-reflection design of the detector also minimizes anomalies associated with reflections at the plug-in connectors. The meter incorporates all of the features of the standard K2701, including an operating range of -18°C to +50°C, multiple reference storage, RF shielding, and a graphic display. (Source: *Siemens Review*, March-April 1996)

Hyperspectral imaging

Soon a hyperspectral imager will go into orbit aboard NASA's Lewis satellite. Able to "see" the Earth in 384 narrow spectral bands, the instrument will be sensitive enough to discriminate between species of trees and identify mineral types. Existing systems, such as Landsat and Spot, are capable of seeing in only a few wide spectral bands, says the builder, TRW Inc.'s Space & Electronics Group, Redondo Beach, CA. The additional information provided by HSI is expected to open the door to new and/or enhanced applications including remote sensing, agricultural-yield monitoring,

locating mineral deposits, disaster relief/assessment, and fire-protection management. The instrument produces images in the visible, near infrared, and short-wave infrared spectral bands between 0.4 microns and 2.5 microns. (Source: *Industry Week*, 18 November 1996)

Polymers detect document forgery

Scientists in the USA believe they have come up with a cheap system for security tagging documents such as credit cards.

Forging and counterfeiting valuable documents are getting increasingly simple as technology advances. Current security techniques, such as the embossed hologram on credit cards, are no longer reliable because they can be copied, according to Nasser Peyghambarian of the University of Arizona and the Center for Advanced Multifunctional Polymers.

Peyghambarian and his colleague Bahram Javidi at the University of Connecticut have developed a device that hinges on a polymer composite which is photorefractive. This means that its refractive index changes through interaction with light. The polymer can record and retrieve optical information when an electric field is applied.

In Peyghambarian's system, a credit card would be labelled with a phase mask, optical elements that hold information coded as the varying intensities of transmitted or reflected light. For approval by the checking system, the pattern held on this mask would have to match a mask used by the security system, explains Peyghambarian.

The device works by comparing the light intensities transmitted through the two patterns—one on the credit card and one in the checking system—that are encoded by the refractive index changes in the polymer. If the patterns match, the device produces a sharp peak. No peak means a counterfeit document.

Phase masks are difficult to forge and are practically invisible—they can be a few square millimetres in size, says Peyghambarian. And they can be permanently attached.

The Arizona researchers claim that their system would be useful for many applications. It is small, compact, relatively cheap to make and its operating wavelengths are compatible with those of commercial low power semiconductor laser diodes, they point out. It is also fast because the processing is done optically and in parallel. What is more, the stored pattern can be easily erased and a new one rewritten. (Source: *Chemistry & Industry*, 16 September 1996)

Biometric identification

Quickly identify individuals by their fingerprint with NRIdentity finger-image identification systems, including scanners and software, from National Registry Inc., St. Petersburg, FL. Suggested applications include protecting personal and business information, improving customer service, facilitating electronic commerce, and deterring fraud. For instance, passwords and PIN numbers can be replaced by fingerprints to simplify access to electronic systems and enable on-line services for customers. Operates on Windows 3.1, 95, and NT. Servers run on UNIX and NT. (Source: *Industry Week*, 21 October 1996)

Bolometer for infrared imaging

High temperature superconductors are used in an ultrasensitive bolometer being built via a partnership of the National Institute of Standards and Technology and Conductus Inc., Sunnyvale, CA. The design incorporates all-epitaxial micromachining technology based on an yttrium-barium-copper-oxide thin film on an yttria-stalized, free-standing zirconia membrane. NIST reports the device has attained a sensitivity of 0.6 picowatts per root hertz, far better than the helium-cooled or other superconducting bolometers at such long wavelengths. Applications: infrared video cameras for satellite monitoring of greenhouse gases, night-vision equipment, and as a detector of clear air turbulence. (Source: *Industry Week, 21 October 1996)*

Smartcard flaw found

Just as US interest in smart cards is mounting, researchers at the US Bellcore Labs say they have discovered a potentially serious flaw in smart cards popular in Europe and used in applications such as the Mondex trial. The Bellcore scientists say that the smart cards are not immune to fraudulent misuse despite their acclaimed security, a feature that has attracted Visa and Mastercard.

Bellcore says that although it would be difficult, it is possible to fraudulently copy the monetary value held in one smart card to another. The scientists will not reveal how this is done or how difficult it would be to do. They are planning to publish a research paper on the flaw and have warned Bellcore research partners, large US telephone companies, about the problem. (Source: *Electronics Weekly*, 2 October 1996)

Film brightens laptop LCDs

A UK company is developing and marketing a plastic film which promises to increase the brightness of laptop LCDs by 70 per cent for no extra power.

The film, invented by Philips in Eindhoven and now being worked on by Merck, of Poole, Dorset, acts to pre-polarize light entering the rear polarizer of a standard LCD.

The rear polarizer of an LCD transmits 40 per cent of light from the backlight and absorbs the rest. The new film alters the random polarization of the light from the backlight so that most of it is accepted by the rear polarizer. (Source: *Electronics Weekly*, 11 December 1996)

SGS-Thomson goes Warp factor ten with fuzzy logic

SGS-Thomson Microelectronics has announced its latest fuzzy logic product, an 8-bit co-processor capable of improving system speed by a factor of ten.

Warp2 is described as a stripped down version of SGS-Thomson's original Warp1 fuzzy logic processor designed for use with simple microcontrollers. It contains fuzzification and defuzzification stages, an inferencing unit, memory and control logic.

The device can handle 8-inputs, 4-outputs and 256 rules. At 40 MHz, the processor can compute the full I/O and rule set in 200 μs.

Suggested applications include motor control, thermal control, image processing and industrial automation.

SGS-Thomson is continuing to develop fuzzy logic devices. In 1997 the company will release Warp3, a cheap fuzzy core combining some microcontroller peripherals.

The first Warp3 product will be aimed at temperature control systems. As such it will integrate an 8-bit A/D converter, timer and triac drivers. (Source: *Electronics Weekly*, 11 December 1996)

Lasers for waste-free cleanups

A waste-free process for removing surface contaminants as small as 0.09 μm has been developed by Radiance Services (Bethesda, MD). The patented dry-cleaning technology, called Radiance processing, is based on a deep-ultraviolet (DUV) light source.

To clean, a photon flux from an excimer laser is applied to the surface while a laminar flow of a high-density inert gas such as nitrogen or argon carries away the contaminants. The gases are selected to prevent secondary reactions with the surface material, such as a photocatalytic effect. The laminar flow provides a stable boundary layer and helps prevent reattachment of particles.

The cleaning mechanism has been variously described as photodissociation photon shock, photon-phonon interaction, photophoresis, acoustic stress waves and quasimetastable states. Essentially, the laser light breaks the bond between the contaminant and the surface while keeping heat to a minimum.

The process can be applied to large, small, flat, textured and curved surfaces. Cleaning speeds depend upon the light source and the applied energy. A 150 nm wafer, for example, can be cleaned in approximately one minute (Reprinted with permission from *Semiconductor International Magazine*, December 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

New memory technology holds more than one bit per cell

The first use of multi-level cell (MLC) technology—storing more than one bit on a memory cell—is likely to come in the form of a ROM from NEC in the next few months. SGS-Thomson expects to introduce a one-time programmable EPROM based on the technology and, by mid-1997, Intel expects to have an MLC-based flash memory.

MLC technology has been pursued by the Big Three flash suppliers—Intel, AMD and Fujitsu—as a way of increasing density without reducing process geometries. (Extracted from *Electronics World*, October 1996)

Anti-terrorism ID chip from Micron

In an effort to combat terrorism, Micron Technology has introduced a new chip designed to be used as an identification device on shipping containers or luggage. Dubbed MicroStamp, the postage stamp sized chip, includes radio telemetry, processing and memory functions. The emitted signal can be detected within a range of three metres by an electronic scanner. Along with replacing bar codes, the company believes that the chip can be used to help combat terrorism through its ability to track packages throughout their journey. Sources state that Micron has been awarded a research contract by the Federal Aviation Administration involving the use of MicroStamp in the development of a luggage security system. (Source: *Electronics World*, October 1996)

New data input system based on voice input

Sonoda Instruments, Inc. has developed a new type of data input system based on voice recognition for electric meter inspection.

Data has been input into computers by the method of manual input through the keyboard, by the optical character reading system or by using bar codes, depending on the application of the computer. Input by voice is also being partly utilized, but only a few systems have been commercialized due to the poor discrimination capability, slow response and other reasons.

The new voice input system fabricated by Verbex Voice Systems Inc. (US) is operated in combination with a software developed by Sonoda Instruments. The voice input unit is based on the specific voice input system and registers the user's voice beforehand. Up to roughly 500 words can be recognized, and the recognition ratio is over 96 per cent.

The new voice input system has a broad scope of applications, including the inspection of electric power meter, water meter survey of warehouse inventory, medical examinations and data storage.

Further details from Sonoda Instruments, Inc., 3-12-15, Nakoji, Amagasaki City, Hyogo Pref. 661; Tel.: +81-6-491-5221; Fax: +81-6-491-6665; Internet: portmaster@rdd.onoda.co.jp (Source: *JETRO*, September 1996)

Architects get wise to electrochromic windows

One of the "simplest" concepts for reducing air conditioning bills is to install window glass that can be darkened or lightened automatically, or at the touch of a button. Unfortunately, how to produce practical systems with acceptable life and cost has proved anything but simple. However, work being carried out at the National Renewable Energy Laboratories in Colorado could help overcome many of the present technical barriers to electrochromic (ec) windows.

The breakthrough made at NREL ("Low-voltage electrochromic device for photovoltaic-powered smart windows", is in developing an all-solid state electrochromic device that can be switched over a range of optical transmissions by voltages of less than 1V. This voltage is smaller than any other device tested so far, and at these levels, the researchers say it should be possible to power the devices by an integrated semi-transparent photovoltaic (pv) cell, so removing the associated wiring costs that substantially push up investment in ec windows.

In the NREL system, indium-tin-oxide (ito)-coated glass forms the electrically conductive transparent substrate for the device, onto which thin films of WO_3, MgF_2 and V_2O_5 are deposited, topped by a semi-transparent gold electrode.

Colouration occurs by a complex reaction between the clear WO_3 and a light-absorbing compound of lithium and WO_3. The reaction involves injection and extraction of electrons and metal ions. But according to the team, the key to the low voltage switching is inclusion of the MgF_2 layer which acts as the lithium ion conducting layer.

When electrical connection is made, the device transmission drops to about 40 per cent of its bleached-state level in around 60 seconds. To return to the original transparent state, the device simply needs to be short circuited to cause spontaneous bleaching within minutes.

In the tests, voltage was supplied by a semi-transparent photovoltaic powered cell connected to the EC device. The researchers say they expect a monolithic PV-EC device to function in a similar manner.

Current cost of EC windows is estimated to be somewhere between \$100 and \$1,000/m^2. However the integration of the power source into a self-contained window could make the NREL devices much more attractive than other designs and also allow smart windows to be retrofitted to existing buildings.

With the cost of energy becoming much more of an issue in building-economics, electrochromic smart windows could one day become a familiar part of architectural design.

More information contact: Clemens Bechinger now at the Universitaet Konstanz, D-78434 Konstanz, Germany. E-mail: clemens.bechinger@uni-konstanz.de. (Source: *Electronics World*, December 1996)

SmartPen

IMEC, the Belgian microelectronics research institute, is producing a pen which can transmit what it is writing to a PC.

The pen, called SmartPen, is the result of three years research at IMEC. It uses IMEC's proprietary skills at

micromachining to produce sensors small enough to fit into the barrel of a pen acting as pressure sensors, accelerometers and gyros to measure 3-D tilts, pressures and movements.

These readings are fed to an RF transmitter, also in the barrel of the pen, and transferred to a PC where they are stored as digital files.

IMEC reckons the device will be favoured by banks which are keen to find solutions to the problems posed by signature recognition. (Extracted from: *Electronics Weekly*, 27 November 1996)

Extra-long embossed electronic component carrier tape

Sumitomo 3M Co., Ltd. has started marketing a newly developed extra-long embossed carrier tape for conveying resistors, capacitors and other types of electronic components smaller than 1 mm for automatic mounting onto printed circuit wafers.

With the downsizing of electronic device, discrete components, capacitors and resistors are now produced in chip form, and more recently, with the wide use of audio-video (AV) equipment such as combination type camera-VTR units, liquid crystal TV sets, notebook type personal computers and mobile communications equipment such as portable telephone sets, the sizes of chips are rapidly falling to as small as 1.0 mm x 0.5 mm, and are likely to be produced in even smaller sizes.

This 3M embossed carrier tape is made of polycarbonate, an engineering plastic material, for the first time from the aspects of formability, transparency and to produce the film in a long configuration. The tape can also be produced in a pitch of 2 mm in addition to the usual 4-mm pitch, and embossing to 0.6 mm x 0.3 mm is also possible. The carrier tape is available in a maximum length of about 4,000 mm, width of 8 mm and in a level wind (long spiral wound form), so taping is possible for a longer period of time than before without having to replace tapes frequently on production lines.

Further details form Sumitomo 3M Co., Ltd., 2-23-1, Tamagawadai, Setagaya-ku, Tokyo 158, Tel.: +81-3-3709-8169; Fax: +81-3-3709-8751. (Source: *JETRO*, September 1996)

High performance vision sensor

Mitsubishi Electric Corp. has started marketing a newly developed vision sensor AS50VS-GN for character recognition and inspection in 256 graduations of contrast. As a result, the recognition of workpiece imprints and cast characters, which had been quite difficult up till now by binary image processing, can now be achieved with ease.

The new vision sensor uses character recognition function by applying neural network technology. The sensor incorporates a neural network based on binary imaging and a neural network based on contrast imaging. Character recognition is possible even if there are differences in the sizes and calligraphic styles of the characters.

System operation adopts a Japanese language menu selection system based on the use of track balls, which eliminates the need for preparing programs, and while the character recognition speed is slower than that of the binary imaging method, character recognition is possible at a speed of up to 50-60 mm/character/sec.

The new vision sensor can be incorporated in the company's sequencer to enable high-speed data transfer and eliminate unnecessary wirings. The company plans to market the new vision sensor for application to automobiles and iron and steel-related machines in which the demand for the vision sensor is increasing, as well as the company's sequencer that is used in a wide range of fields.

Further details from Mitsubishi Electric Corporation, Public Relations Dept., 2-2-3, Marunouchi, Chiyoda-ku, Tokyo 100; Tel.: +81-3-3218-2172; Fax: +81-3-3218-2431. (Source: *JETRO*, September 1996)

Compact hi-definition video/audio storage and transmission system

Kokusai Denshin Denwa (KDD) Co. Ltd. has developed a portable type compact Video/Audio Storage and Transmission (VAST) System-Compact using the INMARSAT satellite circuit, ISDN circuit and telephone circuit for high-definition sound and image transmission.

VAST-Compact was developed based on the information compression technology for transmitting image signals called MPEF, and a high-speed conversion technology developed by the company enabling flexible transmission on circuits of various speeds. Image signals normally requiring a digital circuit of roughly 45 Mbit/s are compressed, then stored, and transmitted at 2.4 kbit/s-1.5 Mbit/s. The system is usable for transmitting news reports including high-definition images from regions lacking telecommunications infrastructures, for example, by using the system in combination with an INMARSAT portable type Earth station and via the INMARSAT satellite.

The new system was developed in response to user demands for a more compact, lightweight and clear image system.

Further details from Kokusai Denshin Denwa Co., Ltd., (Japan's Global Communications) Public Relations Office, 2-3-2, Nishi-Shinjuku, Shinjuku-ku, Tokyo 163. Tel.: +81-3-3347-6939; Fax: +81-3-3347-6953. (Source: *JETRO*, September 1996)

Antenna reduces VDU stress

An autonomous antenna that requires no wiring or plugs has been patented by French company Tecnosphere as a solution to the problems of stress and other health problems encountered by users of VDUs (visual display units). The Tecno AO is a magnetic oscillator that is attached to the side of the VDU—a computer or TV screen—in a vertical position. The device then oscillates in a regular and continuous manner to counteract the effects of the multi-frequential electromagnetic radiation generated by the VDU.

The operation of the device has been studied by the Department of Occupational Health at the Cochin Hospital in Paris. Tests on 119 VDU operators showed an average increase of 15 per cent in overall resistance to stress and a 23 per cent increase in concentration. Other clinical signs of stress, such as headaches, eye problems and irritability, were also reduced or even eradicated. UK distributors for the device are now being sought. (Source: *Engineering*, December 1996)

F. SOFTWARE

Virtual worlds

Virtual worlds, environments explored using an on-screen representation of oneself, called an avatar, are the latest Internet phenomenon. At their most basic they are fascinating graphical extensions to the textual Internet Relay Chat (IRC). At their most complex they become three dimensional landscapes in which one interacts with other avatar "citizens". Virtual worlds and avatars stem from the search for new ways to interact with computers. Windows, files, folders, and drop down menus are seen as limitations that might be replaced by more human-like interaction.

AlphaWorld, developed by Worlds Inc., is the quintessential virtual world with over 100,000 citizens. To get in, users download the Active Worlds browser, fill out a registration form, receive an immigration number via e-mail, choose an avatar to represent themselves on-line and start virtual living. Users can find some land and build a home, a business, a community of friends or just wander around. Each avatar is visible to others and interactive speech is displayed in a box at the bottom of the screen.

Worlds Inc. has also crafted a virtual library for IBM, the Arctic Lights virtual world for Nokia, and a three dimensional banking prototype for VISA. Trade show organizers are looking over their shoulders at the launch of Virtex 96, a year round virtual reality computer trade event from SuperScape that has the virtue of a complete absence of computer salesman avatars. (Source: *Communicate*, November 1996)

On-line information in the 1990s

The on-line industry is a multi-layered business and involves many players from different markets. The information providers include traditional and new online hosts, database producers; and infomediaries/information brokers. Technology has been a key facilitator in both the use and development of information. As information industry companies have adopted new technology, there has been a correlating change in types of end-users. Technology has been developed from DOS-based command language systems to Windows and emerging Internet products and shows how the end-user market is changing. Industry issues which have arisen through the advent of the new technology are copyright protection; pricing; security of information; and quality of information. The role of intermediaries including journalists, authors, Web page designers, telecoms companies, politicians, etc., need to be considered as their impact is often underestimated.

In order to predict the future, it is best to look back first. It is likely that the new technology will continue to provide the biggest impact on the marketplace. The Internet, currently in its infancy, will be the most probable platform for information dissemination. It is expected that users will begin to discriminate between information due to information overload. It is likely that the Internet will split between consumer/leisure products and professional information, while users will continue to demand more value for money as the number of competitive products increases. Information providers and hosts will be required to add more value to their products and take more responsibility for finding solutions to industry issues such as copyright. Market consolidation will probably occur with a number of mergers among information providers, which can only be good news for the end user. (Source: *Managing Information*, 3(11) November 1996)

Information development methodology for the WWW

Increasingly, the Internet's World Wide Web has been used as an information dissemination platform for business and technical information; entertainment; education; publishing products; government information; and research. It has expanded rapidly and contained over 85,000 sites holding an estimated 25 million pages of information by 1996. However, such a rapidly expanding environment can quickly become technology-oriented, and technical communicators need a broader, more process-oriented approach. Developing information for technical communication requires planning, analysis and design skills. Developing information for the Web should rely not only on HTML implementation skills and page layout techniques, but should also include a set of processes. The media characteristics of the Web are that it is unbound in space/time; bound in use context through associative linking; and is organized as a distributed, non-hierarchical system. A Web work should be multi-role; porous; dynamic; interactive; and competitive.

