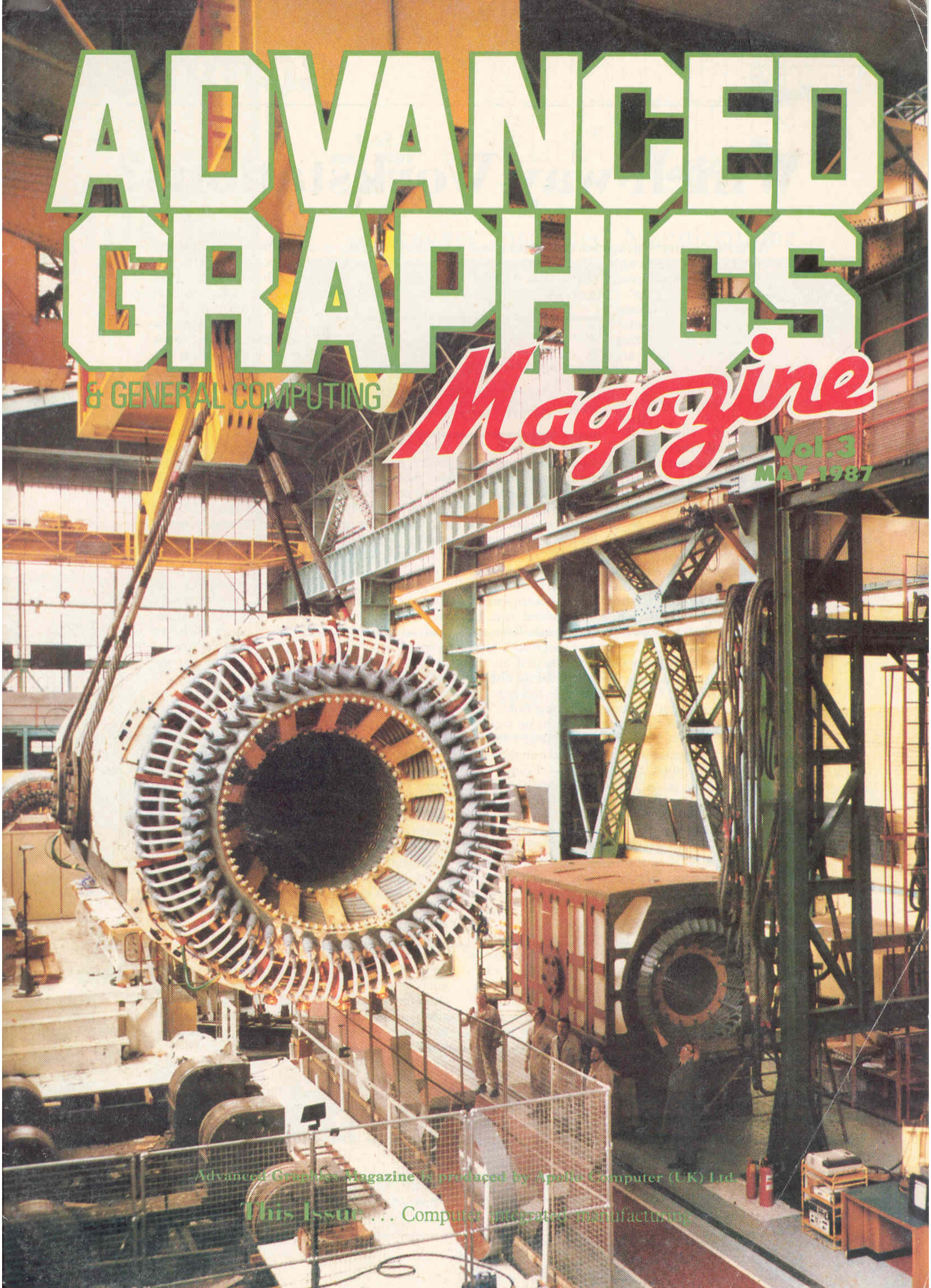
ADVANCED GRAPHICS

& GENERAL COMPUTING

Magazine

Vol.3
MAY 1987



Advanced Graphics Magazine is produced by Apollo Computer (UK) Ltd.