The suggested methodology includes the following elements: audience information; purpose statement; objectives list; domain information; web specification; and web presentation. The six processes needed to develop these elements are planning; analysis; design; implementation; promotion; and innovation. This contains many of the same elements as a traditional information development process and resembles software engineering practice to some extent. However, there is no final state that is analogous to a completion date for a paper document, software or CD-ROM as every day is a new deadline and brings a new information environment. To design a Web, it is necessary to have a thorough grounding in hypertext, multimedia, Java, and other programming possibilities, in addition to knowing how web structures affect an audience. As a web is a round-the-clock interactive service, developers should expect feedback from users and anticipate changing needs. Key innovation practices are continuously and creatively working for improvements to meet user needs which are based on analysis, user testing, and focus groups. It is also necessary to identify new technologies that could better meet user needs. (Source: *Technical Communication*, 43(4) November 1996)

Data delivery via satellite

Many Internet users are looking for faster alternatives to the conventional telephone modem. ISDN, cable modems and XDSL (a high-speed data link between home and the telephone exchange) represent some of the options. Now, there is another: data delivery via satellite. This offers the prospect of receiving data at speeds of 30-40 megabits per second. A 5 Mb file could be transferred in less than a second.

The business world has been using the technology for a number of years. Many commercial systems employ VSAT (very small aperture terminal). This comprises a small satellite dish (between 60 cm and 1.2 metres in diameter) and

associated electronics, linked to a computer network or even an individual PC. The costs compare quite favourably with those associated with land-based systems.

Now, a number of suppliers are looking at the domestic market, and in particular, at SoHo (small office, home office) users. In September, Hughes Olivetti Telecom launched a new, one-way VSAT service in Europe, DirecPC. Operating in conjunction with the Eutelsat II satellite, it links up with individual PCs and transmits data at 6-12 million bits per second. DirecPC will initially be aimed at large businesses needing to deliver data packages to branch offices or individual employees, and will also be used for training and distance learning. There are plans, however, to target home users early in 1997. (Source: *Personal Computer World*, December 1996)

Data warehousing

Data warehousing has the capability to support the core business of an organization directly and effectively. It can contribute to the performance of the bottom line. Successful implementation, however, is not always straightforward: what appears to work in a pilot project may not do so in a full-scale version.

Data warehousing need not necessarily be mainframe-based. UNIX-based client/server systems may represent a more appropriate choice for storing and retrieving data. What is crucial, however, is that the correct relational OLAP (online analytical processing) tools be deployed, enabling the user to interact with the data warehouse and extract data in useful ways.

Intranet sites offer a cost-effective solution to the problem of implementing data warehousing, provided adequate attention is paid to security issues. OLAP tools can be used via Web browsers, enabling a user to create a real-time report and send it to a colleague. The colleague, in turn, is able to drill down, or up, on any dimension of the report, pivot and rotate the results, add further calculations and distribute the document further.

In contrast with the high costs associated with client/server systems, those of intranets are much lower. They represent a "thin client" architecture, with greatly reduced communications costs.

The security issues, however, are highly complex. Not only must the data be safeguarded from the prying eyes of competitors, the levels of authorization required internally must be carefully and fully specified. Users must not be able to drill down into areas they are not authorized to examine. (Source: *Information Management & Technology*, 29(6) November 1996)

Mass storage options

Given the huge volumes of data routinely stored by computer users today, there is a probable need for at least two mass storage devices (apart from the CD-ROM drive) to be attached to the personal computer. Both on-line and backup devices with interchangeable media are likely to be required.

Despite its predicted demise, the hard disk is still alive and indeed flourishing. The technology employed continues to be improved. The rule here is to purchase the largest capacity disk available—1 Gb should be regarded as the sensible minimum. Up to a certain point, bigger disks cost less per megabyte than smaller ones.

As regards backup, the traditional QIC (or recently, Travan) cartridge drive is still an appropriate choice. High capacity drives are available for between $120 and $200 (800 Mb to 3.2 Gb capacity). If it is necessary to establish an audit trail, however, CD-R is hard to beat, while for very large files which must be retrieved rapidly, opto-magnetic storage should be considered.

CD-R is also a good option for long-term storage. Drive prices continue to fall, and as of August this year, internal double-speed drives were available for as little as $800 including software. The disks are priced at $6 each in quantity.

One of the more intriguing optical disks currently available is the PD disk. The drives cost about $450 for an internal unit, $650 for an external, and are both 4 x CD-ROM readers and phase-change optical writers. The optical cartridges cost about $50. DVD also offers possibilities, although it is difficult to say at this stage what impact the technology will have on the computer industry. (Source: *Online*, 20 (6) November/December 1996)

Machine minds your language

German researchers are devising software to provide almost instant translations between spoken languages.

The Verbmobil project involves 29 academic and industrial partners, including Siemens, IBM, Philips and Daimler-Benz. The project is being managed by Wolfgang Wahlster and his team at the German Research Centre of Artificial Intelligence in Saarbrücken.

The first prototype is limited to conversations about making appointments, and can translate a limited vocabulary of German or Japanese speech into English.

The researchers have had to overcome fomidable technical barriers to get even this far. To keep the task manageable, they built the system up in modules, including several for speech recognition and analysis, translation and voice synthesis. Because each module performs a discreet function, the researchers can slot in improved software for any of them without rearranging the overall structure.

Even if the machine recognizes individual words, it has a hard job making sense of spoken language. In speech there are no commas or full stops to help as in written language.

Verbmobil tackles this problem in the prosody module, which uses intonation such as stress and pitch to work out the correct phrasing. It should be able to distinguish between a question and a statement, for example. It then overlays this information on the word lattices.

Another module is constantly on the lookout for keywords, to help Verbmobil build a picture of the dialogue so far.

Next comes translation, which needs modules that can untangle the structure and meaning of the word lattices. The system uses two forms of analysis, known as deep and shallow.

Deep analysis searches for strings of words that are structurally correct, and analyses their meaning by referring to a module containing a lexicon of phrases. Shallow analysis extracts messages by picking out words and phrases, such as times or places, and relating them to what it understands of the previous conversation. This is particularly useful if someone is difficult to understand, for example, because of their accent, resulting in a garbled message.

The system then takes another statistical look at the outcomes of the various approaches and picks the most likely result.

A transfer module then translates these phrases into their structurally correct English equivalents and passes them to the English synthesis module, which finally produces the required speech. The synthesizer even mimics the speaker, so it adopts a higher pitch for a woman than it would for a man. (Extracted from *New Scientist*, 26 October 1996)

Talking in tongues

Siemens has demonstrated a speaker independent, context sensitive, speech recognition and language translation system.

It is part of an eight year development programme to allow Germans to negotiate with Japanese speakers using a machine translator.

The system is capable of recognizing the difference in vocal inflection between identically worded German statements and translating them into correctly expressed English, even when there are no directly equivalent words.

To make the task manageable, the scope of the project is currently limited to the kinds of discussions held during the setting up of meetings.

The demonstrator takes three seconds to translate each second of incoming speech running on a workstation with twin UltraSparc processors and 500 Mbyte of RAM. (Source: *Electronics Weekly*, 30 October 1996)

Connections

In response to the growing need for improved medical care for accidents and emergencies in remote locations—such as on board ship—Aries Communications has developed a PC-based satellite telemedicine system called Medisat.

Medisat can provide a real-time satellite link between an injured or sick person in a remote location and a medical specialist anywhere in the world. Medisat carries not only live video and audio links but also a medical telemetry link which, when connected to a medical monitoring unit can also provide a real-time display of the patient's vital signs, such as ECG, pulse, rate, oxymetry, blood pressure, respiration rate and temperature.

Medisat represents a convergence of several technologies—medical monitoring, electronics, satellite communications, and video compression techniques. The system is delivered as standard in a desk-top PC and runs in the familiar Windows environment. Installed in the optional portable military specification PC the whole system can weigh as little as 10 kg and can easily be carried as hand-luggage aboard an aircraft. (Extracted from *Ocean Voice*, October 1996)

Javasoft gives voice to Wind River RTOS

Javasoft, a division of Sun Microsystems, and real time operating system company Wind River Systems (WRS) have signed an agreement to provide the Java with Wind Rivers VxWorks RTOS. This follows Javasoft's recent agreement with Microtec.

Java is not a real-time language and, said David Larrimore of WRS, some amount of mutual development has to be undertaken.

For example, Java, based on C++, requires memory to be allocated before a task is run. Unlike C++, which needs programmers to de-allocate memory when their task is complete, Java includes a routine which periodically frees tied blocks that are no longer required.

This is called "garbage collection" and it takes a variable amount of time. Java did not allow the system processor to be interrupted during garbage collection—an unreasonable constraint for real-time systems—but this has now been dealt with.

Java gives designers of embedded products with Internet or Intranet connection, like printers and test gear, a standardized way of transferring code. (Source: *Electronics Weekly*, 23 October 1996)

Project-status updates

Get instant access to the status and location of all engineering projects in your organization via AutoManager WorkFlow 5 document-management software. Now operating with 32-bit power in Windows 95 and NT, this customizable package manages CAD drawings, Microsoft Office documents, spreadsheets, memos, scanned images, HTML documents, and related data through their document life cycle. Electronic "briefcases" collect documents for Internet or e-mail transmission in a compressed and secure fashion, according to Cyco International, Atlanta. (Source: *Industry Week*, 18 November 1996)

BT's quantum cryptography

Quantum cryptography is the latest technology to come out of British Telecom's renowned Martlesham Laboratories. The technology has been developed to provide secure information transmission over fibre optic networks, but unlike conventional encryption systems, this is not another piece of new software code. BT's team of physicists has come up with a method for optical fibre transmission which guarantees that any attempt at intercepting encryption keys will always be detected.

Digital transmissions along fibre optic cable take the form of a stream of photons, the basic quantum unit of light. Each bit of information is carried by a pulse containing billions of photons. What BT's physicists have done is to encode the key into the polarization of these photons. The data is encrypted and decrypted in the usual way, but the photons themselves carry the key through their polarization. However, the system does not actually polarize single photons: to do so would require network operators to buy expensive parametric amplifiers. Instead it uses a standard infra-red laser and strongly attenuates a very short photon pulse.

So far, BT has demonstrated the system under laboratory conditions for point to point transmission over distances of up to 30 kilometres and point to multipoint passive optical fibre networks. The next step is to start demonstrating the technique on the ground and to continue the development of the single photon detector. (Source: *Communications International*, October 1996)

Latest security hardware and software

A wide range of hard- and software products are available to help ensure corporate networks are able to exclude unwanted visitors. They include encrypting firewalls and routers, secure TCP/IP stacks protected e-mail packages, auditing and virus protection tools, and authenticating Web browsers and servers. A section of this review is devoted to each of these categories.

Firewalls represent only the first line of defence. Once TCP/IP packets pass beyond the firewall, they can be intercepted. For this reason, about a dozen firewall suppliers—including Border Technologies, Checkpoint Software Technologies, and Trusted Information Systems—have added encryption to their products. To ensure systems from different suppliers can still talk to each other, however, many support standard schemes such as IPSEC (IP Security), from the IETF (Internet Engineering Task Force). Secure routers from companies such as Cisco Systems, Network Systems and Uunet Technologies also employ IPSEC.

Lighter-weight protection schemes such as S/MIME (Secure Multipurpose Internet Mail Extension) and PGP (Pretty Good Privacy) are perfectly adequate for e-mail

messages sent over the Internet. For creating secure sessions between Web browsers and servers, however, two other technologies have found favour: secure HTTP (hyptertext transfer protocol) and SSL (Secure Sockets Layer).

Some suppliers offer certification products which verify users' *bona fides*. They include Cylink, Information Resource Engineering and Western Datacom. Corporate networkers can also add another layer of protection by using token-based systems, such as those offered by Security Dynamics or Digital Pathways. (Source: *Data Communications—Networking Directory Issue,* 21 August 1996)

Public key encryption

The slow progress of SET (secure electronic transactions), the specification being developed by Visa and MasterCard, illustrates some of the inherent security problems and administrative overheads associated with public key encryption. Some banks are suggesting that the logistics involved in implementing SET are such that further work needs to be done, otherwise the cost of creating secure systems will outweigh the perceived risk.

Another concern is the security of public key systems generally. Recently, a message encrypted with a 40-bit key was decoded over one weekend using a network of workstations, raising fears that 56- or 128-bit keys may soon be vulnerable.

Despite the likely delays and frustrations for those anxious to see the system in place speedily, there is no obvious, viable alternative. Secret key encryption is more efficient, but is unsuitable for mass markets. (Source: *Computing*, 17 October 1996)

The growing use of "cookie" files

If, after surfing the Web with one of the common browsers, you look at the files on your PC's hard drive, you may find a file called "cookies.txt". The contents of the cookies file will tell you which of the sites you visited tagged you for surveillance purposes.

As you move from page to page a "cookie" keeps track of the length of your stay and can also help monitor the selections you make. The host of any Web site can gain access to statistics which provide details of hits or accesses made to the site. The statistics can be analysed to discover from which domain name they originated and in some cases the country from which the user accessed the site. Despite this the anonymity of the user remains intact: protected by firewalls or proxy servers.

Now two companies are hoping to cash in on cookies. PrivNet's Internet Fast Forward (IFF) enables browsers to ignore advertisements, to turn off cookies and to limit the size of graphics loaded with a web page. The software is free but there is a charge for the filter updates required to detect new advertisements.

Optimal Networks supplies the server rather than the client market and its Internet Monitor product is used by network owners and web site managers to analyse traffic. A key feature of Internet Monitor is its ability to translate an IP address into a DNS name. While the aim of the software is to assist in network planning, the company admit that the owners of some networks are using it to control their employees' access to the Internet. (Source: *Communications International*, October 1996)

Keep networks safe from viruses

Viruses have been a problem for years, but the threat is heightened by the increasing incidence of interconnected systems. Networks permit viruses to spread rapidly through the system. Contrary to popular opinion, operating systems other than DOS *are* vulnerable. Fortunately, a comprehensive backup plan and centralized antivirus scanning can help minimize the problem.

The more effective antivirus procedures are those applied to the whole enterprise. They use the network itself to report any problems and distribute antivirus software updates, and—via the use of log-in scripts—enforce the regular use of that antivirus software.

Viruses can enter a system at a number of points. Each potential point of entry requires its own protection plan. Infected floppies put the local server at risk. The appropriate counter-measure is to use a virus checker to screen floppies locally. A virus resident on a server puts all users at risk. This should be addressed by running daily virus scans, combined with comprehensive backups and audit trails. Mobile or remote users may unwittingly transfer viruses in the large volumes of data exchanged or updated when they are connected to the host server. All files should be scanned before uploading or after downloading.

The frequency with which checks are made should be determined by the volume of work passing through the system, and the frequency with which it is used. It is essential that antivirus programs be updated at regular intervals, as new viruses, and variants, appear all the time. Updates should be distributed in a timely fashion to all sites. (Source: *Byte*, November 1996)

Measures against software piracy

Software piracy can act as a form of promotion, in that many unofficial copies on office machines are subsequently replaced by licensed versions. Netscape indicated last year that most of its income came from companies registering copies of *Navigator* downloaded by staff. None the less, illegal copying continues to be a major concern for software companies.

The UK organization, Federation Against Software Theft (FAST), was established in 1984. It distinguishes two broad categories of piracy: simple copying, and actual counterfeiting. Copying on a commercial basis has been simplified by the appearance of inexpensive CD recorders. They are used by highly-organized groups which sell their products partly via street markets and car boot sales, but mainly through "black channels", which exist in parallel with legitimate distribution channels.

It is not only the software companies which suffer from piracy. Purchasers of copied software lose out when they need to upgrade their systems, or require technical support, since they will then be forced to pay the full cost of a legitimate package. Legitimate PC suppliers suffer from being undercut by less scrupulous competitors. Ironically, some pirates find that their work is copied by their rivals, and have resorted to inserting signature code and Trojan horses on their disks to discourage copying which omits the signature.

Corporate attitudes have changed in recent years. At one time, they took a relaxed view of copying. Now, they recognize that expensive problems can result from the use of unauthorized products, and are more vigilant as regards monitoring what is on their computers. (Source: *Personal Computer World*, November 1996)

SGML Versus Acrobat: which to use for CD-ROM/on-line publishing?

Among the most promising contenders for digital-document-delivery dominance, Adobe Acrobat's Portable Document Format (PDF) is far and away the leader. PDF is not alone in offering a medium which acts as an excellent

legal archive, since the delivery medium is read-only and therefore cannot be edited and must always be produced from another source. But unlike the other contenders, Adobe Acrobat's PDF is a de facto open standard, based on PostScript.

The format delivers virtually perfect colour renditions of paper originals, and virtually perfect renditions of fine layout details, fonts included. It also supports the easy creation of hypertext links. Furthermore, using Acrobat requires essentially no setup, nor any training to speak of to produce PDF or to use it. In essence, if you can print, you can produce PDF. Not only is PDF easy to produce, it is binary compatible on all major platforms. You can produce PDF on WinTel platforms, Macintosh systems, and UNIX and you can view and use the results on DOS and the production platforms. The viewer, called Reader, is freely distributable.

SGML's payoff is an annuity stream that lasts for a long time. However, no one says that the initial investment in SGML is cheap or easy. You must spend energy to analyse your present document needs: what kinds of documents are you likely to want to derive from your document investment, and what navigation aids will you want to automate. (Source: *CD-ROM Professional*, 9(10) October 1996)

CD-ROM networks-in-a-box (two products compared)

Two diminutive, box-based products promise full-service multi-protocol CD-ROM network management for about $900. Axis 850, from Axis Communications, and TopSpin, from Compact Devices, both offer self-contained *NetWare* and Network File System (NFS) access, simultaneously. Axis 850 also supports Microsoft's *Server Message Block (SMB)* protocol, the new *Windows NT* equivalent of Novell's *NetWare Core Protocol (NCP)*. TopSpin also supports Web access, and Axis claim to be considering adding this feature.

TopSpin comes in two versions: one offers a standard 10BaseT connection, the other a BNC 10Base2 attachment. The Axis server is also sold in multiple configurations. Using an inbuilt bay which accommodates an existing (user- or dealer-supplied) CD-ROM drive, it is sold in an Ethernet version as the Axis 851. There is also a Token Ring version with an internal drive, sold as the Axis 951. (Source: *CD-ROM Professional*, 9(10) October 1996)

Event-based personal retrieval

People handle large amounts of information in the course of their working lives and these collections can need some kind of retrieval aid. Personal information retrieval is different from conventional retrieval in that the required data was once known to the searcher so the retrieval system will be most effective if it can help and be helped by the searcher's own memory. In addition, there is a wide variation of the items being retrieved which range from a name or a telephone number to the contents of a research report. Personal information can fall into two broad classes—events and documents. The University of Kent is currently engaged in a project to investigate techniques for the use of Memory Repositories (event-based personal retrieval systems) which is building on the Pepys and Forget-Me-Not projects undertaken at the Rank Xerox company which feature battery powered identification badges (active badges) which could be detected electronically.

As people in an academic or research environment spend a great deal of time at a computer terminal, information can be captured electronically using hand-held personal computers (personal digital assistant or palmtop computers). While it is possible to capture detailed information about the working life, information is generally at a lower level than events that are remembered. The hive event browser takes a low-level approach and is the first attempt to develop a graphical event browser.

The most important browser requirement in a large, complex structure is that it should allow the user to build up a mental picture of the whole system by viewing parts and seeing how they fit together. The hive browser allows users three ways to create a new event sequence—searching; expansion; and matching. Four queries are discussed and screen examples given. It is concluded that it is too early to say how effective event-based personal retrieval is. The hive approach of combining and manipulating event sequences seems to provide effective access to event-based data. However, it is less easy to say how successful it is at solving personal retrieval problems. More research needs to examine the temporal relationships between past events as an effective retrieval aid. (Source: *Journal of Information Science*, 22(5) 1996)

How to get ahead in Web sites

The key to building a Web site is to plan ahead. The design team should start by asking lots of questions and gathering content. Your potential designer may not come to the door with all team members in tow. Often, small companies have a series of stringers they hire to handle the graphics and programming parts of each site. Designers should provide a quote for your whole site which is based largely on the number of hours it will take to create it. Be cautious of anyone offering "price per page" quotes. A Web site is an integrated presentation of some aspect of your business, not a bunch of pages stuck together.

Obviously, you want to put "not to exceed" limits into your contract but the idea of scaling the cost of the site by the effort it took to build it makes a lot of sense. Some designers will want to package the site as a fixed- priced deal. That is fine too if the designer can also tell you immediately approximately how many hours that price represents.

Every site requires maintenance. Information has to be updated and the site has to have a fresh face to entice users to revisit it. Make sure maintenance responsibility and costs are agreed at the beginning. Maintenance costs may even exceed the costs of the original site within the first year. If your designer is out of this world, he or she will be so busy they will not have any interest in going back to the unexciting work of keeping your site up to date. Protect yourself by signing a contract that guarantees you will get a piece of their time to keep things current.

A Web site has to be hosted somewhere. You can put it on your company's own computers or pay an outside service to host it. Some hosting services will design your page as well but you should insist on designers or services breaking up the pricing and allocations of the two components. You may be getting a good deal but you need to know what you are paying for. (Source: *Internet World*, Autumn 1996)

E-mail address databases

A successful search on the Internet for an e-mail address depends less on the skill of the searcher than on whether the available databases contain the required information. It is a good idea, however, to search multiple databases, as no single source is sufficient.

If the employing organization is known, searchers can access the Web site to determine whether the institution maintains its own local e-mail database. If this option is not available, the next step is to try one of the Internet-wide databases.

One of the larger and better-organized of these is *Four11 Directory Service*, which also includes a US telephone number database and a much smaller file of NetPhone users. Search options include first and last names, domain, city, state and country. Its correct use of the AND operator means that searches result in fewer duplicate entries than some of its competitors.

Another database is the *Internet Address Finder (IAF)*, with about four million entries. Truncation is available, but is not automatic. The results display gives not just the name and e-mail address but also details of the organization, when the record was last updated, and an attempt to display a link to the appropriate Web site (the latter is often inaccurate).

Other databases include OKRA, with a claimed five million entries, and *WhoWhere?* The former offers only a single line entry box, but works well for simple searches.

Apart from the above, a longtime standard database to search is the Usenet database, which includes a clearly delimited subset of e-mail addresses. Many e-mail lists are mirrored on Usenet. (Source: *Database*, 19(5) October/ November 1996)

Getting real about virtual private data nets

The idea of replacing remote access networks with Internet-based facilities is rapidly gaining acceptance with many large organizations. This arrangement, referred to as a virtual private data network (VPDN), can reduce costs substantially. Implementing the new systems, however, may take longer than anticipated: creating *secure* Internet links requires serious effort.

Digital Equipment Corporation (DEC) is replacing the remote access network used by its sales force—which allows access by 2,000 users via an 800 number—with an Internet service. The cost of the current system is $2 million a year: DEC believes that a secure VPDN will cost only $1.05 million a year. The savings would be even bigger were DEC replacing a private-line network.

Security weighs heavily on the minds of net managers. DEC is using its own security software, *Alta Vista Tunnel.* This establishes an encrypted "tunnel" through the Internet for DEC applications, by encapsulating packets within TCP/IP. It requires authentication software on the server ($995), as well as client software ($99 per client).

This solution, however, does impose a performance penalty. A number of suppliers, therefore, are introducing dedicated compression chip sets. They include Cisco Systems, Novell, Bay Networks, DEC and Microsoft. Performance generally is also variable. Internet service providers (ISPs) could facilitate acceptance by offering service guarantees. Another problem is the administrative burden associated with implementing an effective security system. This can include the maintenance of access lists and the distribution of private or public keys. (Source: *Data Communications*, September 1996)

A Web site

There are three specific types of Web site: the basic, promotional type; one with content (such as searchable databases and links to other sites); and transactional sites, where business actually takes place. Before implementing a Web site, companies must be quite clear as to which type they require. Unfortunately, all too many sites serve no obvious purpose.

Content is important. A site needs to satisfy at least one of the three Rs: reference, recreation or reward. The key feature of the Web is its interactive nature, so a visit to a given site must be rewarding if it is to become popular. It should not, however, be overly complicated. People are discouraged by sites which require the latest version of *Netscape* or *Explorer* in order to use it properly. They also become irritated by long download times, so graphics should be used with discretion.

It is essential that the existence of the site be publicized at every opportunity. The URL should be displayed wherever the company logo appears, whether on stationery, vehicles or press advertisements. It is also a good idea to collaborate with other companies whose products complement your own, arranging for links between each other's sites.

Web sites should not be mounted prematurely: all too many appear with "under construction" labels on them. Once a site has been set up, it is important that it be maintained. If it disappears after a short period, customers may assume the business itself has failed.

Measuring the return is straightforward if the objective is to sell products via a credit card ordering system, less so if the site is merely for promotional purposes. It should be remembered, however, that the medium is less expensive than television or print. (Source: *Internet World*, Autumn 1996)

Introducing an intranet: the management issues

An intranet is an internal Internet—it uses the same technology as the Internet and the difference is that, while the Internet has open, world-wide access, an intranet is used by a closed, relatively tightly defined community. Typically, they are used by single organizations or parts of organizations to facilitate internal communication and share information. Information ownership needs to be addressed from a number of different perspectives including protectiveness; editorial control; whether to push or pull information; and information policy. The most difficult issues are related to organizational culture which includes consideration of access to information and technology; policies; skills; and different working practices.

An increasing number of public authorities are realizing the value of an intranet. Some have put effort into developing an Internet presence for the delivery of information and services and have realized the potential for internal use. It is concluded that the issues surrounding the introduction and use of an intranet are centered on the technology, information and culture in ascending order of difficulty. As the technology is standard and used widely, the primary issues relate to the information. Technology, or the lack of it, cannot be used as an excuse for failing to address the information issues. Intranets offer information professionals the opportunity to use their skills by addressing and solving the information issues and contributing to the debate on cultural change. (Source: *Managing Information*, 3(10) October 1996)

Internetworking

Net managers required to link the corporate net with outside services, notably the Internet, face bandwidth shortages, rising prices for remote access and expensive mainframe connectivity. New devices, however, are making the task slightly easier.

New switch-router hybrids deliver high-speed routing, while server-based routers and low-end ISDN routers help to cut the cost of connecting branch offices and teleworkers.

Despite predictions that switching would render routers obsolete, routing is still very much alive: last year, sales of routers exceeded $4,000 million world-wide. Some of the more modern routers, however, reveal an unfamiliar architecture, combining the intelligence of routing with the speed of Layer 2 switching. The ATM 1600 IP, from Ipsilon Networks, for example, offers IP routing over an ATM switching engine.

Although speed is of the essence at headquarters, cost-effective routing is crucial at branch offices. Server-based routers may offer an answer. Three basic schemes are available, from Microsoft and Novell. Software-only server-based routing, however, suffers from the drawbacks of increased overheads and less certain reliability. Routers on a card, such as Source-Comm's Incarda, offer a solution to both problems. Costs can also be held down by using personal ISDN routers on remote sites. Priced at less than $1,500, these allow users to take advantage of ISDN speeds. Some can also share an ISDN line with voice or fax traffic, or combine multiple networking functions.

SNA and intranetworks can be integrated with SNA gateways and SNA encapsulation. Both approaches have seen considerable activity this year. (Source: *Data Communications*, 21 August 1996)

Neural intelligent agents

AutoNomy's Agentware technology was announced in 1996 and over 10,000 copies were downloaded from the company's World Wide Web site within two weeks of launch. The Autoware agents are designed to be easy to use and require no prior technical knowledge. The user briefs the Web Agent with information about a subject area in plain English and can then send it out into the World Wide Web to find and evaluate new material.

Anyone with a PC and Internet connection can have a free trial version for 30 days, in which they will get three fully functional retrainable Web Agents and a number of other agents pre-trained in popular subjects. Pre-trained agents can be downloaded or purchased with a library of information on popular subjects already to hand. An agent's owner does not need to be connected to the Internet while agents are abroad: agents can go to a staging post known as a Kennel to await connection. Kennel services are provided by AutoNomy itself or by Internet Service Providers, for a small monthly fee.

AutoNomy provides agents pre-trained in various fields. Three are available so far: Press Agent is included in the trial version of Agentware, and collects and compiles a personalized newspaper for its user. It is designed to be able to access all newspapers and magazines on the Internet: it can be configured to use passwords and registration details to get at those sites which require registration or charge subscription. Mail Agent collects, sorts and prioritizes e-mail messages by analysing their content. If it feels an e-mail is urgent enough it can alert the user to its existence or even fax it. Guardian Agent prevents obscene or violent material from reaching the user's computer. (Source: *Online and CDROM Review*, 20(5) October 1996)

Lab test: speech recognition software

At present, most dictation-based, commercial speech recognition systems—including the three products reviewed here—are incapable of continuous speech recognition. Current levels of desktop computer processing power impose limits on what is possible. In order to work with existing systems, it is necessary to modify one's normal speech patterns, inserting pauses between each word.

DragonDictate for Windows 2.1 (£399 for 10,000 words) required a 66 MHz 486DX2 with 16 Mb of RAM and 26 Mb of hard disk space. It gave the best trained accuracy score in the test. In addition, formatting of the text as it was created was straightforward. On the other hand, it is necessary to correct errors as work proceeds, otherwise accuracy does not improve.

Kurzweil's *Voice 2.0* (£595) required a 75 MHz 486DX4 with 16 Mb of RAM and 30 Mb of hard disk space. It offered a 200,000 word vocabulary, with 60,000 in active memory. On the other hand, it confused commands and text.

The best overall was IBM's *VoiceType Dictation 3.0* (£535 for a single user). This required a 90 MHz Pentium with 256 k of Level 2 cache, 16 Mb of RAM, a CD-ROM drive, 38 Mb of hard disk space and *Windows 95*. It allowed for delayed or delegated correction, and trigram analysis gave excellent recognition accuracy. The only significant limitation was speed: there was a definite lag before what was said appeared on the screen. (Source: *PC User*, 16-29 October 1996)

Virtual Reality Modelling Language (VRML)

VRML is a means of describing three-dimensional networked scenes, via the Internet and hyperlinked through the World Wide Web. VRML 1.0 supports worlds with relatively simple animations while VRML 2.0 (just published) supports complex 3-D animations and simulations, for example involving Java applets that act upon VRML objects. VRML 1.0 derived mainly from Silicon Graphics, Inc. and the Open Inventor file format VRML 2.0, which adds many interactive capabilities, was designed by the same team with contributions from Sony Research and Mitra.

As with HTML, a VRML file is tagged text, which can be created and edited in a word processor, but there are special authoring packages to make life much easier. In addition there are conversion programs to convert other types of 3-D files to VRML. From the description received by the VRML browser, the renderer creates visible representations of the objects described in the VRML documents and displays them. A VRML world can be distributed across the Web in many different places, and other world files may be imported as inlines to help create a VRML scene.

The latest (August 1996) versions of the two most popular Web browsers both support VRML. A new feature called Live 3D adds VRML viewing to Netscape Navigator 3.0, letting you walk, fly, or point, with selectable camera viewpoints, collision detection, and optional gravity. It is initially available for Windows 3.1, Windows 95, Windows NT, and Power Macintosh. Versions for 68K Macintosh and Unix are under development. From Microsoft comes VRML Support in Internet Explorer 3.0 for both Windows 95 and Windows NT 4.0. You must have at least a 486/33 DX computer with 8 megabytes of memory and a fast video card. (Source: *Digital Publishing Technologies*, 1(9) September 1996)

Traffic in (Web) graphics

The Web authoring language, *HTML*, is somewhat limited in its handling of graphics. Nonetheless, a little ingenuity can produce interesting effects, even without the use of *Java*. The key to getting the best out of Web graphics is to understand how GIF and JPEG files work.

The GIF (Graphic Interchange Format) was the first to allow the display of graphics without the need for an external viewer. Developed by CompuServe in the mid-eighties, GIF files are limited to 256 colours, but are none the less far from unsophisticated. One colour can be defined as transparent, so

that an underlying colour shows through. GIFs can even display simple animations. There are two main methods of getting the best from them when they will be displayed using a variety of browsers: reducing the bit depth, and to employ only the colours used by *Navigator's* internal colour palette.

JPEG files always use full 24-bit colour, so viewing them on a 256-colour monitor results in an unpredictably dithered image. JPEGs also lack some of the options offered by GIFs, such as transparency and built-in animation. On the other hand, the files can be very much smaller, due to superior compression ratios.

There is much activity at present concerning the use of Netscape plug-ins to add new ways of displaying graphics. Infinet's *Lightning Strike*, for example, uses fractal compression to produce smaller files with less degeneration of quality than is the case with JPEG. Other techniques being explored include wavelet compression, and the use of vector graphics rather than bitmapped graphics. (Source: *Internet World*, Autumn 1996)

The CAJUN project

The CAJUN (CD-ROM Acrobat Journals Using Networks project, which is investigating the electronic dissemination of journal articles using Adobe Acrobat technology, entered its second phase in December 1995. Sponsored by the publisher John Wiley and Sons, it is being led by the Electronic Research Group at the University of Nottingham in association with two local specialists, Electronic Publishing Solutions and Merlin Open Systems.

It opted to use Adobe Acrobat software and its underlying PDF (portable document format) technology: a sound decision, it turns out, as Acrobat technology is now as close to an industry standard as they come. CAJUN's overall aim has been to develop a methodology which would enable journal publishers to prepare papers in the normal way, with their normal front-end typeset suppliers, and then output electronic versions with minimal extra effort.

Its first phase was a pilot focusing on a single computer science journal, which resulted in software which would take a postscript file and produce a PDF file in which all the hyperlinks were automatically placed, for example between citations and references. For CAJUN II, Wiley asked for "commercial strength" application of this technology, to make it applicable to a wider range of journals. Eventually there would be large-scale corpuses of documents available both on CD-ROM and the Web, with automated hyperlinking in place. (Source: *Digital Publishing Technologies*, October 1996)

3-D imaging pinpoints tumours

A better cure rate for cancer patients is the potential for visualization software that allows doctors to view tumours as detailed 3-D images. The key is in the software's ability to work from 2-D CAT-scan X-rays. With the enhanced view of the tumour, physicians can avoid damaging adjacent critical organs. Pinnacle[3] has thus far been used on 100 patients by Dr. Daniel Fass, director of radiation oncology at Greenwich Hospital, Greenwich, CT. The software, now produced by ADAC Laboratories, Milpitas, CA, was originally developed in 1988 by Dr. T. Rock Mackie, a medical physicist at the University of Wisconsin. The technology is available at 15 hospitals in the USA. (Source: *Industry Week*, 19 August 1996)

Organizing the Internet

The Internet searcher has two main directories of intellectually organized site lists which can be browsed using an hierarchical menu structure and search engines; and automatically generated indexes that can be searched using free text. Examples of the former are general directories such as Yahoo with recently launched UK offspring such as BUBL for the library/information area. Examples of the latter are Webcrawler; Lycos; Alta Vista; and Infoseek. Regular Internet searchers know that finding things on the Internet is not like finding things in on-line or CD-ROM databases as good material is missed and garbage can be generated. This can be improved by using finding tools that are based to some extent on the use of metadata—information about the nature of the resource that they describe. One form of familiar metadata is an AACR library catalogue record, but this usually requires a great deal of modification. One alternative to the AACR record is the IAFA/Whois plus template is a relatively simple attribute-value based structure which originally devised to describe the contents of items available for downloading via the Internet from ftp sites via the Whois electronic mail directory system.

A simpler approach is the Dublin Core which has been specifically devised to describing Internet resources with 13 fields. Its aim is to provide a level of description between AACR and the free text approach of search engines such as Lycos and AltaVista. At the other extreme, complex metalanguages have been developed, often using SGML (standard generalized markup language) which are adapted to the description of certain item types. Some Internet gurus believe that the answer is to combine resource description information with location—a combination of the URL (Uniform Resource Locator) with a URN (Uniform Resource Name) and URC (Uniform Resource Characteristic), to provide a URI (Uniform Resource Identifier). A number of examples of different metadata format use is given. The incorporation of metadata elements into more Internet resources should make it easier for the searcher, although it is unlikely that a single format will suit every user. (Source: *IT Link*, 9(12) December 1996)

Applications for managing Web data

Symantec's entry into the Net software arena is a mixed bag of Windows 95 applications that includes tools for searching multiple Web search engines, for notifying you of changes to particular Web pages, and for zipping and unzipping files. On first impression it offers little of the clout and authority of its sister product Norton Utilities, however there are a couple of gems within its collection of modestly priced tools.

The first is WebFind, which takes search terms and sends them to several search engines on the Internet. WebFind collects the names and addresses of these pages, eliminates duplicates, eliminates advertising, and sorts them. It then creates an HTML document on your PC containing descriptions of each document and a hypertext link to it. WebFind finally opens that document with your Web browser. Another useful tool is Notify, which allows you to track specific Web, FTP and Intranet sites as well as network files and folders for any content changes since they last connected.

More modest in its ambitions than Internet FastFind is a package called highlights, from Canadian start-up Tierra, that aims to monitor Web sites and does the job supremely well. Where this package comes into its own is that it takes the basic monitoring of tools like Notify and advances it several steps further. First of all, keyword filters can be set to search only for changes that contain specific words or terms. The software can also monitor the results of search engine queries and inform users when new sites that match their interests are

created. The real time-saver, though, is that the user can view any changed page with the updated portion highlighted in a colour of their choice. (Source: *Information Today*, December 1996)

Software piracy

The Business Software Alliance (BSA) and the Software publishers Association (SPA) jointly released a survey on global software piracy estimates in December 1996, finding more than $13 billion lost world-wide to software piracy in 1995.

The survey, conducted by International Planning & Research (IPR), evaluated sales data and market information for 80 countries in the six major world regions and was based on 27 business applications. Data developed for the years 1994 and 1995 produced the following conclusions:

- World-wide software piracy losses are estimated at $13.1 billion in 1995, a 9 per cent increase over the $12.2 billion estimate for 1994. Eastern Europe had the highest overall piracy rates, with an average of 83 per cent. The lowest regional piracy rate was seen in North America, with an average 27 per cent rate.
- Individual countries with high rates include Viet Nam (99 per cent), El Salvador (97 per cent), China (96 per cent), Oman (96 per cent) and Russia (94 per cent).
- By contrast, individual countries with lower software piracy rates include the United States (26 per cent), Australia (35 per cent), the United Kingdom (38 per cent), New Zealand (40 per cent), and Germany (42 per cent).

"Although all regions saw a modest improvement in their overall piracy rates when compared with 1994, software piracy remains at unacceptably high levels around the globe", according to a BSA/SPA release announcing the results.

"Software piracy continues to plague the software industry around the globe, hindering growth and innovation. The industry as a whole and, more importantly, its customers bear the burden of these losses. Global software piracy losses—more than $13 billion—exceed the combined revenues of the 10 largest personal computer software companies. Efforts will continue to stem the growth of piracy, the industry's unfortunate, yet foremost, competitor", said Robert Holleyman, BSA president.

Regional Summaries

Western Europe

With piracy losses in Western Europe exceeding $3.5 billion, Greece had the highest piracy rate in Europe at 86 per cent, followed by Spain at 77 per cent, according to the report. The United Kingdom produced the lowest percentage of illegal use at 38 per cent, a 4 per cent improvement over 1994. Of the largest markets, Germany and France were next with 42 per cent and 51 per cent, respectively.

Eastern Europe

Eastern European countries continued to demonstrate the "worst piracy levels of any region" with Slovenia at 96 per cent, Bulgaria at 94 per cent, and Romania—which showed a slight improvement from 1994—at 93 per cent. The Czech Republic and Slovakia had the lowest piracy rates of the region with 62 per cent each.