This Issue . . . Computer integrated manufacturing

Which way Workstations?

America's major graphics exhibition and conference, Siggraph '87, is to be held this July at Anaheim, California. Annual shows such as Siggraph are a useful barometer for industry trends. Take the rise of the workstation as an example: only a few short years ago it was the display terminal that formed the backbone of interactive computer graphics. As such they were a major focus at any Siggraph exhibition. But the trend was towards more local intelligence, more local storage, more colour, and faster drawing speed. Last year, at Siggraph '86 in Dallas, there were still some companies selling high performance display terminals, like Evans and Sutherland and Daikin Industries. But in the main they have disappeared from the centre stage, squeezed out of the market by workstations and PCs.

The annual Siggraph exhibition presents a useful barometer of industry trends

Turner Whitted, Numeric Design Inc; University of North Carolina commented on the main reasons for this. "For one thing, display terminals will not support the richness of applications that are coming along now. The application and the display have to be so intimate that you can't afford to do it in a terminal. So the notion of having a terminal at the end of a so-called 'skinny cord' — I don't care how wide it is — it's still skinny if it's not memory mapped — is not something that is going to survive. And it hasn't!"

The price/performance of workstations has simply overwhelmed display terminals, and they have become the main platform for computer graphics. Benchmarking a current production engineering workstation using a typical engineering problem shows that on average they are ten times faster than a VAX 11/780. Additionally, PCs have become powerful enough during the past few years to be able to effectively support graphics applications when enhanced with a plug-in graphics board. The impact on the market has been significant.

On the Apollo stand, the first Apollo workstation, the DN100, was put next to its current bestseller, the DN3000. The price/performance contrast was dramatic after only five years. When introduced in 1981 the monochrome sold for about $35,000 and was rated at 0.3 MIPS. In 1987 the monochrome DN3000 sells for under $15,000, and is rated at 1.2 MIPS — four times the performance at less than half the price.

Given all this, a central issue at Siggraph was trends in workstations, particularly the problems of product differentiation in a crowded market where all the major vendors claim similar performance specifications, at almost the exact same price. According to George Foly of George Washington University "the smart workstation vendors have discovered that they must have some PC compatibility, so that, as they claim their position on the desktops of the engineers of the world, those engineers don't have to have two workstations, namely the PC to run the PC-based software, plus the higher performance workstation. We are now seeing workstations with AT buses, so engineers have the best of both worlds."

Another talking point was the price/performance convergence of low-end integrated workstations and souped-up PC-AT systems with graphics cards. As Turner Whitted pointed out "On IBM PC class machines, I can buy networking and bit-mapped displays from third parties and run any application I want. Or, I can buy the whole thing ready integrated from workstation manufacturers. Interestingly, the prices of these two approaches are about the same." However, the PC approach does have its limitations. Carl Machover, a consultant, said "the bus structures of many PCs that these cards are used with do not permit you to transfer the data fast enough to take full advantage of the card's characteristics. So you do not get the throughput you might expect from looking at the specification."

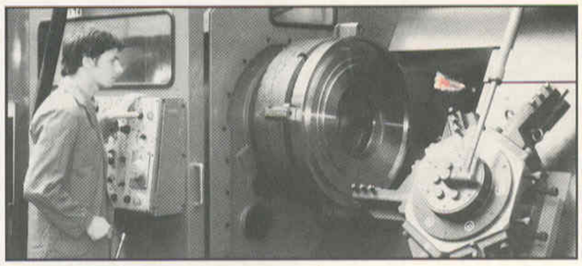
So what developments in workstation technology will visitors to Siggraph '87 expect to see. 1986 was the year that workstations made the jump to high performance 3-D colour graphics, but there is still a demand for greater performance at the high end, with real-time integrated graphics applied to areas such as solid modelling, molecular modelling, fluid mechanics and all sorts of dynamic simulation. The next generation will make use of faster processors, more custom vlsi, and parallelism. Andries Van Dam of Brown University said "in 1986 we saw stations reported to be in the 4-5 MIPS region. At Siggraph '87, and certainly at Siggraph '88, you are going to see workstations for under $100 thousand that have well over 10 MIPS and MFLOPS performance."

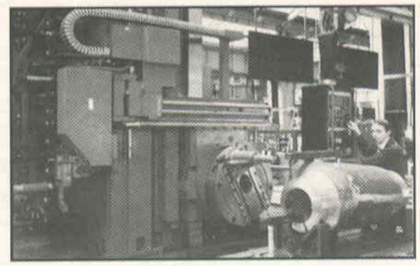
This report was based on SIGGRAPH '86 — a two hour video report compiled and produced by Frost and Sullivan Inc.

Vol.3
MAY 1987

ADVANCED GRAPHICS Magazine

This Issue ... Computer Integrated Manufacturing





cover...

Assembling a turbine generator at the Heaton Works of NEI Parsons — one of the most up-to-date works of its kind — where computer integrated manufacturing is an important part of the overall operation. Story — page 14.

Advanced Graphics Magazine is published by Octagon Marketing Group, for Apollo Computer (UK) Ltd.

Editor: John Abbott

Production Director: M.G. Evans

Advertising Manager: Clive Farrand

Advanced Graphics Magazine,
Octagon House,
32-36 Little Horton Lane,
Bradford BD5 0AL
Tel: (0274) 309930.

London office:

12 De Walden Court,
85 New Cavendish Street,
London W1
Tel: 01-631 1044.

MAP — myth or reality?

The CIMAP exhibition, organised by the Department of Trade and Industry at the NEC last December attracted over 6,000 visitors. But is MAP here to stay? J.S. Wright reports

MAP — Few can claim a complete understanding of the technology.

MAP, we are told, is set to change the face of computer-integrated manufacturing virtually overnight. It seems that almost every computer and control-equipment manufacturer in the Western world has thrown its weight behind the concept, and that the notorious "islands of automation", typical of modern production environments, are soon to be intelligently interlinked.

Nor is Europe lagging behind in this effort — nearly 6,000 senior engineers and managers found it worth their time to attend the Department of Trade & Industry's 'CIMAP' awareness event at the National Exhibition Centre last December. There they were able to see MAP in action — as the backbone of demonstrations covering a whole range of activities from semi-automated inspection systems to fully integrated manufacturing cells.

But despite all the fuss being made about the emerging Manufacturing Automation Protocol standards, there is apparently still some doubt in the market-place about whether MAP will really be the standard to win the widespread acceptance, and multi-manufacturer support, which it must acquire if it is to deliver what it promises.

To those manufacturing concerns not yet familiar with MAP concepts — and few can yet claim to have a complete understanding of the technology — some fundamental questions arise. What is MAP? Who is behind it? Where is it going? When does it really start to happen? Why should we need to know about it today? Or will it all blow over, another futuristic scheme which never quite saw the light of day?

Many of these questions are linked — but the fundamental answer is that MAP is *not* likely to go away, it *is* going to happen, and it is going to be fundamentally important to anyone who has any existing or future interest in computer-integrated manufacturing.

The reason is very straightforward. When an organisation the size of General Motors — one of the world's largest manufacturers — says to the market-place: "in future, we shall only buy equipment from you when it complies with this standard," then even the so-called computer 'giants' can hardly fail to take notice. GM, after all, is planning to increase its programmable automation base by a factor of four or five by the end of the decade — which makes it a very important customer indeed. But luckily for the manufacturing community as a whole GM has not laid down a standard which reflects only GM's individual requirements.

Almost every conceivable automation requirement has arisen at GM at some time — to that extent, GM's operation represents much of what other manufacturers may need. But also, GM has been working closely with the International Standards Organisation for some time, to define a true 'open systems' model — where an automation system is 'open' to the potential connection of equipment from a wide variety of manufacturers. This is an absolute must — you may have acquired Apollo engineering workstations, but your CNC machine tools come from elsewhere — and if the two are to communicate effectively, some agreed standard for data interchange is essential.

So it is not just the fact that GM carries a lot of weight in the market-place — although certainly it does — but also the fact that standards organisations have been working very hard to arrive at a true manufacturer-independent open systems specification, which secures the future for MAP. And what equipment manufacturers are going to have to do for GM, they are hardly going to be reluctant to supply elsewhere to similar needs.