United States

Although the United States reported piracy revenue losses of $2.9 billion—the largest revenue loss to software piracy of any individual nation—its piracy rate of 26 per cent (a decrease of five per cent over 1994) "shows that strong anti-piracy efforts continue to prove effective", the groups said.

Latin America

Piracy losses in Latin America exceeded $1.1 billion in 1995. El Salvador again had the highest piracy rate in the region with 97 per cent, followed by Paraguay at 95 per cent and Guatemala with 94 per cent.

There was an overall decline of 2 per cent in the piracy rate from the previous year. "Nevertheless, most countries in the region continue to exceed a piracy rate of 70 per cent", the report noted. Countries where some modest progress is being made include Chile (68 per cent), Venezuela (72 per cent), and Brazil and Mexico (both at 74 per cent).

Asia-Pacific

Piracy losses in the Asia-Pacific region were estimated at $3.9 billion, with Japan alone reporting losses of more than $1.6 billion. Viet Nam and China continue to have the highest piracy rates in the region with 99 per cent and 96 per cent, respectively. These rates were a modest 1 per cent decrease over the 1994 figures.

Australia showed the lowest percentage of illegal use, with a piracy rate of 35 per cent. Of the largest Asian markets, Japan reported a piracy rate of 55 per cent (down 11 per cent over 1994), and Korea 76 per cent (up 1 per cent over the previous year).

Middle East & Africa

Piracy losses for 1995 were estimated at $521 million in the Middle East and Africa. Oman had the highest piracy rate with 96 per cent, the same as 1994, followed by the United Arab Emirates (92 per cent) and Qatar (91 per cent).

South Africa reported the lowest piracy rate in the region at 58 per cent, a significant decrease of 6 per cent over the previous 1994 estimate.

SPA is the principal trade association of the desktop software industry, representing the leading publishers as well as start-up firms in the business, home office, consumer entertainment, and educational markets. The Business Software Alliance represents the following leading publishers of software for personal computers: Adobe, Apple Computer, Autodesk, Bentley Systems, Lotus Development, Microsoft, Novell, Symantec Corp. and The Santa Cruz Operation.

Full text of the release and piracy figure charts are available at http://www.spa.org/piracy/releases/spa_bsa.htm on the Internet. (Source: *World Intellectual Property Report, Vol. 18*, December 1996)

Managing information

1996 marks the 50th anniversary of The Economist Intelligence Unit (EIU), which began in 1946. A major milestone will occur early in 1997 with the launch of EIU's first independent Internet web site. EIU reports on economic, political, and business issues in 180 countries and produces quarterly country reports; annual country profiles; forecasts; and research reports. Between 400-500 titles relating to management, finance, human resources, and the automotive industry are published annually. The research department in London plays an important part in the publication process and is described as a mix between library, statistics, and graphics department. It was formed in 1992 and provided information to authors and editors. Enquiries are received by e-mail, telephone fax. Most on-line searching is done within the unit and the most used data bases and services are Reuters Business Briefing; FT Profile; Dow Jones News Retrieval; Asian Wall Street Journal; Nexis; US Dept. of Commerce's Electronic Bulletin Board; Datastream; and Bloomberg News Service. Staff includes a periodicals librarian who handles 3,000 periodicals subscriptions; three research assistants; and three statisticians. (Source: *Managing Information*, 3(12) December 1996)

An electronic learning network for continuing professional development in information work

With the progressive widening of Internet access, the opportunity now exists for the information manager, information scientist and librarian communities to set about building and participating in Internet-based learning networks for continuing professional development. This is an emerging area for all types of information users and one in which information professionals should be highly visible and on the leading edge. Although not every information professional has easy Internet access at the moment, now is the time to begin building the infrastructure for the future.

A well-focused learning network would be more structured than current open discussion and news groups, and be targeted at specific topics for specific purposes. Participants in learning networks are committed and mature professionals, self-directed and self-motivated learners, committed to a consistent participation over a limited time period in order to achieve particular goals.

Initially, an information learning network might take the form of an Internet site accessible through a standard World Wide Web browser. This might include virtual workshops, on specific topics and led by knowledgeable "speakers", conducted via computer conferencing techniques which allow participants to contribute to the discussions at times and locations which suit them. Also, up-to-date information packages of supporting materials and resources, including documents, online links and access to databases, of relevance to workshops and other topics; brokering access to more formal distance learning materials and purpose built multimedia materials of relevance to information workers; and facilities for using the people resources of the network to arrange situation-based learning, such as tele-placements and simulations. (Source: *Online and CDROM Review*, 20(6) 1996)

Combat e-mail viruses and spies

MIMEsweeper 2.3-2 (£1,995 for ten users), from Integralis, offers protection against e-mail-borne viruses. Designed to be mounted on a dedicated *NT Mail* server, it performs four distinct functions: scanning, content analysis, validation and disposal.

During scanning, it breaks the mail message down into its component parts, unpacking any attached compressed files. Then it employs anti-virus tools, user authentication and lexical attributes to determine what actions should be taken as regards the message, such as placing it in quarantine, informing the e-mail administrator as to its content, or perhaps adding a legal disclaimer before forwarding it to the recipient.

Significant improvements over the previous version include self-configuration and the reduction of processing time to about 0.3 seconds. In addition to *cc:Mail*, it now supports *Groupwise* and SMTP—including backboning of MS *Mail* and *Exchange*. (Source: *PC User*, 30 October-12 November 1996)

Secure IP communications

Many users or would-be users of the Internet worry about the security of data transmitted over the network. The latest annual report from the Computer Emergency Response Team (CERT) states that there were nearly 2,500 reported security incidents, affecting over 12,000 sites, in 1995.

In response to what appear to be well-founded concerns, the next-generation Internet Protocol, IPv6, includes authentication and encryption as necessary security features. These can be employed with both the existing IP and the future IPv6.

Essentially, there are two approaches to exchanging secure data packets. The first is to operate in transport mode: the originating system encrypts part of the Encapsulating Security Payload (ESP) header and all of the transport-level segment, and adds an IP header. The Internet examines and processes the IP header, using the information to route the packets to their destination, but the encrypted contents are hidden. At the other end, the transport-level segment is decrypted. The second approach is to employ tunnel mode: the packets contain an inner packet which is able to cross an Internet firewall. The originating system encrypts the entire IP packet, and adds an IP header. At the destination, the firewall decrypts the packet, and re-transmits it to the internal network. The internal network in turn routes the package to its final destination, where the transport-level segments are decrypted.

Export restrictions imposed by the US and some other countries hinder the deployment of secure IP. Nonetheless, products offering this facility are starting to appear. One recently-announced example is *Secure Wan(S/WAN)*, jointly developed by RSA Data Security and TimeStep. (Source: *Byte*, December 1996)

Software, who needs it

Until recently, designing customized chips has been a highly-specialized, labour-intensive and time-consuming task. Now, however, a number of research groups around the world plan to simplify the process with software packages referred to as hardware compilers. These convert any application program into a list of the components and connections required to make a dedicated chip capable of performing the same functions. Existing software, *netlists*, can then be used to turn the lists into chip designs.

At the University of Toronto, a team has developed *Transmogrifier*, a compiler which allows programmers with no knowledge of circuit design to write their programs in *C*. Groups at Oxford and Cornell have created compilers which work with languages called *Handel* and *Promela*, respectively. Both *Handel* and *Promela* are based on the well-established *Occam*, and support parallel processing. The Cornell team has already used the technique to design customized chips to control modems. Companies such as Hewlett-Packard and Sharp are now expressing interest in hardware compilers, seeing them as a means of reducing the high costs associated with chip design.

The technology does have some limitations. The chips produced are likely to be less efficient than those designed by humans, as the compilers apply general principles rather than produce an optimal solution. On the other hand, their performance is expected to improve over time, and they certainly offer the prospect of rapid and straightforward chip development. Given this, customized chips could more readily replace software applications running on general-purpose chips. (Source: *New Scientist*, 2 November 1996)

Geographical information systems

The GIS industry estimates that 85 per cent of all corporate data includes a geographic component, such as an address or telephone code. Despite this, only about 2 per cent of the data is ever analysed with any geographical mechanism. A geographical information system (GIS), however, permits companies to view their data in ways not otherwise possible.

Spatial information from a large database can be converted by a GIS "engine" into coordinates (longitude and latitude) for each record. The process is referred to as *geocoding*. The graphical front-end then allows the material

to be presented topologically, revealing new relationships between data items. An intelligent layer, such as Informix's *DataBlade* is sometimes interposed between the database and the GIS software, since the former is not usually designed specifically to work with spatial data.

The market for GIS systems, it has been predicted, will be worth £640 million by the end of the decade. Much of this growth is being fueled by the move of applications from "niche" systems to the desktop. Traditionally, GIS products have been reserved for UNIX systems, but increasingly they are available as *Windows* applications. Such applications are being employed in diverse markets, including telecommunications and distribution. Both Oracle and Informix stress that object orientation is not an essential pre-requisite for implementing a GIS. Oracle claims that its *Universal Server* manages various types of data, and treats spatial information as just another data type. Informix prefers to describe its technology as "object relational" as opposed to object database technology. (Source: *MicroScope,* 30 October 1996)

How to prepare for data disaster

Backing up data can be boring, but lightning strikes, hard disk failures, software conflicts, viruses, and goofs can cause enormous problems. For people working alone, important records tend to be stored in a single location. The best solution is to use a tape backup which uses cassette-size magnetic tape cartridges as these are the easiest backup devices to use and most drives will have software that allows for a full backup of the complete hard disk; selective backups of particular files and directories; and incremental and automatic backups. It is important to ensure that the entire contents of the hard disk can be stored on a single cartridge. However, tape is not the most reliable media as it can be wound too tightly, stretched out of shape, demagnetized, ruined by heat, or fail due to a misaligned read/write head on the drive. An old technique is to install a second hard disk and copy the contents of the C: drive onto it. Removable cartridge drives such as Iomega's Zip or high-capacity floppy drives like OR Technology A: drive could be used.

For the user with several PCs, it may be necessary to keep critical data archived for a long time, or have other high-capacity storage requirements. The best option is probably to keep desktops and laptops backed up by a portable tape drive such as Iomega's Ditto Easy 3200. A less expensive but more risky way to back up a notebook PC is to copy files from it to the desktop system, then backup the desktop. A more permanent storage option is to use a magneto-optical drive such as Fujitsu's 3.5 DynaMO 230. Panasonic's PD-CD-ROM drive does double duty as a backup drive and quad-speed CD-ROM player. Larger operations could consider Eagle Nest from Exabyte or Iomega's Jaz, while LAN system backups can be provided by HP Colorado Memory Systems T4000s and the HP Colorado Backup software should be considered.

The commandments for backup are to backup at regularly scheduled intervals; use a different tape for each weekday; keep at least one full backup of the hard disk offsite, in a fire secure area; use a storage medium that is large enough to hold the complete contents; run virus programs prior to every backup; label backup media in pen, not magnetic pencil; store tapes and floppies in cases away from magnetic fields; check backup randomly; ensure back-up media is device independent; and clean tape heads after about 20 uses and retention tapes periodically. (Source: *PC World*, December 1996)

SGML and HTML

The increasing uptake of SGML and HTML has generated a number of trends in how these approaches are applied. The interest in merging SGML/HTML with document management has been largely generated by the increasing maturity of SGML and HTML, which has led to serious users into document management issues relating to their SGML/HTML documents. Most of these users have realized that the benefits of re-use and control over these documents can only be realized by the application of document management techniques.

Experience from SGML/HTML document management projects demonstrates that many traditional document management issues are just as relevant here as elsewhere. However, additional issues also exist, the most important being to determine the Minimum Revisable Unit (MRU) within the documents being managed. The concept of the MRU relates to the level of granularity of control exerted by the document management system.

The increasing maturity and business focus of the SGML industry has led to an acceptance by many players that SGML can often be applied with other techniques rather than in competition with these techniques. A particularly common approach here is the use of SGML as a core document format from which output formats, such as HTML or PDF, are generated. While this approach is not popular amongst some of SGML's more evangelical adherents, many organizations are taking the pragmatic view that in different applications different output formats are applicable.

SGML/HTML users can also now take advantage of a wide variety of products for authoring, editing, parsing, storing, managing, composing, outputting and viewing/browsing documents. These are available from a number of suppliers which further demonstrates the maturity of this area. (Source: *Information Management and Technology*, 29(6) November 1996)

SciFinder 2.0 (direct access to CAS files)

Chemists have been blessed with excellent abstracting and indexing services for nearly a century. Chemical information has grown both in size and complexity over the years and secondary information providers have designed powerful computer-based systems for effective retrieval of chemical information. This has meant that the end-users have been dropped out of the direct information access loop through the chemical information explosion; increased research specialization; and diminishing education and training in basic information retrieval. This has meant an increasing number of competent information professionals. SciFinder is a user-friendly package from Chemical Abstracts Service (CAS) which allows chemists to use CAplus (Chemical Abstracts); REGISTRY (chemical compounds); CHEMCATS (chemical catalogues); and CASREACTS (chemical reactions) files. SciFinder is a useful tool for end-users which integrates well with the search services provided by information professionals.

Features of Release 2.0 are discussed and illustrated including EXPLORE, BROWSE, TABLE OF CONTENTS, and KEEP ME POSTED. Other features explored in detail include reference analysis; browsing in the table of contents; keep me posted, and document detective service. Additional enhancements are the user's ability to load SciFinder simultaneously in all their computers and there is a good help desk and software support desk. It is available under two access plans—subscription which starts at $54,000 annually

for unlimited usage by up to 20 scientists, and task based which starts at $5,000 for a predetermined number of searches or tasks. It is concluded that SciFinder allows chemists to explore the literature as they wish and rediscover serendipity, while information professionals become the trainers and coaches. The primary benefit of SciFinder is the simplicity of the interface. It is important for information professionals to spearhead the introduction and implementation of new tools such as SciFinder. (Source: *Database*, December 1996)

PCs reconfigured by plug-in device

The ADC 200 converter from Pico Technology can be plugged into the parallel port of a personal computer (PC) to turn machines into a dual channel storage oscilloscope (DSO), a spectrum analyser or a multimeter. The latest version of the associated PicoScope software, moreover, now runs in the Windows operating system and offers simultaneous display of multiple views of the same signal. Data such as the actual waveform, its frequency components and AC voltage can be displayed on-screen at the same time. Pico says that by exploiting the PC's processing power the ADC 200 is able to provide data storage and printing facilities normally only found on dedicated instruments several times the price. The device also incorporates triggering capabilities, which enable it to capture irregular events. (Source: *Engineering*, December 1996)

Machining information managed in Windows

Seiki Systems has introduced three new Windows-based software programs—NC Program Manager, Direct DNC and Networked DNC—to support the storage, distribution and management of shopfloor machining information.

NC Program Manager is the most simple and is intended for users who require "portable" data transfer that eliminates the need for hard wiring. The software can run on a PC and enables programs to be stored in machine-specific directories. The integral communications module allows direct, two-way communications with each connected device, for instance tape/punch reader, disk drive or machine control, and each can be configured with its own icon.

Meanwhile the Direct DNC package provides a permanently wired DNC facility with direct program transfer from a single PC to up to 64 CNC screens. The system can be set up to return modified programs back from the shopfloor and a password can be arranged to allow program data from other directories to be accessed. Communication can be effected via both the RS232 and the more comprehensive RS422 protocols.

Finally the Networked DNC system enables shopfloor-based PCs to access program data on network fileservers and then be connected to up to eight machine tools. The shopfloor computer also allows all files to be viewed, supports coded access to other directories, such as unproven files, and enables any other software package, such as an SPC program, to be initiated. All three packages can be upgraded to Seiki's comprehensive Manufacturing Data System (MDS). (Source: *Engineering*, October 1996)

Document formats investigated

SURFnet, the academic and research network in the Netherlands, initiated the Premium project in 1995. Premium (Production of Electronic Materials on the basis of International and Uniform Methods) was intended to investigate the state of the art as regards document formats: standards, available products and their use in education and research.

A previous study had shown that a variety of formats—ASCII, *WordPerfect*, MS *Word*, *PostScript* and SGML/HTML—were in use, but there were problems associated with conversion from one to the other or the availability of appropriate viewers. The Premium project started by defining the advantages and disadvantages of the various formats, with particular reference to SGML/HTML and PDF.

HTML, as a DTD (document type definition) of SGML, adds internal and external hypertext links to a document. It enables the integration of text and graphics, as well as sound and moving images. Some observers believe, however, that other DTDs offer more scope. HTML records only a limited amount of structural information, which limits the extent to which the document can be re-used, both in terms of retrieval and presentation.

SURFnet is considering the establishment of an Electronic Text Centre which would offer guidance to information producers. Details regarding the first phase of this venture can be found at http://www.surfnet.nl/surfnet/projects/premium/. Another element of the Premium project is concerned with software evaluation, and several products have already been studied. (Source: *The New Review of Information Networking*, (2) 1996)

G. COUNTRY NEWS

European Union

Harmonized legislation on copyrights in information age

The European Commission has outlined in a Green Paper how it will focus new legislative proposals concerning reproduction rights, on-line communications, and distribution of protected material, as well as protection against circumvention of anti-copying devices. (*Copyright, the Information Society and the Single Market*).

Commission officials said EU legislation is needed in tandem with action at the global level, where international negotiations are in progress, including those at the recently held Diplomatic conference sponsored by the World Intellectual Property Organization in Geneva.

The Commission's legislative proposals are due in 1997.

The four priority areas addressed in the Communication are reproduction rights, distribution rights, legal protection of anti-copying systems, and public right to "on-demand" services.

Because distribution rights differ in EU member States, the Green Paper outlined how the Commission plans to harmonize these differences.

The market for "on demand" services such as videos and movies is considered to be one of the main areas of growth, especially with further technological services to come. The Commission will propose protecting digital on-demand transmissions on the basis of a further harmonized right of the public to access of works and other protected matter. The Commission will also address other copyright issues, including broadcasting rights, enforcement, management, and moral rights in future legislation. (Extracted from *World Intellectual Property Report*, Vol. 11, 1996)

Putting theory into practice

The EC's DG XIII aims to stimulate the European electronic information services market and multimedia content industries. A flagship programme, Info2000, was formally launched in May 1996.

According to Frans De Bruine, head of the EC's DG XIII, there are three main ways in which the EC can have an effect. The first is by developing a "vision" of what new technologies might mean for European society at large. That is what the EC tried to do with its White Paper in 1993 and with the subsequent Bangemann Report: stimulate discussion, and thereby stimulate change. Secondly, and more concretely, it can create an environment in which these changes can take place. For example, the policies to liberalize the European telecommunications markets, which come fully into effect on 1 January 1998, will have a far-reaching effect on the information industry. Finally and most directly, the EC can catalyse change by encouraging and funding cooperative research and development projects.

Info2000, as the successor to IMPACT, is fundamentally different. IMPACT focused specifically on the electronic publishing market, whereas Info2000 looks at the information industry in the broadest sense, from print on paper to audio-visual material, and tries to answer the question "what do these new technologies mean?". The EC is not saying that electronic information is going to replace print, but that it adds a new dimension to information provisions. A simple example is when a local newspaper goes on-line, enabling people to read it even if they are on the other side of the world. It's the same piece of information, but the new technology makes different uses of it possible. The essence of what the EC is trying to do with Info2000 is illustrate that point. (Source, *Information World Review*, December 1996)

Searching for your needle in the EC haystack

If you want information on forthcoming EC legislation or funding programmes, chances are you will have to use the services of a specialized intermediary. He or she, in turn, will be relying on a combination of official publications, commercial databases and personal contacts in Brussels. The overwhelming message coming from those who spend their working lives accessing EC information is that you have to know the system. This is especially true in areas where advance information is important, such as legislation.

One problem is that CELEX, the official EC legislation database, only contains details of proposed measures once they have reached a certain stage. Another is that there is no standard way of obtaining information any earlier. Commercial publishers make efforts to include a certain amount, but even here there are many gaps.

European Information Centre (EICs) exist to provide information to the public about European legislation and funding programmes, and help them find partners, agents or distributors. When and how this type of information is released can make the process of communicating the EC's mission a complicated one. It is very difficult to get sufficient and clear information at an early stage, which of course is exactly the kind of information businesses want to have. While many of the commercial products available are extremely good, they are an expensive way for an end-user to get information, and the average user will need more information than any one database can provide, especially if they are new to the EC game. (Source, *Information World Review*, December 1996)

Germany

Planning for the APE1000

Germany's national research centre for particle physics, DESY, and Italy's National Institute for Nuclear Physics, have signed an agreement to build a next-generation massively parallel computer by the year 2000. To be called the APE1000 (Array Processor Experiment, 1000 gigaflop per second), the computer will be ten times faster than the current APE100. It will be installed at DESY's Institute for High Energy Physics in Brandenburg. (Source, *Nature*, Vol. 383, 26 September 1996)

Government plans massive investment

The German Federal Government could start the move to a new generation of chip-making technology with a massive investment in a twelve inch joint German-US wafer fab, revolutionizing the economics of chip manufacturing.

Siemens is about to start building a new joint wafer fab with Motorola at Whiteoak in Virginia, USA. There have been reports in Germany that a new Siemens/Motorola fab to

be built in Dresden—supported by both the German Federal Government and the local state government—will be the world's first 12 inch fab.

However, concerns of the German government is said to centre on the costs and feasibility of 12 inch manufacturing. (Extracted from *Electronics Weekly*, 20 November 1996)

Hong Kong

Software Industry Information Centre

With funding support from the Government's Industry and Technology Development Council, a two-year project for a Software Industry Information Centre will be jointly established by Hong Kong Productivity Council (HKPC) and the Hong Kong Information Technology Federation (HKITF). The Centre will provide the software industry with market information and information on technology trends in order to improve the competitiveness in the regional information technology market.

According to a consultancy study on Hong Kong's software industry conducted by HKPC, the market size of the territory's software products and services was US$ 217 million in 1993, and was forecasted to reach US$ 586 million in 1997. In the coming year, there will be a tremendous demand placed on software products. Hong Kong has around 500 software companies and most of them are "project focused" rather than "product focused", which represents a good understanding about the market. At present, market information is available through various media sources such as newspapers, trade magazines and journals, television, and the Internet. However, information from these sources remain fragmented and unstructured, making it very difficult for software companies to retrieve specific information quickly. Many software companies are rather small and lack the resources to gather relevant market and business information on the software industry. Despite the existence of some high quality market research reports, most of them are expensive and remain unknown to the software industry.

Once a niche market has been identified, the next critical issue is the time to market. As software are now developed on a modular basis, software developers do not have to do all the coding from scratch, but can re-use some software modules developed by others. The information on what software could be licensed from others is also important to many developers.

For the local software industry to develop appropriate solutions to their software problems, the Software Industry Information Centre will provide relevant market information such as market reports, target industry profiles, updates on technology trends, market and resource information from the People's Republic of China (PRC), success case studies, and new software product information.

The registration cost for this service is HK$ 1,000. The Information Centre plans to disseminate to registered companies a bi-monthly newsletter on the latest software products, technology trends, and industry reports, as well as a bi-annual target industry report. Briefing seminars on software development, research, and success case stories will be conducted every quarter and an Internet Web server will be established to access the released information. (Source, *HKPC Productivity News*, November 1996)

Israel

Smartcard project for Jerusalem

Veriphone and Capsit are to provide hardware and software for one of the largest smartcard projects, involving 30,000 people at the Hebrew University in Jerusalem.

Students and teaching staff will be issued with a Unicard; a smartcard with the cardholder's picture, name and number which will be used for information storage and as an electronic purse. The Unicard will be manufactured by the French firm Gemplus.

Students will be able to use the same card for checking books out of the library, accessing health facilities, registering for examinations, providing authorization for using the University's computers for Internet access, and using it to store personal data such as tuition fees and grades. (Source, *Electronics Weekly*, 4 December 1996)

Japan

Research on the gas phase reaction vapour deposition technique

The aims of this research project are to discriminate specific types of excitated atoms and molecules, for supply to wafers at uniform energy levels and to elucidate the reactions with wafers in detail. The results may allow improvements in the technology for growing thin compound films by the CVD technique.

The Osaka National Industrial Research Institute has been investigating technologies for forming high-functional thin films by applying the ion beam process, and found that thin films which cannot be obtained by the thermal equilibrium process can be obtained by the high-excitation process. To elucidate the effects of electric charges and the effects of momentum in high-excitation processes, the research project aims to elucidate the surface reactions of simplex type excited molecules possessing simplex energy. Further details from Agency of Industrial Science and Technology, MITI, Research Administration Division, 1-3-1, Kasumigaseki, Chiyoda-ku, Tokyo. Tel: +81-3-3501-1777, Fax: +81-3-3501-7899. (Extracted from *JETRO*, September 1996)

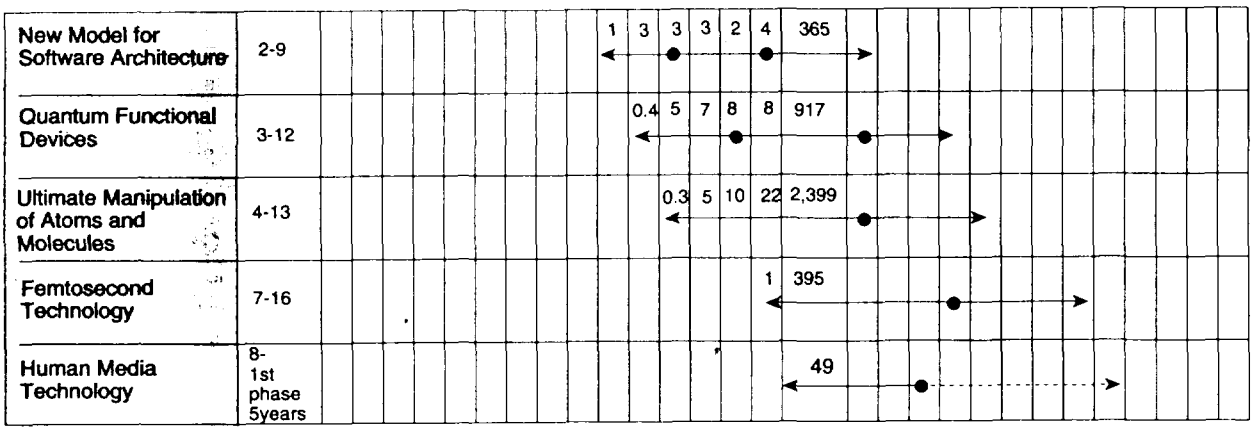
R&D projects in electronics, information processing and communications

In FY 1996, there are five ongoing R&D projects in the field of electronics, information processing and communications. They are "New Model for Software Architecture", "Quantum Functional Devices", "Ultimate Manipulation of Atoms and Molecules (Atom Technology)", "Femtosecond Technology", and "Human Media Technology". Table 1 below summarizes the R&D schedules and budgets for these projects. (Source: *JETRO*, November 1996)

R&D projects in the superconductor and advanced materials fields

There are seven national R&D projects in progress today in Japan relating to the fields of superconductors and advanced materials, with objectives specifically to develop superconductors, superconducting devices, very environment-resistant advanced materials, non-linear optoelectronics

Table 1

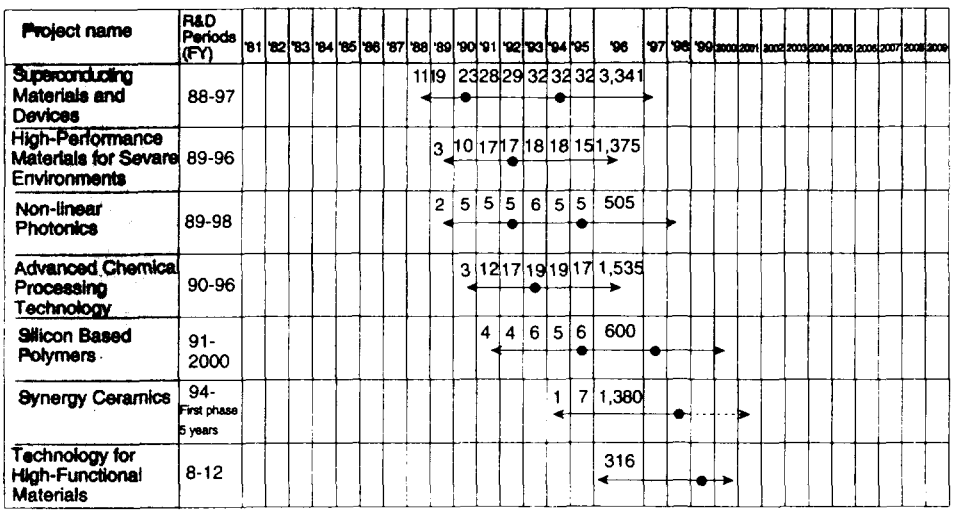


(Source: *JETRO*, November 1996)

Table 2

R& D of ISTF Projects Schedule and Budgets

(Unit: one hundred milion yen) (FY 1996 Unit: million yen)



(Source: *JETRO*, September 1996)

materials, advanced function creative machining technology, silicon-based polymer materials, synergenic ceramics and creative high-functional material creation technologies.

Table 2 above shows the schedules and budgets for these projects. The contents of the R&D projects being advanced during FY 1996 are described here in connection with superconducting materials and devices and synergenic ceramics. (Extracted from *JETRO*, September 1996)

Present state of Japanese electronic information industry and related themes

The introduction of advanced electronic information technologies is vital for the invigoration of private enterprises, industry and economy. However, the overall information-related capital investment in Japan is less than one-half that of the United States. This sluggishness in information-related capital investment in Japan is manifested as the relatively low qualitative and quantitative level of the Japanese electronic information market compared to the world market.

To correct this discouraging state in Japan, revive the activity of the electronics information industry and to contribute to the world economy through fair competition, serious consideration is required of the full-scale utilization of advanced electronics information in the fields of public activities as well as in various industrial activities (research & development, manufacture, physical distribution, etc.) by transcending the simple concepts such as "Internet", "personal computer communications," "electronic mail" and "multimedia boom".

Futuristic dreams and possibilities should not only be discussed but also regarded as investment targets and consideration given to utilizing these investments in economic activities. The themes to be resolved are industrial activation by introducing advanced electronic information technologies in the industrial sector, and the fostering of an open, high-quality electronic information market in Japan that will trigger investments in the sectors of public activities and industrial sectors, or the creation of an optimum cycle for the stabilized progress of the electronic information industry that supports future employment through market stimulation.

The timing is right for serious consideration of the actions required for recreation of the optimum cycle to revive Japanese industrial and economic dynamism based on electronic information on industrial technology. The recognition is increasing among private enterprises and

industrial circles for the necessity to recover dynamism by applying advanced electronic information technologies. This recognition is based on the realization that the protracted economic recession is not merely a cyclic phenomenon but rather a result of immature systems and organizations as well as the inappropriate structures of the corporate and industrial economy, and that the utilization of electronic and information processing technologies may correct these systems, organizations and structures into those commensurate with a new age.

The introduction of new technologies into intercorporate information systems is under study and interest is rising in the use of the Internet system, but these are not conceived merely as a fascination for novel ideas. A major issue in Japan concerns how to realize the germination of the recovery of dynamism and how to sustain its expansion. If these themes are resolved in the direction of a change in the economic and social structure, this will invite an enthusiastic outlook on the Japanese economy and industry in the advance into the 21st century.

Industries utilizing electronic and information processing industrial technologies and for the industries supplying these technologies must engage in challenging activities. This challenge is not merely in the aspects of technological advances but also involves the strategies relating to how the domestic economy and industry should be lead by corporate managements. Further vitalization of the domestic economy and industry is expected, and the recovery of dynamism into the 21st century is based on the challenges implemented by industry. A report by the Electronics Policy Division, Machinery and Information Bureau, Ministry of International Trade and Industry describes the present state of the Japanese electronic information industry and related themes which expand on the ideas outlined above. Further details from Electronics Policy Division, Machinery and Information Bureau, Ministry of International Trade and Industry (MITI), 1-3-1, Kasumigaseki, Chiyoda-ku, Tokyo 100. Tel.: +81-3-3501-2964, Fax: +81-3-3580-6403. (Extracted from *JETRO*, November 1996)

Korea

LG introduces 16X CD-ROM

LG Electronics (Republic of Korea) has announced the development of a 16x CD-ROM drive that can process 2.4 megabytes of digital information per minute.

This newly developed product is an advanced high-speed drive capable of processing twice as much information as the current 1.5 megabyte 12x CD-ROM drive. It is also equipped with a high-speed data processing capability applicable to video CD as well as CD-I.

The device will prove to be a key product since it is the first time ever that a Korean company has developed a domestically produced "pick-up" system for CD-ROMs. Projections have been made that this will lower the dependence on the Japanese market and thus increase Korea's competitiveness in the future. (Source, *Korean Business Review*, November 1996)

Russia

Distributors lead growth in Russia

Russian component distributors have issued a plea to their western counterparts for joint ventures and partnerships to develop the Russian component market.

Oleg Sotenko, director of May, a leading Russian component distributor, said their experience and understanding of local market conditions and practices would prove invaluable to western companies. Distributors already account for most of the 40 per cent of the total semiconductor market in Russia represented by foreign-made, imported components. Major manufacturers like SGS-Thomson Microelectronics and Philips Semiconductors and major distributors like Arrow and Macro who had established direct operations in Russia had not penetrated the local market. (Source, *Electronics Weekly*, 11 December 1996)

United Kingdom

High-tech future in doubt

Fears for the UK's high technology future have escalated after the British displayed a minimal commitment to collaborative European R&D at JESSI Day, which kicked off a four-year microelectronics research programme.

The programme, called MEDEA (Microelectronics Development for European Applications), proposes to spend 2 billion ECUs ($2.5 billion) over the next four years to maintain the renaissance in Europe's high-tech fortunes following the previous Megaproject and JESSI European collaborative research programmes.

The Department for Trade and Industry (DTI) has relaxed its attitudes to European collaborative R&D by allowing companies with over 250 people to take part, but insists that all projects must involve at least one company with under 250 people. It has also limited the UK Government's financial commitment to 25 per cent of a project's cost (whereas other European national Governments pay 38 per cent) and to a ceiling of £250,000 per project.

In effect, those limitations restrict British companies to projects costing up to £1 million which, in JESSI accounting terms, means an eight man project lasting one year. (Extracted from *Electronics Weekly*, 4 December 1996)

BBC sends Ceefax via digital radio

A non-interactive Internet-style information service is being broadcast to radios in the UK. The BBC is transmitting Ceefax information in HTML format over its digital audio broadcast (DAB) network.

Glyn Jones, the BBC's DAB project director, said that the transmission illustrates two points: that HTML, which is universally recognized and requires no expensive licensing, can be used with DAB. It also proved that data could be transferred from the Ceefax database fully automatically through to the DAB multiplex, making broader use of the Ceefax information gathering capability.

While the Ceefax information transmission is designed to be displayed on PCS linked to DAB receivers, at least one potential receiver manufacturer is thinking of incorporating a graphics display. Jones said that DAB radios could display photographs and graphics along side station names and music titles. (Source, *Electronics World*, October 1996)

Training catalyst

The UK's first national centre for semiconductor research and training has given further details of its plans.

The National Microelectronics Institute (NMI) will initially provide guidance and support to training centres around the UK. Training facilities that it aims to coordinate are Edinburgh University's Microelectronics Imaging and

Analysis Centre, the Nikon Lithography Education and Applications Centre at Livingstone and the new Applied Materials Centre in Tyneside.

Newport Wafer Fab, one of the NMI's nine members, is involved with the Welsh Development Agency (WDA) in setting up such a training centre. (Extracted from *Electronics Weekly*, 6 November 1996)

Lack of funding hits technology research

According to the Parliamentary Office of Science and Technology (POST), the recent DTI Technology Foresight programme does not highlight the importance of nano-technology. "The Foresight process was remarkable for its lack of mention of the subject" says a report by POST.

The report agrees that "current research priorities centre on the recommendations of the 1995 Technology Foresight programme". All the relevant centres of excellence in nanotechnology have failed to obtain funding from the Foresight awards.

It is research into nanotechnology as a generic technology, rather than into specific applications, that is important according to the POST report. "Recent exercises in the USA," it says, "focused directly on identifying 'critical technologies' and concluded that nanotechnology is clearly one of those 'generic technologies' underpinning a wide range of technologies and markets". (Extracted from *Electronics Weekly*, 13 November 1996)

Scotland's Silicon Glen

Silicon Glen is the 70-mile wide belt of lowland that crosses Scotland and includes Glasgow and Edinburgh. This region forms the most concentrated semiconductor manufacturing area in Europe and contains most of the major British semiconductor producers.

Scotland accounts for 12 per cent of the European semiconductor production capacity, with over 7,300 employees and over 60 per cent of the total UK capacity. It accounts for 9 per cent of Europe's total production, a figure that should rise to 11 per cent by 1999. Electronics producers from over 400 companies account for 49 per cent of Scotland's exports, including 35 per cent of the personal computers sold in Europe.

One advantage of the Silicon Glen area is that the Scottish universities produce many students well-trained in the microelectronics field so that companies do not have to train them from the beginning. Ten of Scotland's 13 universities are involved in semiconductor R&D, much of which is closely linked to the neighbouring industry, such as work on advanced photomasks at Dundee University supported by Compugraphics International (Glenrothes). The collaborative National Microelectronics Institute will also help raise training standards to the highest possible levels.

The University of Edinburgh Microfabrication Facility has been utilized by all the major UK semiconductor fab facilities. It supports the University's semiconductor processing technology research and provides specialist processing services. Similarly, the Nano-electronics Research Centre of the University of Glasgow has a multi-million dollar portfolio of collaborative research grants and contracts with industrial partners.

Devices produced in Scotland can be marketed throughout the EU without any import duty charges. The Scottish microelectronics industry is near major European markets; more devices for communications are produced in Europe than in any other global region.

Another advantage for fabs in Scotland is that this region of the European Union (EU) includes not only suppliers of components, raw materials, gases etc., but also a first-class transportation infrastructure. The price of Scottish electricity is less than that in most European countries, while water charges are among the lowest in Europe and the lowest in the UK. (Extracted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

UK technology to clean up US nuclear waste

Simulation and mechanical handling technology originally developed in the UK's nuclear industry is set to play a crucial role in a major environmental clean-up and removal project in the USA. Electricity generator Magnox Electric has won a contract to adapt its "Snake" manipulator technology, previously used for in-reactor repair and refurbishment, to carry out remote robotic decommissioning work at the Hanford nuclear facility in Washington State.

The technology involved has been developed by Magnox's remote operations team and involves the use of virtual reality simulation that enables operators to see an apparently "live" television image of the remote manipulators in action. This use of graphics simulation for real-time remote control was adapted from a commercially available 3-D robotics simulation software program called "Telegrip". The software was originally developed by US company Deneb Robotics in Detroit, the US motor industry's hometown, to provide simulation of the interaction of car bodies and robotic systems on an automobile factory floor.

The Magnox team's achievement has been to combine this off-the-shelf software capability with the equally well-established Snake technology, which has been in development and use at UK nuclear facilities for over 10 years. In use the system means that operators can follow and control the progress of operations not just through CCTB cameras that can only provide a view of events from a single angle, but also through access to virtual images which can provide information in multiple formats.

The virtual images can, for instance, provide views from any angle and can also make use of shaded, translucent, wireframe or partially edited images to highlight particular parts of the plant. In addition intended next moves of the manipulator can be displayed together with collision and near-miss detection provided by visual or audible warnings of any potential clashes between the manipulator and other objects.