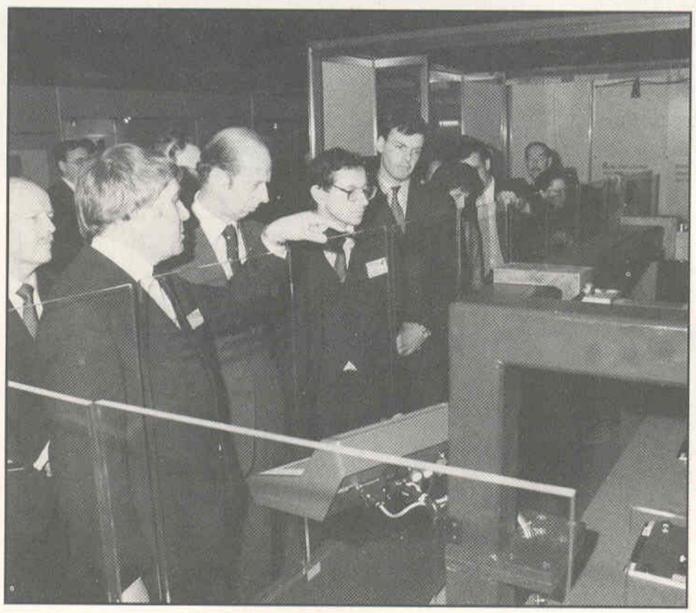
The widespread adoption of MAP is not an industry blindly following in GM's footsteps — what matters is whether they have the right specification; and certainly the International Standards Organisations is working hard to try to ensure it. People adopted UNIX, not necessarily because they wanted to follow in the wake of AT&T, but because UNIX is a fundamentally good operating system. MAP can be expected to follow a similar course.

In fact, the analogy can be pursued further. UNIX has turned out to be one of the most fundamental forces influencing recent computer hardware design — instead of messing about trying to make new machines look like the old (ie compatible with previous proprietary operating systems) design teams at many different manufacturers have accepted UNIX as the target, and have managed to produce systems with even higher levels of price/performance, through having a clear definition of the requirement.

A similar acceleration effect should come about from MAP. Nothing simplifies the design process as much as an exact statement of targets — and now that many equipment manufacturers are trying to reach the common target of MAP, new levels of cost-effectiveness will be attained.

So what is MAP. To quote from GM's own documentation, "MAP is a seven-layer, broadband, token-bus based communication specification for the factory environment." In essence, it defines how data may be meaningfully interchanged between different programmable systems, using the basic physical medium of a wide-bandwidth coaxial cable bus system.

The 'seven layers' come from the ISO open systems model — a means of allocating clearly the hierarchy of functions which must take



The Duke of Kent at CIMAP.

place between, at the top, what the application wants; and at the bottom, the cables and connectors and the signals on the wires.

Today, it has to be admitted that not every detail of every single layer is yet fully defined in MAP. The standard is evolving — the current specification (MAP 2.1) dates back to 1985, and the new specification (MAP 3.0) is targeted for 1988. While some manufacturers have understandably held back temporarily from designing to a specification not yet finalised, others (both in the USA and in the UK) already have demonstrable systems.

The general feeling in the market-place is that while only a small quantity of MAP-compatible equipment will be sold to European and US industry during 1987, a

ISO Layer	Standard
Application	FTAM VTP X.400
Presentation	Null
Session	ISO 8327
Transport	ISO 8073
Network	ISO 8473
Datalink	undefined
Physical	undefined

The seven layer ISO model and the current state of ISO standards.

guarantee of 'future MAP compatibility' will increasingly be sought by buyers of equipment for industrial automation.

Apollo has a particular commitment to the MAP program — when the definition of what is to be manufactured originates on an engineering workstation, it is essential that means exist to convey that information to the centre of manufacture. Apollo's CIM unit in the USA has been set up specifically to address MAP — and intends to demonstrate MAP capability later in the year. Here in the UK, a co-operative venture with a leading University is aimed to ensure that the European operation is in the forefront of MAP technology.

And close on the heels of MAP, comes TOP. The Technical Office Protocol (initially promoted principally by Boeing) is very similar to MAP (the two protocols are to be identical in all but the two lower layers) and is based on baseband Ethernet-type technology — with 'carrier sensing' bus techniques rather than 'token passing' as its data transfer strategy.

TOP represents the future for co-operation between engineering workstations in a technical office environment. 'Gateways' will be used to connect the TOP networks of the design office to the MAP networks of the factory floor.

Even though the standards are still evolving, a great deal of what MAP can do — and a significant amount of TOP's capabilities — are demonstrable today: indeed, have been publicly demonstrated working in the UK. Both standards are set to take on primary roles in the future of computer-integrated manufacturing — a future which, very probably, begins right now.

CIM '87 is to be held at Olympia between June 2nd and 5th as part of British Manufacturing Technology Week.
Contact: Independent Exhibitions Ltd, 15 Heath Road, Twickenham, Middlesex TW1 4BN.

Telephone 01-891 3426.

Public DOMAIN — Communications at large

Apollo demonstrated multi-vendor networking at Uniforum in Washington last January — and plans to do the same at the European UNIX User Show at Olympia later this month.

The concept of the workstation is quite a recent phenomenon. If you were a typical technical user back in the 1970s, you would most probably have had to be content with sharing a mainframe or a minicomputer with your colleagues. By the 1980s, however, your luck might have changed — workstations gave each individual user the power of a VAX on the desktop. Marvellous, you might think — no more the frustrations of unpredictable response times. Unfortunately, however, you have lost the advantages of a shared file system and resources.

Bring on the networks! After a few years, most workstation vendors had recognised the need for communications between individual users, and were offering networking facilities that allowed file and resource sharing with varying degrees of transparency and performance. Ideal? Only if you had religiously stuck to one manufacturer when buying in your computer hardware. If not, what do you do with the old VAX, all those IBM PCs? And what about new products you might wish to buy in the future — the Texas Instruments Explorer for AI work, or an Alliant Parallel Processor on which to offload some of the heavier tasks?

Perhaps one of the most important trends in the history and development of computing has been the shifting balance of power between computer vendors and computer users. As computing power became cheaper and more accessible, so real users (rather than computer professionals) began to dictate to the market. To most of us nowadays, the computer is not in a mysterious and far removed basement room, but on our desks, or in a corner of the office or workshop. Users work in real-world situations, and wish to utilise whatever equipment might be available. It was user pressure that prompted manufacturers to start exploring the possibilities of multi-vendor networking around 1985, leading them in one of the more promising directions of recent times.

In November 1986, at the Autofact trade show in America, Apollo Computer announced and demonstrated its Public DOMAIN environment, an extension to the long established DOMAIN distributed computing system. At Autofact the focus was on efforts to link the various design and production processes found in the manufacturing industries. A further demonstration at Washington's Uniforum UNIX exhibition in January showed the potential of the workstation to become the single unifying technology in the corporate computing environment, bringing together transparently all of the computing levels typically found there: high performance UNIX-based workstations, specialised systems such as the TI Explorer symbolic processing machine, MS-DOS based applications, personal computers, DEC VAX/VMS files, Wang O/A wordprocessing systems, applications running on Sun's Network File System (NFS), minisupercomputers such as the Apollo DSP9000, and Tektronix VT100 terminal emulation.