Magnox says that the Hanford site provides the opportunity for pioneering a major new source of business in waste and decommissioning work beyond current UK activities. Several other US companies have now been in touch with Magnox to discuss similar projects. (Source, *Engineering*, November 1996)

USA

US money men boost Mondex

Seven top US financial services companies have endorsed the Mondex smartcard technology in what is the largest US vote of confidence in smartcard technology. So far the US has lagged behind Europe in smartcard applications.

AT&T, Chase Manhattan, Dean Witter Discover, First Chicago NBD, MasterCard, Michigan National Bank and Wells Fargo Bank have invested in Mondex USA Services which will use the Mondex smartcard technology in a series of pilot programmes in the USA.

In spite of this backing behind it, Mondex will still face stiff competition from Visa and American Express who are pursuing their own smartcard projects.

The first commercial Mondex cards will be introduced in 1998, following the result of key trials. Mondex USA says it will license its technologies to other US companies to help further establish the technology.

In a separate move, Mondex announced its agreement with Sun Microsystems for the inclusion of its format in the Java Commerce Toolkit. This toolkit will allow the development of open, secure and integrated electronic commerce applications which will link Mondex to the Internet. (Source, *Electronics Weekly*, 11 December 1996)

Achieving scientific competency

In science awareness and science education, the USA lags behind other industrialized countries. The growing science-oriented industries complain that people hired for marketing, management, and other business functions often lack the necessary science knowledge for effective communication with scientific personnel. The fastest growing industries in the world are those in the biotechnology, genetics, computing, electronics, telecommunications, and pharmaceutical areas. USA competitiveness is suffering partly through the failure of the educational system to provide students with scientific competence. The university library is often overlooked as an avenue for gaining scientific competence. Business persons in science-related industries need to develop a basic knowledge of scientific information resources, especially those related to the products and services of their employer.

The scientific library resources for business librarians and researchers are discussed briefly under the headings encyclopaedias and dictionaries; handbooks and manuals; journal literature; current awareness sources (basic list provided); technical reports and conference proceedings; and patents. It is concluded that, as business schools seldom have basic science courses built into their curriculum, the university library is an interdisciplinary organism which can be used. Business students should be taught to recognize that the library is a source of basic information that they will need to communicate effectively in the scientific milieu. Business librarians should be prepared to assist patrons who are seeking to achieve scientific competence. (Source, *Journal of Business & Finance Librarianship*, 2(2) 1996)

The virtual academic mega-library

Twelve of the largest US universities are building a virtual mega-library. This Virtual Electronic Library (VEL) is a project of the Center for Library Initiatives run by the Committee on Institutional Cooperation. The institutions involved are the universities of Chicago; Illinois; Indiana; Iowa; Michigan; Minnesota; Purdue; Wisconsin Madison; Michigan State; Northwestern; Ohio State; and Pennsylvania State. These encompass 13 research libraries; 60 million volumes; 550,000 serial titles; and a myriad of electronic databases. Each university has its own different and separate automated system and special challenges have to be faced as institutions are competing with each other for admissions, placement and research. The project is funded by contributions from each university and a grant from the US Department of Education.

VEL Phase I, completed in December 1996, calls for the installation of a customized version of OCLC's Web and Z39.50 gateway software, WebZ. It will provide a single graphic user interface for searching the consortium's OPACs and locally mounted databases and placing requests using standard protocols. The complete system will be open for public use. Phase II will include the establishment of an ILL system using standard protocols— ISO or Z39.63. Other projects are fully managed access to electronic journals and humanities electronic texts, which will eventually coalesce into a complete digital library. The next big push will be to go beyond the catalogue to the integration of all digital information and all types of data. Elements in the eventual mega-system will include centrally mounted indexes; access to full-text databases; increased access to bibliographic databases; a core collection of electronic journals; and 24-hour document delivery turnaround. In addition, future plans call for collaborative collection building and conservation and preservation of traditional library collections. (Source, *Information Retrieval & Library Automation*, October 1996)

H. AUTOMATION

Weeds get the robot treatment

How do you tell a plant from a weed? It is sometimes difficult for the ordinary person, so how do you lay down the rules to enable a robot to make that distinction? R. Brivot and J.A. Marchant at the Silsoe Research Institute think they have found the answer, and hope they have the basis of a robot that can move along lines of plants, selectively picking out the weeds to spray them with chemicals.

Motivation for the work is the huge amount of chemicals currently used in crop protection programmes, and pressure from consumers and environmentalists to make reductions. Using a robot sprayer to put the chemicals only and precisely where they are needed could help achieve that goal.

But first the robot has to be able to see the difference between the weed and plant. Brivot and Marchant have developed an infrared-based system that, under the right conditions, is showing good results.

The system relies on a high resolution sensor in the form of a ccd camera, permitting the use of grey-level distribution of the infrared images as well as texture information. The camera is fitted with a near-infrared filter and is linked to a data acquisition system which stores 256 x 256 pixel image sequences.

Key to successful discrimination is the strength of the algorithms used to process the images and these are based on a number of hypotheses—for example plants are defined by single blobs which do not touch each other. Most of the time the grey level distribution is sufficient for discriminating plants and weeds (and certainly good enough for discriminating plants and soil). But where it is not, texture information can be used, because the grey-level surface of the plants is more constant than the weeds and the plants appear brighter than their centres.

Results so far show a 92 per cent correct classification with "good" images and up to 72 per cent with "bad" images. The processing can be carried out in realtime too as most of the algorithms do not need a knowledge of the whole image so multiprocessors can be used.

However, more work needs to be done before the robot is ready for work. (Source: *Electronics World*, October 1996)

Sandia opens robotics centre

Research across the spectrum of robotic technology will be the charter of a new $33 million facility at Sandia National Laboratories, Albuquerque, New Mexico, Pat Eicker, director of intelligent systems and robotics, describes how pervasive robots will become: "They will make able the disabled. They will safeguard the peace. They will swim in the veins of our children's children performing molecular analysis and surgery as needed. And using their sensors and communication capabilities, they will carry us to foreign and hostile environments without our leaving our home". In manufacturing and material-handling applications, Eicker says Sandia's work "is intended to make robots and other machines cost-effective in less-than-mass-production operations." (Source: *Industry Week*, 18 November 1996)

I. STANDARDIZATION AND LEGISLATION

Standardization

UK mobile initiative to benefit standards

A UK initiative for researching and developing mobile communications technology will help develop standards for the third generation of mobile communications equipment, rather than create a global standard alone as some reports have suggested.

According to the DTI, the Virtual Centre of Excellence for Mobile Communications (VCE) will aim to make "vigorous and leading edge contributions" to international standards towards a Universal Mobile Telecommunications System (UMTS).

The centre will focus on four areas: services and service metrics, networks, terminals and the radio environment—although specific details of projects are not yet known.

The virtual centre currently has a membership of five universities, and 18 companies who operate within the mobile communications sector. The universities' research will be focused on a core programme.

Member companies will contribute funding for the research in exchange for voting rights at board level. The minimum contribution, buying one vote, is £25,000. (Source: *Electronics Weekly*, 27 November 1996)

MPEG compression technology in a camera

After a brief accord, a battle over competing standards has begun between electronics companies manufacturing digital video cameras. Hitachi has broken away from the pack and launched a new camera that records video in a format already widely used for multimedia CDS.

Hitachi previously agreed with the other big manufacturers to develop cameras to a standard known as DVC. Three companies—JVC, Sony and Panasonic—have already launched DVC cameras. But Hitachi has now opted for a camera that relies on the powerful MPEG compression technology.

The MPEG compression standard, originally devised for storing video on CDS, is widely used for playing back multimedia material on personal computers. Until now, the electronics needed for MPEG compression have been too unwieldy to be used in a small consumer camera, but now Hitachi has succeeded in integrating all of the 300,000 components needed for MPEG coding into a single chip that consumes only 600 milliwatts.

The MPEG camera weighs only 540 grams and looks like a rotary head-shaver. The head has a high-resolution video camera lens on the front and a colour LCD viewfinder screen on the rear. Inside the handle there is a slot for a miniature hard disk drive of the type now standard for notebook computers. The disk stores moving videos of a quality better than VHS, still pictures or hi-fi sound. Images can be played back through the camera's LCD, or by plugging it into a TV set. Alternatively, the hard disk can be plugged into a computer and the data viewed there.

MPEG was designed to make digital movie players simple and cheap, but until now it has required whoever is making the recording—typically the film studios—to use massive processing power to compress the video. Hitachi's chip changes all that.

The MPEG standard compresses video by a factor of around 100 by comparing groups of up to 15 pictures at a time and coding only the differences between them. It needs a data handling capacity of only 1.5 megabits per second.

The compression system used in a DVC camera codes each picture individually. This keeps the recording circuitry much simpler than the MPEG equivalent, but generates around 20 times as much data to describe the same video sequence, so the camera consumes a lot of tape to make a recording.

Hitachi already makes miniature hard disk drives, which plug into portable computers and look like a thick credit card. The MPEG camera takes a 260-megabyte drive that stores 20 minutes of video, or a hefty 340-megabyte version that stores 30 minutes.

The single Hitachi chip can also compress still pictures to the JPEG standard, which is widely used to store photographs on a PC or send them over the Internet. The camera can record up to 3,000 still pictures. Alternatively, it can record four hours of sound. Access to a selected sequence or still on the hard disk is virtually instantaneous.

Hitachi plans to start selling the new camera for under US$ 2,000. (Source: *New Scientist*, December 1996)

Codec chip meets AC '97 standard

National Semiconductor has announced a codec chip for desktop computers that implements the AC '97 standard, to be sampled in the first quarter of 1997.

The chip includes 16-bit A/D and D/A sigma-delta converters, its proprietary 3-D sound circuitry, a headphone driver and a volume control.

AC '97, which is an open standard, was initiated by several companies, including Yamaha, Creative Labs, Intel and Analog Devices in May 1996. It calls for two separate chips, one a mixed signal codec and the other a digital audio controller. The idea behind separating the functions is that performance can be increased.

The interface between the two chips is standardized (AC-link) and both Yamaha and Creative Labs are said to be producing digital chips.

The National part, the LM4545, does not implement all the possibilities of the AC '97 standard as it has no tone controls or modem. (Source: *Electronics Weekly*, 11 December 1996)

MPEG-7 gives 4 a little bit more

The main components of MPEG-4, the emerging audio visual coding standard, have achieved working draft status following a recent meeting in Brazil.

The meeting also saw the Moving Pictures Expert Group begin work on a follow-on standard, curiously called MPEG-7.

MPEG-4 aims to provide a universal mechanism for communicating audio and visual "object" data. Unlike the MPEG-1 and -2 standards, which encode frames of video, MPEG-4 reflects the emergence of myriad media content, and is capable of manipulating such content whatever its shape.

MPEG-7, the follow-on standard, will add value to MPEG-4. MPEG-7 will be concerned with "bits about the bits". It will offer ways to describe content whatever its guise,

allowing identification much in the way search engines identify text on the World Wide Web. (Source: *Electronics Weekly*, 11 December 1996)

Modem firms promote speed

To promote faster Internet access, five major cable modem manufacturers have joined forces to establish standards enabling cable modems to be used with cable TV systems. Com21, General Instrument, Hewlett-Packard, LANcity and Motorola are working with Arthur D. Little to set up the data interface standards which will then be made available to other companies. The first cable modems adhering to those standards should be ready by the end of 1997. (Source: *Electronics Weekly*, 2 October 1996)

Alliance eases Internet phone calls

Making phone calls over the Internet should become easier following an alliance between Intel and US firm Infospace. The two will promote standards and develop products to improve the quality of telephone calls made over Internet connections. One of the issues the collaboration will address is temporary IP addresses currently used to identify callers. A better way of finding and connecting Internet telephone users will have to be found to improve Internet telephone services. Infospace has developed Internet technology that can be used to find users and information on the Internet. Intel is offering free beta version software for its Internet phone. It is designed to run on Pentium machines executing Windows 95. The site is at http://www.intel.com./iaweb/cpc (Source: *Electronics Weekly*, 2 October 1996)

ETSI in GSM call

ETSI, the European telecoms standards body, is looking to adopt a further speech coding standard for the GSM digital cellular communications standard, in response to some industry dissatisfaction with existing GSM standards.

According to ETSI, there are three key goals in speech quality which are not being fulfilled: wire-line quality, robustness to channel errors, and the ability to operate at half rate as a means of increasing capacity.

This is not the first attempt to improve the performance of the GSM speech coder specification. The last was in October last year when an enhanced full rate speech coder/decoder (codec) was proposed to complement the currently used full and half rate speech codecs. The latest approach is to develop an adaptive multi-rate (AMR) codec.

The adaptive codec varies the balance of bits allocated for speech coding and channel coding (which provides error protection) with the aim of giving the best speech quality at any given time. At present GSM uses fixed bit allocations for the speech and channel codings, totalling 11.4 kbit/s for half rate and 22.8 kbit/s for full rate.

A feasibility study has been started to better understand the radio channel, with the view of having the codec employed in two to three years time. (Source: *Electronics Weekly*, 6 November 1996)

ITU to standardize mobile videoconferencing

Reports have indicated that the International Telecommunications Union (ITU) is to develop a standard for mobile vidoeconferencing. The resulting mobile videoconferencing standard could be exploited using a range of cellular phones and PDAs such as the Nokia 9000, Apple's Newton and Psion Organiser. Current displays could easily be modified for images as well as data. A cellular system would add error correction and retransmission to the H.324 standard. This describes a V.34 modem terminal (28.8 kbit/s) that can carry realtime voice, data and video. (Source: *Electronics Weekly*, 6 November 1996)

Europe to drive EBS standard

The European Union is set to adopt the Electronic Braking Systems (EBS) technical standard for cars and commercial vehicles as a directive in the coming months. This will aid manufacturers in promoting common systems and remove the trade barrier currently existing between countries.

The EBS standard will increase braking response speeds and improve vehicle control and maintenance. Similar to ABS, EBS automatically adjusts the brake controls based on sensor feedback. It will also act as a diagnostic took, highlighting problems which occur during braking.

EBS is proposed as a complete electronic system comprising traction control, ABS and brake apportioning. It will use at least two 16 to 32-bit microcontrollers and be linked to a communications bus, such as CAN.

Current developers of EBS include Bosch and Lucas, as well as certain heavy-goods vehicle manufacturers such as Scania and MAN.

Technology based on EBS is currently deployed only in commercial vehicles and trailers which traditionally have used air-braking systems. Passenger vehicles, starting with luxury models, are expected to use EBS around the year 2000.

EBS and other conventional and electronic vehicle systems such as airbags, lights and seat belts, are also to be adopted in the European Whole Vehicle Type Approval (EWTVA) set of agreements. As of January 1998, all new registered cars in the UK will need to have an EWTVA.

The European Union is also in active discussions with the US for standardizing vehicle systems to further ease transatlantic trade. Source: *Electronics Weekly*, 20 November 1996)

US firms settle HDTV standard

US consumer electronics and computer companies have agreed on a common high definition TV (HDTV) standard after an eleventh hour attempt by computer companies to change the standard which has taken eight years to develop.

The agreement came after the supporters of the Grand Alliance HDTV standard agreed to include the computer based progressive scanning display as one of 18 formats to be used in broadcasting digital TV programmes. Computer companies had argued that progressive scanning was necessary so that computers could display digital TB.

The FCC says it expects to approve the standard before the year end, setting the stage for the first HDTV sets to appear in early 1998.

The HDTV agreement will make it easier for computer firms to target the TV market with hybrid systems that combine a traditional TV set with digital TV/PC functions. (Source: *Electronics Weekly*, 4 December 1996)

ATM Forum puts specs onto Web

The ATM Forum, which is promoting the Asynchronous Transfer Mode communications technology, has released three specifications to help ensure compatibility between different ATM implementations.

The group's Test Working Group has released the PICS (protocol implementation conformance statement) Proforma for the UNI 3.1 ATM Layer, the Conformance Abstract Test Suite for the UNI 3.1 ATM Layer of End Systems, and the Conformance Abstract Test Suite for SSCOP (Service Specific Connection Oriented Protocol) Sub-Layer for

UNI 3.1. "This PICS takes into account the minor differences between the UNI 3.0 and UNI 3.1 specifications at the ATM layer", said Gregan Crawford, chair of the ATM Forum's Test Working Group. Full details of the new specifications can be obtained at the group's web site at: http://www.atmforum.com. (Source: *Electronics Weekly*, 30 October 1996)

Establishing standards for reticle carriers

A task force to establish standards for next generation reticle carriers has been formed by SEMI. Initiated and coordinated by Advanced Micro Devices (AMD, Sunnyvale, CA) and PRI Automation (Billerica, MA), the new task force met for the first time in San Francisco.

Many different types of equipment utilize reticles, including mask writers, resist processors, inspection systems, storage systems and steppers. Currently there is no interchangeability between carriers used in mask houses with those used in fabs and no interchangeability even among carriers for the half dozen different steppers manufacturers. If the same box, a universal carrier, were used from the mask shop to the stepper, manual handling of reticles could be avoided.

Mask houses use reticle carriers designed primarily for shipping while fabs use carriers designed for specific equipment. Problems arise during the transfer from shipping box to stepper-type box, for example. This is done manually, creating an opportunity for droppage and contamination.

The ultimate impact of establishing a universal carrier is logistics and efficiency. Carriers can range from $200 to $2,000 for pods holding several reticles; an ASIC house could have 10,000 to 20,000 reticles. The potential for financial advantages is implicit in improved efficiency and a reduction in risk.

For more information on task force activities, contact Bob Davis at (508) 670-4270, x 3046 or by e-mail at bdavis@pria.com. (Extracted with permission from *Semiconductor International Magazine*, October 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Legislation

OECD expert group finalizes cryptography guidelines

An ad hoc group of experts from OECD Member countries with a one-year mandate to draft Guidelines for Cryptography Policy has now completed its work. The Group met in Paris for a five day drafting session on 16-20 December 1996. The OECD Member countries considered it necessary to develop Guidelines which would help to co-ordinate national cryptography policy and would at the same time foster the development of international trade. The Guidelines represent a consensus on basic principles which can be built into existing national policies and legislation, or serve as a basis for policies and legislation in those countries which do not yet have them. The Guidelines will be forwarded for approval as a formal Recommendation of the OECD. (Source: *OECD News Release*, 23 December 1996)

Libraries, copyright and the electronic environment

Although the new electronic environment is inevitable and developing rapidly, it has not yet arrived as the dominant technology and has yet to be determined. Publishers have not yet decided which products will be available only in electronic format or in print, or in multiple forms. They are concerned about what they can do legally with the products they acquire and how to use the new technology to provide new forms of customer service. In planning for the future electronic environment, creators (authors and publishers); users; intermediaries (libraries, retailers, electronic service and access providers); legislators and other policy makers, and the courts, need to consider the role of copyright. Copyright is a necessary building block without which no meaningful content is made available, and not an obstacle for the information society. The new electronic environment is very different from the analogue print environment. It requires new understanding of words such as browse and browsers.

Making a photocopy of a print product is very different from creating a digital version of the same work. Digital versions of works need copyright protection that is adequate to their nature. There should be a mechanism to discuss the impact of technology on various types of libraries which differ in size and service function. Digital document delivery which provides users with individual articles and short excerpts of longer works is a new service being offered by publishers and is not the same as print-based interlibrary loans. Unrestricted library document delivery violates article 9(2) of the Berne copyright convention. Lending electronic products carries more risk than lending print products as the transmission of copyright works to remote locations is a copyright violation.

While publishers agree that libraries play an important role in preserving the cultural heritage and should use technology for preservation and conservation purposes, they are concerned about the protection of copyrighted works that have been digitized for preservation. It is concluded that rules in the electronic environment must be developed according to the principles and purposes of copyright laws and the rights and interests of creators. Libraries and publishers should work together as they both have new roles, responsibilities and means. (Source: *Electronic Library*, 14(5) October 1996)

Copyright: a constant theme in a changing world

Over the past 13 years, the importance and interest in copyright has changed out of all recognition. Information and library professionals make their daily living out of using and exploiting the intellectual property of others. Far from diminishing, copyright is extending into more and more areas. Protection has been extended from 50 to 70 years. The European Commission's recent legislation on copyright law has extended protection to databases through its directives. A clause awaiting ratification in the UK would allow exclusive right for 25 years for the first person to publish an unpublished work which is out of copyright. Copying material is also being affected. Traditionally, making copies beyond certain limits was available to libraries under the fair dealing concept with libraries having special exceptions which are now under strong attack by copyright owners. Other actions being reserved to copyright owners need to be considered. These include issuing copies to the public; playing; performing; broadcasting; and making adaptations and translations. Some of these have very complex legal implications and need to be considered before any material is acquired by the library.

The acquisition of material such as CD-ROMs; material on disk; and multimedia works needs to be considered carefully and is usually governed by contract. Copyright could be infringed if work is performed in public. Transferring material from another medium, language, or programme is a copyright infringement and needs the agreement of the copyright owner. Legislation is pending that will extend the actions exclusive to the copyright owner so that public libraries could be prohibited from lending sound recordings;

videos; electronic material; dictionaries, pictures, maps, and even periodical issues. What is meant by document delivery, preservation and conservation has to be reconsidered. Moral rights raise different issues which have been neglected in the Anglo-Saxon law tradition. The European Commission has funded a number of projects on electronic copyright management systems which potentially could solve problems. It has to be realized that librarians and academic publishers are small fish in a very large pool, amounting to about 3 per cent of the gross national product. As one of only two net exporters, copyright in the UK is an increasingly important theme. The information revolution has caused the scale to tilt heavily against the user, so library and information workers must act as intermediaries to ensure that the balance is redressed. (Source: *Taking Stock*, 5(2) November 1996)

Authorship copyright issues in electronic environment

The emergence of a new electronic environment has called all of the issues of authorship into question and new paradigms are already emerging. The notion of State funded research as public property is beginning to emerge. Scholarly publishing will relate to dynamic, not just static, documents; presentations will relate to the capacity of the browser rather than the design skills of the publisher. The whole concept of writing up research may change as these collaborations develop.

The first requirement that the academic community needs from publishers is that publishing houses understand that the purpose of research is to expand the boundaries of knowledge and then to promote public access to that knowledge. Publication is one, but only one way, of doing this. Its function is not to act as a reservoir fuelling the bottom line of multinational conglomerates.

Rather than publishers and librarians climbing into their respective trenches of copyright and fair use, it would be more imaginative to look at new models for the licensing of material. Of course, many publishers are already involved in working with information professionals, notably in the Higher Education Funding Councils electronic libraries programme, but it requires not just a partnership but a new frame of mind if we are to develop a system of publication which reverses almost all the present behavioural norms. What information professionals seek from publishers above all is a combination of imagination, cooperation and willingness to take risks. (Source: *Bookseller*, 22 November 1996)

Free dissemination of patent information

It is argued that the use of electronic media for the international exchange of patent information could create end-user access difficulties. Previously, the use of paper and microform media permitted convenient duplication and distribution, but restrictions are imposed on the free duplication of electronically-based material.

Over the last few years, the Trilateral Union (USPTO, JAPIO and EPO) has developed and promoted the MIMOSA system. It has been announced that the system software for CD-ROM creation will be offered to patent offices for their own use, for a nominal charge of $200. The software will be distributed without the source code and without any right to modify it.

The general adoption of this as a de facto standard would probably make it uneconomic for patent offices to develop their own systems. Although this would ensure the information independence of the USA, Europe and Japan, it would threaten the independence of non-members of the Union. One solution to this problem would be to transfer control of the MIMOSA system to an organization such as WIPO.

The All-Russian Institute of Patent Information (VNIIPI) has published two CD-ROM sets—*Patents of Russia*—since 1994. These employ software developed by the Institute, with an interface resembling that used by the ESPACE system. The Institute has agreed with the EPO that it will cooperate in modifying the MIMOSA system so as to process information in Cyrillic. The transfer to MIMOSA, however, can only be made when the situation regarding future development has been clarified. (Source: *World Patent Information*, 18(4) December 1996)

Delivering patent information on the Net

MicroPatent has published patent documents on CD-ROM since 1990, but now offers the alternative of delivery via the Web. The perceived competition for the new service is from the fax on demand bureaux.

A number of problems had to be addressed when setting up the new facility. Industry-standard software had many of the features required to establish the service, but was slow and lacked document management capabilities. In the end, the retrieval software from the CD-ROM product was adapted for the purpose, resulting in a viewer package which supported viewing, printing and document management at the customer site. PC and Macintosh versions were developed.

Given that the existing collection of patent documentation (covering a period of 20 years) was in TIFF Group 4 format, this standard was used for the new system. For the future, conversion to SGML format will offer better compression.

The basis of the service was to be an NSM CD-ROM jukebox. The software would ultimately have to manage 4,000 disks in forty jukeboxes, and a product from Luminex Software was selected.

Internet overload is a problem for many users, exacerbated by the large size of the TIFF files. A number of expedients have been adopted to minimize this problem. The user can place an order and return to retrieve it at any time in the ensuing twenty-four hours. At times of heavy usage, the system can receive patent orders and queue them for subsequent delivery to the customer.

The system requires pre-payment for any billable services. At present, billing still requires manual intervention, but the eventual aim is to introduce automated invoicing via e-mail. (Source: *NFAIS Newsletter*, 38 (9) September 1996)

Expert finds value of intellectual property

An intellectual property (IP) expert has begun to solve the tricky problem of the valuation of IP.

The industry-wide clamour for "system-on-a-chip" or "system-level integration" has led to organizations like the virtual socket interface (VSI) alliance being formed. While they look at standards and the protection of IP providers' rights, few individuals have looked at the issue of how much the IP is worth.

A novel method of IP valuation has been proposed.

In simple terms, the different blocks of IP to be used in a design are given an index value. This is calculated using factors such as whether other companies provide a similar block, its complexity and whether software is included. The indices can be used to show the providers the relative value of their IP and to fairly split royalty money.

This technique can also be used to value IP passed around within a company's divisions. (Source: *Electronics Weekly*, 2 October 1996)

J. RECENT PUBLICATIONS

More efficient Web searches

It is becoming easier to search for design information on the World Wide Web. From your WWW browser, you can now key in a few words, hit "search", and receive a list of applicable resources in seconds. Some WWW sites make particularly good starting points for useful design information.

Those who are new to the Net will find useful overviews at http://riceinfo.rice.edu/Internet/ which is Rice University's search report, and http://www.eg3.com/srcnet/htm which is an electronics search FAQ (frequently asked questions).

Semiconductor makers now publish most of their data sheets, new product specifications and other useful design information on their WWW sites. The most innovative companies offer search capabilities. These can range from simply entering a specific part number to retrieve the appropriate data sheet, to searching for useful information by key words such as "68HC11" or "realtime". Advanced Micro Devices, for example, recently initiated at *http://www.amd.com/search.html* its impressive Thunderstone search engine. Not to be outdone, Intel offers both a search engine (at *http://www.cs.intel.com.search.htm*) and a customizable Web interface. The latter means you can customize Intel's site to display only the information you want.

Motorola has yet to make its semiconductor Web sites fully searchable. Though designers can search only the Motorola corporate Web site, there is a search capability for the Motorola data library. The data library search site *http://design-net.com/cgi-bin/dlsrch* lets users identify Motorola data sheets or design information. Also searchable at *http://motserv.indirect.com/cgi-bin/msg* is Motorola's Master Selection Guide.

Like Intel, Texas Instruments offers a customizable Web interface that lets users pull useful information at the TI site. At *http://www.ti.com/corp/docs/search.htm* is found TI search capabilities. An all-in-one interface to numerous semiconductor search sites at *http://www.cera2.com/hunter.htm* is known as the EE Hunter site. It unifies a number of companies that include Analog Devices, Motorola and TI, letting users toggle between them to identify useful information.

Even non-commercial Web sites now offer search capabilities. At *http://sweng.falls-church.va.us/AdaIC/* is the impressive ADA IC site. It covers everything you ever wanted to know about the Ada language and related topics. Norway's excellent contribution to Internet design information at *http://ftpsearch.unit.no/* is called FTP Search. It is the fastest way to scan the Net for downloadable source code or for files by entering key words.

Looking for an 8051 compiler? There is even a Free Compiler search engine at *http://cuiwww.unige.ch/cgibin/freecomp* where you can locate the program you seek. Similarly, the searchable Shareware.com at *http://www.shareware.com* is an outgrowth of the Virtual Software Library. Indiana University operates the Unified Computer Science Technical library, searchable at *http://www.cs.indiana.edu/cstr/search* where computer and EE-related technical reports can be located. However, most are highly academic. CERA Research maintains a comprehensive list of searchable non-commercial sites at *http://www.cera2.com/micro.htm.*

Finding the Web sites of even major vendors can be difficult, partly because of non-intuitive Web site names. Hitachi, for example, resides at *http://halsp.hitachi.com.* Fortunately, major search engines now simplify the process. Among the most widely used is Alta Vista at *http://altavista.digital.com* and underwritten by Digital Equipment Corp. (Source: *Machine Design*, 24 October 1996)

Information technology, development and policy: theoretical perspectives and practical challenges

Edited by *Edward M. Roche*, University of California, USA, and Michael James Blaine, Ohio State University, USA, this book examines the impact of information technology on the social and economic structures of developing countries and provides practical examples of ways in which information technologies can be used to enhance the effectiveness of national development strategies and generate critical competitive advantages for local businesses and national economies. Available from *Averbury Publishing Ltd., Gower House, Aldershot, England.*

Neural networks—producing dependable systems conference proceedings

Microprocessors have found extremely wide application in a short space of time. An approach using neural networks, which allows them to behave adaptively is likely to spread just as quickly, to all of their present industrial, medical, commercial and military applications. Neural networks have received a lot of interest in recent times; their key advantage is their ability to be trained, without the necessity to develop and input complex computer algorithms. Tremendous commercial advantages have been demonstrated for neural network computer systems and this is creating pressure for their early adoption into all spheres of measurement, monitoring and control. But neural network based systems must be demonstrably dependable, otherwise there is enormous potential for damage in terms of lost time, wasted energy, excessive operating costs and even human safety.

The dependability issue is still in its early days and has not yet fully left the academic arena. However, neural networks offer such attractive performance benefits that there is a lot of pressure to reach solutions which are acceptable to industry and the certification authorities. The papers in these proceedings look at the problem of producing dependable neural network computing systems from theoretical and practical angles. The different approaches to producing and demonstrating dependable systems are discussed, and case studies illustrate the state of the art and draw on lessons that can be applied from one area to another. The speakers at the conference were drawn from both industry and academia and the papers will be of interest to all engineers, managers, technical directors and industrial scientists who wish to know more about the practical application of neural networks.

Price £80. Available from ERA Technology Ltd., Cleeve Road, Leatherhead, Surrey KT22 7SA, England. Tel.: +44 (0) 1372 367014; Fax: +44 (0) 1372 377927; E-mail: pub.sales@era.co.uk.

Principles of performance engineering for telecommunication and information systems

M. Ghanbari, C.J. Hughes, M.C. Sinclair and J.P. Eade

This book describes the basic theory of performance engineering (essentially the control of traffic in communications, but nowadays applied to other aspects of systems design as well) and its application to both circuit- and packet-switched systems. As an increasing number of systems have become too complex to be analysed theoretically, simulation techniques are introduced. Also covered are other applications, such as reliability and tolerances, including the relationship between radio fading and teletraffic in cellular mobile communications. The book is aimed at senior undergraduates as well as graduate and professional engineers and their managers. (336 pages, ISBN 0 85296 883 3, expected spring 1997, £39)

Telecommunication networks, 2nd edition

J.E. Flood (Ed.)

Despite the growing literature on many aspects of communications technology, relatively little has been published on the functioning and planning of completed networks. The long-awaited 2nd edition of this seminal and best-selling telecommunications book is intended to fill that gap, discussing the structure and performance of networks in the context of the services they provide. It is written with the young engineer in mind, but will give professional specialists a deeper understanding of their work too. Much of the material has been developed from teaching within successive IEE Vacation Schools. (520 pages, ISBN 0 85296 884 1, published 1997, casebound price £75, paperback, ISBN 0 85296 886 8, £28)

Optical communication receiver design

S.B. Alexander

This tutorial text provides an overview of design principles for receivers used in optical communication systems, intended for practising engineers. The author reviews technologies used to construct optical links and illustrates the flow of system performance specifications into receiver requirements. Photodetector fundamentals, associated statistics, characteristics and performance issues are presented, together with a tutorial on noise analysis and the specific techniques needed to model optical receivers. (336 pages, ISBN 0 85296 900 7, published 1997, £28)

Properties of wide bandgap II-VI semiconductors

R. Bhargava (Ed.)

Semiconductors comprising elements from groups II and VI of the periodic table and having a large energy gap (e.g. ZnSe) are generating intense R&D activity world-wide, largely as a result of their use in blue green diodes.

To review the accumulating knowledge and provide an up-to-date picture, 34 scientists from leading research groups in the USA, Europe and Japan have pooled their knowledge under the editorship of Dr. Bhargava. The book is illustrated, structured for reference and deeply indexed. (250 pages approx., ISBN 0 85296 882 5, published 1997, £125)

Exhibiting electricity

K.G. Beauchamp

This unusual book traces the history of public and technical exhibitions, from their origins in the late 18th century to the present day, and, particularly, how they have reflected the progress of science and technology.

Not only does the author show how electrical innovation and manufacture have been presented to the wider public through this period, but he also shows how the exhibitions themselves have required technological advance. It is through this combination of roles that the importance of these exhibitions within scientific and technological advance can be understood. (352 pages, ISBN 0 85296 895 7, published 1997, £45)

Designing businesses: how to develop and lead a high-technology company

G. Young

This is a practical but stimulating book. It aims to support engineers, and other technical professionals, who find themselves with the opportunity to run their own business as entrepreneurs (either personally or as "corporate entrepreneurs"running a division of a larger business). The book focuses on designing the business to meet market-place requirements, financial design and raising venture capital, alliances and acquisitions, management buy-outs and buy-ins. It is hoped that there will be much of interest to the engineer facing the many future changes in his/her career and industry. (216 pages, ISBN 0 85296 891 4, published 1997, £40)

Developing a make or buy strategy for manufacturing business

D.R. Probert

The tactical choice of "make or buy" is familiar to most in manufacturing industry who are concerned with optimizing their manufacturing capability. However, few recognize that this choice can be made strategically. This book represents the results of research and application by the author, followed by development and application within industry. He offers a procedure to make such decisions consistently over time and thereby optimize the success of the business.

The book follows a recent DTI awareness publication by the author. (150 pages, ISBN 0 85296 863 9, published 1997, £33)

Properties of III-V quantum wells and superlattices

Pallab Bhattacharya (Ed)—University of Michigan, USA

The characterization and precisely controlled building of atomic-scale multilayers have been the subject of intensive R&D world-wide.

In this book, the large volume of research results which have accumulated is distilled down to a manageable concentration of up-to-date knowledge for electronic engineers and solid-state physicists.

This has been carried out by an invited international team of over 50 specialists under the editorship of Professor Bhattacharya with support from INSPEC, which also compiled the subject index.

There are 40 individually written, self-contained modules "Datareviews", which comprise tables, text, figures and expert guidance to the literature as appropriate.

"*Properties of III-V quantum wells and superlattices*" is number 15 in the IEE EMIS Datareviews Series and is

intended both as a look-up source of evaluated data and as a structured review for academic and industrial R&D workers. It comprises 420 pages and is priced at £125 (casebound, ISBN 0 85296 881 7).

Low-power HF microelectronics: a unified approach

Gerson A.S. Machado (Ed)—Imperial College, London

Market-driven pressure to lower manufacturing costs while improving performance leads to the need for improved circuit technology.

This book brings together innovative modelling, simulation and design techniques in CMOS, SOI, GaAs and BJT to achieve high yield manufacture of low power, high-speed analogue and mixed mode integrated systems with reliability built in.

Examples from industry and academia combine process and design knowledge with affordable tools exploiting principles for robust design and low cost.

"*Low-power HF microelectronics: a unified approach*" (1,028 pages, 234 x 156 mm) is number 8 in the IEE Circuits and Systems Series. It is aimed at practising engineers and senior students and is priced at £65 (casebound, ISBN 0 85296 874 4).

Surface penetrating radar

David J. Daniels—Era Technology, UK

This is the first comprehensive treatment of radar which penetrates the surface of the ground or man-made structures.

The technique is increasingly used to examine archaeological sites and engineering structures and recently it has come to prominence in forensic investigations and landmine detection.

"*Surface-penetrating radar*" is number 6 in the Radar series and is aimed at the professional/academic level. It has 320 pages (234 x 156 mm), has colour illustrations and was published in August 1996 at £85 (casebound, ISBN 0 85296 862 0).

Spectral theory and excitation of open structures

V.P. Shestopalov and Y.V. Shestopalov

Open resonators, open waveguides and open diffraction gratings are used extensively in modern millimetre and sub-millimetre technology, spectroscopy and radio engineering. In this book the physical processes in these open electromagnetic structures are analysed using a specially constructed spectral theory.

The solution of electromagnetic problems in open structures needs a different approach from that used for closed structures because of radiation loss, edges, multiconnected cross-sections and the behaviour of electromagnetic fields at infinity. This book should be of interest to all engineers concerned with the analysis of electrodynamic structures.

"*Spectral theory and excitation of open structures*" is No. 42 in the Electromagnetic Waves Series (ISBN 0 85296 876 0) and comprises 411 pages of casebound text, priced at £59.

Propagation of radiowaves

Edited by M.P.M. Hall, L.W. Barclay and M.T. Hewitt

This book is based on the fifth IEE Vacation School on Radiowave Propagation and covers many aspects of the subject, from the principles of diffraction theory and the physical nature of the propagation medium to the analysis of modern service requirements.

The field of radio communications continues to change rapidly with the introduction of new services and the proliferation of mobile communications. The growing need for wider bandwidths and the consequent need for frequency reuse demand improved prediction methods.

This book deals with those aspects of radio theory that are essential to develop these tools. The emphasis throughout is on the ITU Radiocommunication sector recommendations.

"*Propagation of radiowaves*"(ISBN 0 85296 819 1) is No. 501 in the Electromagnetic Waves Series Related Publications and comprises 456 pages of casebound text, priced at £55.

The Internet for Scientists and Engineers

1996 edition—Brian J. Thomas

This new publication was written to give guidance to both the novice Internet user and the experienced user alike on how to navigate the net, discover the abundance of information present and to fully utilize the resources available. The book shows the user: how to get on-line, the hard and software requirements and the basics of e-mail, telnet, ftp and the World Wide Web. The 1996 edition includes material on Netscape, Lycos and Yahoo.

"*The Internet for Scientist and Engineers*" comprises 496 pages of text and is available as a paperback for £25 (ISBN 0 8194 2148 0). It is published by SPIE Press, USA, but is sold outside the USA by the IEE.

1996/7 INSPEC List of Journals now available

The 1996/1997 List of Journals is now available (ISSN 02647508, £20) providing an invaluable reference to the serial publications scanned for the INSPEC Database. The main list of approximately 4,000 entries is sorted under full title. Each entry includes the abbreviated title, CODEN, ISSN, publisher's address, the date of the first issue covered by INSPEC and, where appropriate, any change in title.

It also features the publication frequency and the BLDSC shelf number for each entry. Cross-referenced entries are provided to assist the user in locating titles within the list. CODEN, ISSN, Abbreviated Title and Country of Publication indexes are included.

Approximately 1,000 journals are "abstracted completely" for the Database and are indicated in the main listing, and listed separately.