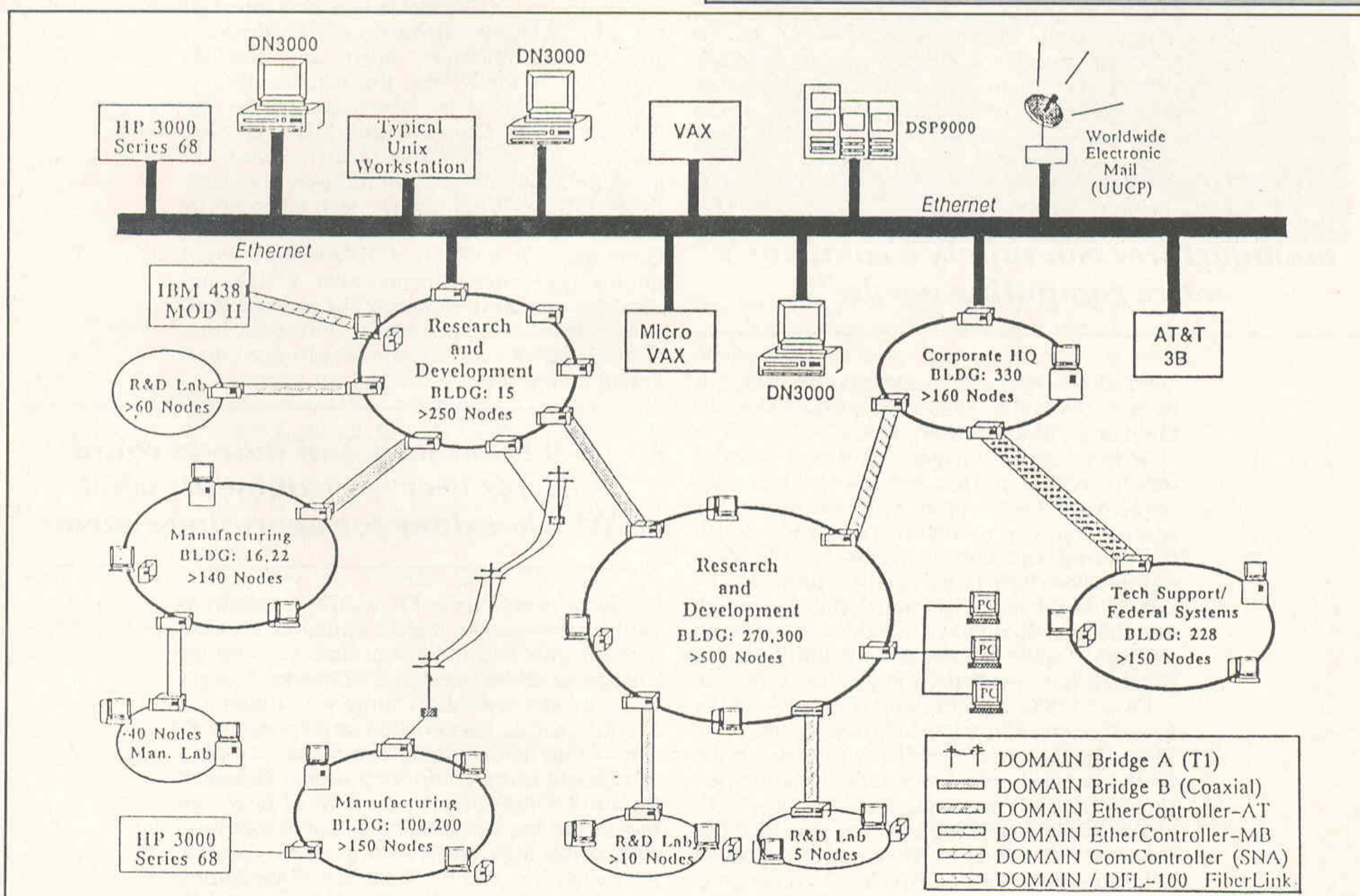
How did Apollo arrive at Public DOMAIN? Apollo's workstations were designed from the outset to be networked together. At that time, local area network standards had not surfaced, so the company developed its own. DOMAIN is a 12 Mbyte per second token-passing ring, the technology IBM was later to adopt for its own LAN standard. Individual workstations, or nodes, transmit data onto the ring by first acquiring the token — of which only one exists on the network at any given time. The method can be likened to the system operated by engine drivers working single-tracked lines — only the train in possession of the physical token is allowed down the track — others must wait until the token has been surrendered.

By contrast, nodes on an Ethernet network use the principle of collision avoidance. A node attempts transmission — if it collides with an existing message on the network, that transmission is aborted, and re-transmission is attempted until successful. Ethernet networks can lose efficiency as the collision rate increases when heavily loaded. Such motorway pile-ups cannot happen on the DOMAIN