Nikkei Microdevices' Flat Panel Display

1996 Yearbook. Report IL 3

Every year *Nikkei Microwave Devices Magazine*, one of the most respected publications in the display technology field, compiles an annual report to summarize *where the field is now and where it is going*. For the first time ever this report has been translated into English by Interlingua, a US translation and information company specializing in Japanese business and technology.

The Flat Panel Display Yearbook draws from the best of the past year's issues of the magazine and combines them with new reports about industry breakthroughs such as the much doubted $500 colour TFT panel. This 200 page issue also contains interviews with dozens of the industry's leaders as well as descriptions of significant technological events, such as: the entrance of Korean and Taiwanese products and technology into the field; Plasma Display Panel activities; and TI's much-feared DMD. There are hundreds of photos, charts and tables. This publication will be an invaluable tool for all those involved in the design, manufacture, sale or use of products which contain display technology, as it takes and in-depth look not only at current but possibly more importantly, future prospects.

The Yearbook is divided into 6 parts. The first section **"Trends"**, details the latest developments in the industry: advances in the field of process equipment; the acceleration of development of materials; and components including the progress towards thin, lightweight, low power displays. It includes interviews with executives of LCD manufacturers, LCD OEMs, and components and materials manufacturers. The next 4 sections are examined through papers and lectures presented at the *"Third Liquid Display Seminar"*, together with other interviews and articles. **"Markets"** includes both the PC and consumer markets. **"Panel Design"** and **"Process Engineering"** each look at four of five key areas, and **"Large Screen Displays"** studies topics such as the battle between rear projection TV and wall hanging TVs. Interviews with PDP manufacturers are included. Finally, there is an extensive **Directory** covering manufacturers, products, equipment and materials. It is in mainly tabular format for ease of comparison. Full details of the contents of the report are given below and overleaf. Copies of the report can be obtained by completing the order form and returning it to ERA Publication Sales. Price £450. Available from ERA Technology Ltd., Cleeve Road, Leatherhead, Surrey KT22 7SA, England. Tel.: +44 (0) 1372 367014; Fax: +44 (0) 1372 377927; E-mail: pub.sales@era.co.uk.

Industrial Information and Design Issues

J.E. Dubois, Université Paris VII, France; N. Gershon, Mc Lean, VA, USA (Eds.)

1996, XVIII, 293 pp. 102 figs., 8 tabs. (Data and Knowledge in a Changing World) Hardcover DM 148; £ 69; FF 558; Lit. 163,460; ÖS 1,080.40; sFr 130.50. ISBN 3-540-61457-5

The series *Data and Knowledge in a Changing World* covers the quality and accessibility of quantitative and qualitative data, classical and ground-breaking methods by which numeric and symbolic data are acquired, analysed and managed. The current volume is devoted to the specific information problems of the industrial world.

Contents: *Part One: Knowledge: The Driving Force in CAD Systems:* Creative Design and its Cognitive Components Information. Artificial Intelligence in Knowledge Based Systems (KBS). Modeling Tools for Knowledge Discovery. *Part Two: New Data Channels: Industrial Information Tools:* Industrial Information Exchange: Step, Standards and CAD Design Needs. Information Seeking Strategies: Selective Access to Current Information Online. Information Resources: Intelligent Complex Databases.

The Information Revolution: Impact on Science and Technology

J.E. Dubois, Université Paris VII, France

1996. XX, 273 pp. 50 figs., 17 tabs. (Data and Knowledge in a Changing World). Hardcover DM 148; £69; FF 558; Lit. 163,460; ÖS 1,080.40; sFr 130.50. ISBN 3-540-60855-9

Contents: *Emergence of and Information Society:* Facts and Challenges: Information Highways: Internet and Web Services. Obstacles to a Free or Fair Circulation of Scientific Data. Distributed Data and Information Networks. **World-wide and Regional Information Systems, Policies and Programs:** UNESCO Policy, World-wide networks, Regional Exchange Equity. Numerical, Textual and Image Databases. Case Study: World-wide Bioinformatics Distributed Databases.

TECHNOLOGY AND INVESTMENT OPPORTUNITIES

SELECTED INVESTMENT/TECHNOLOGY REQUESTS

PRODUCTION OF ELECTRONIC INVERTERS, CONTROLLERS AND METERS

Through the proposed project, it is planned to launch the existing products on a commercial basis. The company has developed four products in the field of power electronics, data acquisition, controls and factory automation. The annual capacity of the solid state inverter for industrial furnace is 50, power factor relay is 2000, motor speed controlled is 200 and power factor indicator is 2000 units.

Preferred mode of cooperation: Joint venture, buy-back arrangement, joint R&D, market access.

(For further information, please contact: Mr. Aqeel Ahmad, Director, Hi-Po Electronics (Pvt.) Ltd., Thokar Niaz Beg, Katar Bund Road, Off Multan Road, Lahore, Pakistan. Tel.: 5220748, 5412013; Fax: 5220060)

MANUFACTURE OF ELECTRONIC CONSUMER PRODUCTS

Development and manufacture of electronic consumer products for the domestic and foreign markets. The products will include uninterruptible power sources, dish satellite receivers, semi-automatic electronic panels for washing machines, electronic panels for remote controlled air conditioners and voltage stabilizers. The objective is to further expand and upgrade current R&D and production facilities to improve product quality for export.

Preferred mode of cooperation: Joint venture, market access, marketing expertise, sub-contracting, buy-back arrangement, joint R&D.

(For further information, please contact: Mr. Nauman Saeed, Chief Executive, Microtech Labs, No.11, 2nd floor, Saleem Chambers, 114 McLeod Road, Lahore, Pakistan. Tel.: (92-42) 7226328; Fax: (92-42) 7226328)

PRODUCTION OF ELECTRONIC BIOMEDICAL INSTRUMENTS

The proposed project is to manufacture electrocardiographs (single and multi channel) and computerized patient monitoring units (ECG, heart rate and temperature monitoring for up to six patients at a time). The company, through its R&D efforts, has developed these products at a cost that is far lower than that of imported articles. The project aims to improve the products further.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, technology transfer, buy-back arrangment, joint R&D.

(For further information, please contact: Mr. Nauman Saeed, Chief Executive, Microtech Labs, No.11, 2nd floor, Saleem Chambers, 114 McLeod Road, Lahore, Pakistan. Tel.: (92-42) 7226328; Fax: (92-42) 7226328)

MANUFACTURE OF PHOTOVOLTAIC SOLAR CELL MODULES

This R&D organization is specialized in the development of photovoltaic technology. At present the production is restricted to the production of modules on a non-commercial basis since the facilities are not able to cater for large-scale production. Assistance is required to upgrade the existing facilities for commercial production.

Preferred mode of cooperation: Joint venture, buy-back arrangement, equipment purchase.

(For further information, please contact: Dr. Parvaiz Akhtar, Director General, National Institute of Silicon Technology, Plot 25, H-9, Islamabad 44790, Pakistan. Tel.: 051-448470-1; Fax: 051-448469)

SOFTWARE DEVELOPMENT AND TRAINING HOUSE

The proposed project aims at establishing a computer software development and training facility. The major products of the software development component would be customized packages for various types of business, such as banking, hotel management, etc. As the products will be custom made, a production capacity definition would be irrelevant. The training facility will provide the software section with quality programmes and systems engineers, and will also provide software development and analysis training to individuals from outside the company. The company hopes to focus the major part of its business on foreign markets. The firm has the expertise required to provide solutions for the upcoming "Millenium Bug" problem.

Preferred mode of cooperation: Know-how, licensing, equipment supply.

(For further information, please contact: Mr. Khurshid A. Abbasi, Executive Director (Finance), Saigol Computers (Pvt.) Ltd., Units B & C, Block 1, Diplomatic Enclave, G-5, Islamabad, Pakistan. Tel.: 92-51-828347/8/9; Fax: 92-51-824125; e-mail: sclisb@isb.compol.com; Web site: www.cyber.netpk/sgl)

SOFTWARE DEVELOPMENT

The project aims to establish a software technology park near Lahore. A site has been purchased for the project and the sponsors would like to obtain high-end computer equipment which they would combine with their expertise and manpower to increase the already established clientele. The services to be provided would include contract software development, IT services (work/job processing, etc.) and

multimedia content design and development. The expected annual turnover from each of these is between $10 and $15 million.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, buy-back arrangement, loan.

(For further information, please contact: Mr. Mubashir A. Mian, Chief Executive Officer, Nextbridge (Pvt.) Ltd., 3-A/3 Gulberg III, Lahore, Pakistan. Tel.: 0092-42-575-0797; Fax: 0092-42-5758114; e-mail: Mmian@nextwerk.com; Web site: www.Nextbridge.com)

SOFTWARE DEVELOPMENT AND INFORMATION TECHNOLOGY SERVICES

The company is seeking to develop export-oriented software in the fields of application development and conversion, digitization and drawing management, CAD/CAM/CASE, Internet application, graphics and multimedia. The intention is to expand and modernize existing software and hardware capabilities and facilities. The company is confident it has the potential for the project to succeed in view of the availability of highly skilled English speaking experts at low cost. Being a subsidiary of a large Pakistani business group, the sponsors have strong links with local and international information technology markets.

Preferred mode of cooperation: Joint venture, sub-contracting.

(For further information, please contact: Mr. Iqtidar Zaidi, President, Pakistan Technologies (Pvt.) Ltd., House number 3, Street 57, F 7/4, Islamabad, Pakistan. Tel.: 92-51-821559, 812853; Fax: 92-51-274749; e-mail: suntech@paknet1.ptc.pk)

SOFTWARE DEVELOPMENT

The company aims to expand its current facilities of software production in the field of information technology consulting services, Internet-based services and data entry services. The purpose is to expand by increasing market share through assured business and through joint venture collaboration to introduce the latest information technology to Pakistan. The target market of the proposed project is hospitals, software houses and companies that require legal transcriptions in Europe and the USA.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, technology transfer.

(For further information, please contact: Mr. Shabbir A. Usmani, Executive Director, System Research (Pvt.) Ltd., Gulrez Plaza, Gulrez Colony, Chaklala Scheme, Rawalpindi, Pakistan. Tel.: 051-508282, 508270-6; Fax: 051-508284; e-mail: usmanisi@transcripts.com; Web site: http://204.192.4.60\index.html)

ESTABLISHMENT OF ELECTRONIC MESSAGING SERVICE

The aim is to set up an e-mail network for the entire country. The EMS network would consist of a set of central e-mail servers that are the repositories of incoming and outgoing mail. In order to achieve wide coverage, there will be several hundred or even thousands of smaller message centre clients that can communicate with the central e-mail servers.

Preferred mode of cooperation: Joint venture, management expertise.

(For further information, please contact: Mr. Shahid Jaffrey, TCS (Pvt.) Ltd., 22-A, Amber Tower, Block 6, P.E.C.H.S., Shahrah-e-Faisal, Karachi, Pakistan. Tel.: 9221-4534316; Fax: 9221-4548428; e-mail: shahid@tcsit.khi.erum.com.pk)

INTERNET MARKETING SERVICES

The Coral group of companies is proposing to set up a new project involving the establishment of an interactive Internet marketing service. The basic idea of electronic shopping is to take information from a mail-order catalogue and create a very large computer database which can be regularly upgraded and improved to display new products. This database can then be accessed by a series of smaller outlets at any strategic location such as airports, malls, neighbourhood stores and entertainment venues. The service will be provided to the general public of Karachi. The company has the necessary technical and managerial expertise.

Preferred mode of cooperation: Joint venture, technology transfer.

(For further information, please contact: Mr. Muhammad Yousuf, Director, Coral Group of Companies, Al-Sayed Arcade, R.No.5, 3rd Floor 1/c, Fl-1, Block 5, Gulshan-e-Iqbal, Karachi, Pakistan. Tel.: 9221 461407, 4993220; Fax: 9221 4993220; e-mail: mfi@khi.compol.com; Web site: www.acropolis-corp.com)

PRODUCTION OF ELECTRONIC SECURITY SYSTEMS

The proposed project aims at expanding the production of various types of electronic security systems for domestic and foreign markets. The security systems being produced at present are: security systems for private residences, commercial buildings and markets, security networks for public housing schemes and automobile security systems. The aim is to further upgrade the current level of R&D along with an expansion of production facilities.

Preferred mode of cooperation: Joint venture, market access, sub-contracting, technology transfer, buy-back arrangement, joint R&D.

(For further information, please contact: Mr. Nauman Saeed, Chief Executive, Microtech Labs, No.11, 2nd floor, Saleem Chambers, 114 McLeod Road, Lahore, Pakistan. Tel.: (92-42) 7226328; Fax: (92-42) 7226328)

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BRAZIL TECHMART '97

Belo Horizonte (Minas Gerais) Brazil
1 – 3 December 1997

INTERNATIONAL BUSINESS FORUM

Organized jointly by UNIDO (United Nations Industrial Development Organization) and the Federation of Industries of the State of Minas Gerais (FIEMG), BRAZIL TECHMART '97 aims to promote and support the formation of technological and joint venture partnerships between and among enterprises from Brazil, particularly the state of Minas Gerais, and from other parts of the world, paricularly Austria, Italy, Slovenia and the Republic of Korea. By putting into focus the technological needs as well as the strengths of enterprises in the Brazilian metal-mechanic, agro-processing and biotechnology sectors, the event aims at forging strategic business partnerships that will promote the competitiveness and growth of these three sectors.

Over 70 Brazilian enterprises seeking technological solutions for company growth and competitiveness will be present at BRAZIL TECHMART '97, as well as trade associations, chambers of commerce, manufacturers associations, research institutes, government organizations, technology transfer agents, development banks and venture capitalists

For further information, please contact:

- Director, Technology Services, Investment and Technology Promotion Division, UNIDO, P.O. Box 300, A-1400 Vienna, Austria. Tel: (43-1) 21131-3693, Fax: (43-1) 21131-6809, E-mail: opadickakudi@unido.org
- The National Project Coordinator, Brazil Techmart '97 Minas Gerais, FIEMG (Industrial Federation of the State of Minas Gerais), Av. Do Contorno 4520 - 10th floor, CEP 30110-090 Belo Horizonte, Minas Gerais, Brazil. Tel: (0055-31) 229 6645/229 6565; Fax: (0055-31) 239 4636; e-mail: fiemg@fiemg.com.br

TECHMART AFRICA '97

Grand Bay, Mauritius
24 – 26 November 1997

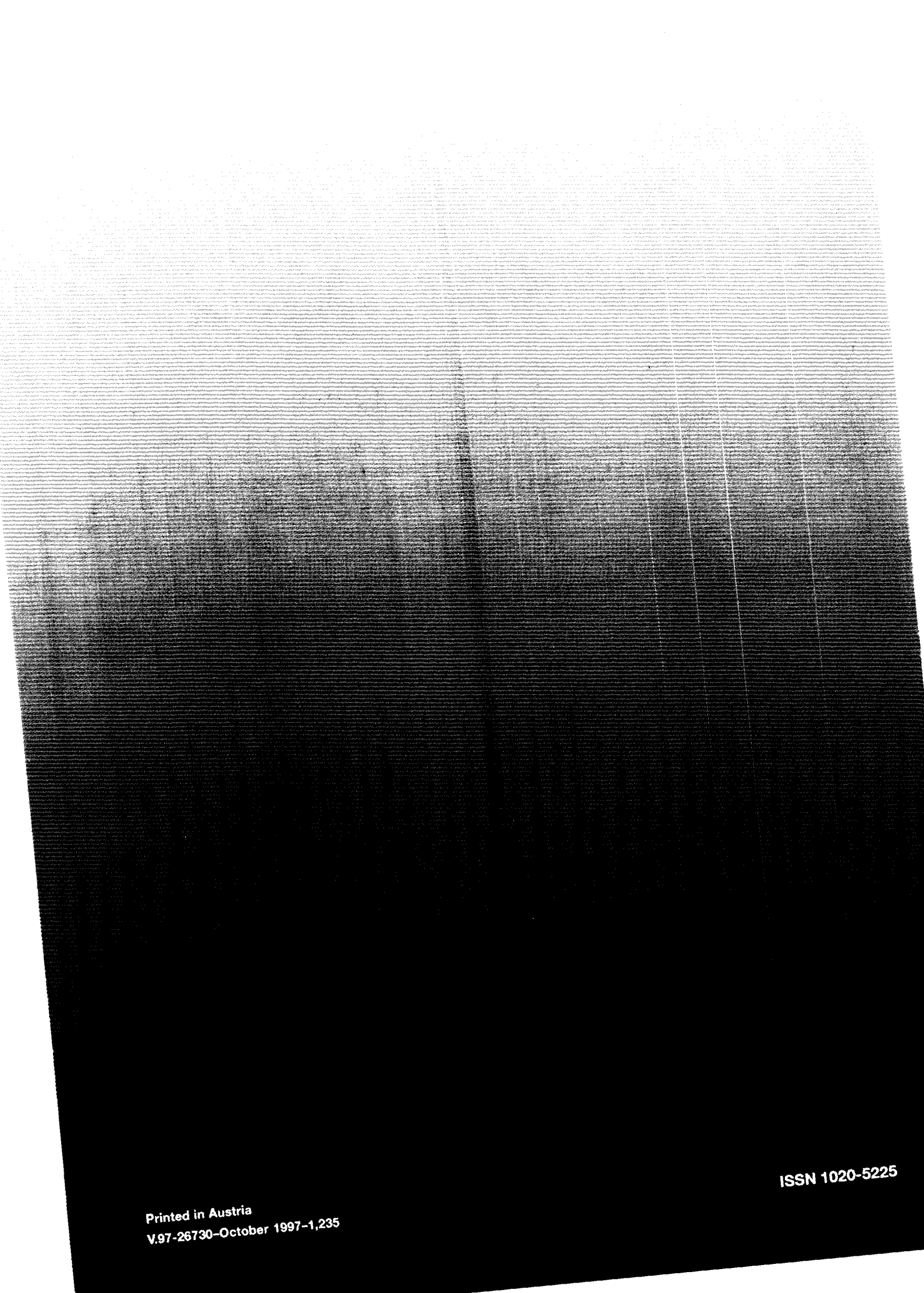
INTERNATIONAL BUSINESS FORUM

Organized jointly by the Government of Mauritius, UNIDO (United Nations Industrial Development Organization), SMIDO (Small and Medium Industries Development Organization) and COMESA (Common Market for Eastern and Southern Africa), TECHMART AFRICA '97 is an International Business Forum to promote direct contacts between investment and technology seekers from Egypt, Ethiopia, Ghana, Kenya, Mauritius, Namibia, Uganda, Zambia and Zimbabwe, and investors and technology suppliers from developed and developing countries. TECHMART AFRICA '97 will support private small and medium enterprises in forging technology and joint venture partnerships in the manufacturing, agro-based and agro-related industrial sectors.

Technology acquisition and joint venture partnership discussions between foreign and African coumpanies will take place during the TECHMART, and individual business meetings will be arranged on the basis of indication of interest on the technology and joint venture proposals. Technology seekers from African countries will meet foreign technology suppliers and arrangements will be made to display technologies using sample products, drawings, process flow diagrams, etc.

For further information, please contact:

- Director, Technology Services, Investment and Technology Promotion Division, UNIDO, P.O. Box 300, A-1400 Vienna, Austria. Tel: (43-1) 21131-3693, Fax: (43-1) 21131-6809, E-mail: opadickakudi@unido.org
- Director, Small and Medium Industries Development Organization (SMIDO), Industrial Zone, Royal Road, Coromandel, Republic of Mauritius. Tel: (230) 233-50 30 or 57 12/3/4; Fax: (230) 233-55 45; e-mail: smido@bow.intnet.mu
- Acting Director, Industry, Energy and Environment Division, Common Market for Eastern and Southern Africa (COMESA), Lotti House, Cairo Road, P.O. Box 30051, 10101 Lusaka, Zambia. Tel: (260) 1-229 726/32; Fax: (260) 1-225 107 or 227 318; Telex: ZA 40127; e-mail: comesa@comesa.zm



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