DOMAIN/ACCESS	transparent file-access to VAX/VMS systems via TCP/IP
DOMAIN ETHERNET	gateway to systems on ETHERNET networks
ETHERBRIDGE	wide-area DOMAIN internet link via ETHERNET networks
802.3 Network Controller-AT	board-level product for full ETHERNET support for series 3000
DOMAIN/PCI	communications to IBM PC,XT,AT and compatibles
DOMAIN/SNA	IBM 3270 and 3770 emulation via SNA
DOMAIN/BRIDGE	wide-area DOMAIN internet link (via T1 ACCUNET or coaxial cable)
RS232C	for peripheral and factory floor devices
X.25	for public data networks
VT100/Tektronix	terminal emulation
IBM HASP/2780/3780RJE	for IBM mainframes
Serial/Parallel Expansion	peripheral device board for Series 3000
GPIO	general purpose I/O software for peripherals

The Public DOMAIN Communications Products

Apollo corporate DOMAIN topology in the U.S.A.



token ring, which has the added advantage of using much cheaper cabling.

Ethernet, however, along with TCP/IP, forms layers one to four at the International Standards Organisation's Open Systems Interconnect reference model (the confusingly abbreviated ISO/OSI). And many firms moving into new buildings are finding themselves already wired up for Ethernet. Increasingly, companies are wishing to integrate their IBM, DEC, and PC-based systems into corporate networks to implement (for example) computer integrated manufacturing using MAP and TOP protocols, which are in turn based on the ISO/OSI model.

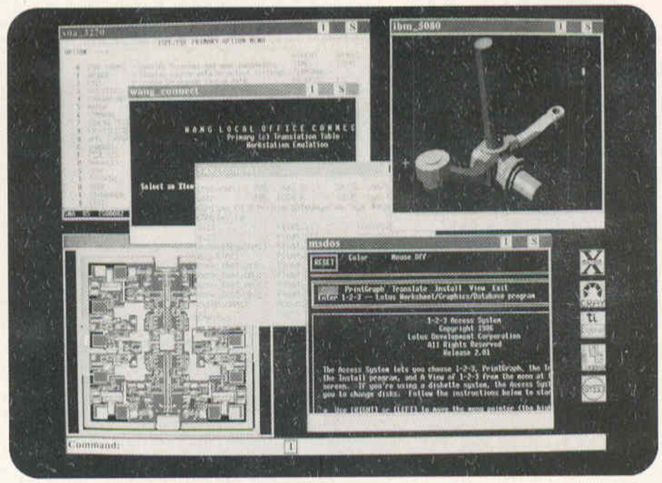
The Public DOMAIN philosophy aims to bring the advantages and security of its proprietary DOMAIN network across to Ethernet type networks and beyond. A user sitting at an Apollo workstation display will be able to access, completely transparently, MS-DOS software, VAX files, Wang-based programs, as well as UNIX applications (both Berkeley 4.2 and System V) running on other manufacturers' workstations. DOMAIN was the name of the network, now it is a way of using the resources a user needs wherever or whatever they may be. Software mops up the total useable resources of the entire computing environment, sending subtasks to the processor best suited to it. For example, a designer could use the resources of an Apollo DSP9000 number cruncher to explore a concept on-screen, analyse its predicted performance, interpret the results, and move on to

"The move to CIM has brought about a new realism — that no one manufacturer can supply a company's entire computing needs."

detailed design and drafting, all without having to leave his seat, or re-adapt to an unfamiliar graphics environment.

With its demand paging across the network (which reduces traffic, and ensures that subsequent references proceed at main memory speed), transparent file sharing, and record/file locking across the network, DOMAIN is rightly considered a paragon of protocols by system builders. That functionality, though not the speed, is now available on Ethernet through Public DOMAIN. Additionally, a user can plug in to IBM and other networks.

Over 1,000 Apollo workstations can be linked together on a DOMAIN network, more at remote sites via a bridge over megastream — the user experiences vitually the same performance, and sees the same file structure, although the disk being accessed may be thousands of miles away. VAX based data can be reached using NFS or Apollo's Vaccess gateway. One customer has used Apollo workstations to unify a PC network — eight PCs



X-Windows

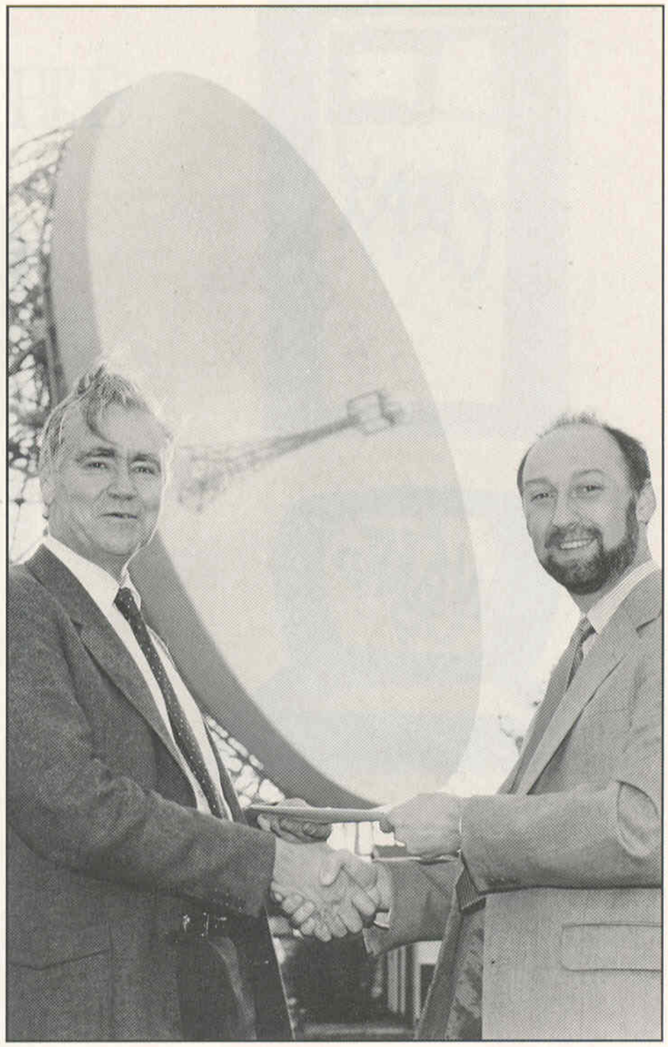
can be linked via a multiplexor or RS232 port to the back of a single node. And at the other extreme, low cost, long haul links like X.25 can be used to join sites in European locations on the network.

Events at the Uniforum Show in Washington helped to establish a further element — a portable windowing system called X-Windows, that allows applications to run transparently across multi-vendor networked environments. X-Windows was developed at the Massachusetts Institute of Technology, and is nonproprietary, open, and publicly available. At Uniforum, the windowing system was endorsed by eleven companies, including Apollo, Data General, DEC, Hewlett Packard, MassComp and Siemens, who will promote X-Windows as an industry standard. In the UK, X-Windows has been taken up by another workstation manufacturer, Torch Computers. It looks as if X-Windows could do for user environments what UNIX has done for operating systems. The portability of X-Windows from application to application fits well with Apollo's vision of advanced integrated computing.

"It looks as if X-Windows could do for user environments what UNIX has done for operating systems"

Apollo, with Public DOMAIN, is committed to providing the highest functionality with data integrity within a token ring or by bridge to other wide and local area networks. The recent move towards Computer Integrated Manufacturing has brought with it a new realism — that no one manufacturer can supply a company's entire computing needs. However, Public DOMAIN means that a firm can match the implementation to the application without having to worry about where the data is or what it is doing. The user will be getting the highest functionality from the best available resources. Apollo will look after the rest.

Tracing the origins of the Universe



John Davies, professor of radio astronomy at Jodrell Bank and John Parkinson, UK managing director of Apollo, standing in front of the Jodrell Bank radio telescope.

Jodrell Bank, the world's leading radio astronomy laboratory, has announced the installation of one of the most powerful mini-supercomputers, the *DSP 9000*, from Apollo Computer (UK) Limited. The Apollo computer, which provides computing power in the Cray class at a fraction of the cost, will be used to process data gathered from remote parts of the universe, thousands of millions of light years away, to trace the origins of the cosmos.

Research at Jodrell Bank involves the analysis of galaxies, black holes, quasars and pulsars to discover their structure from their radio emissions. The £700K mini-supercomputer will, each day, be processing up to hundreds of megabytes of data to produce detailed radio maps.

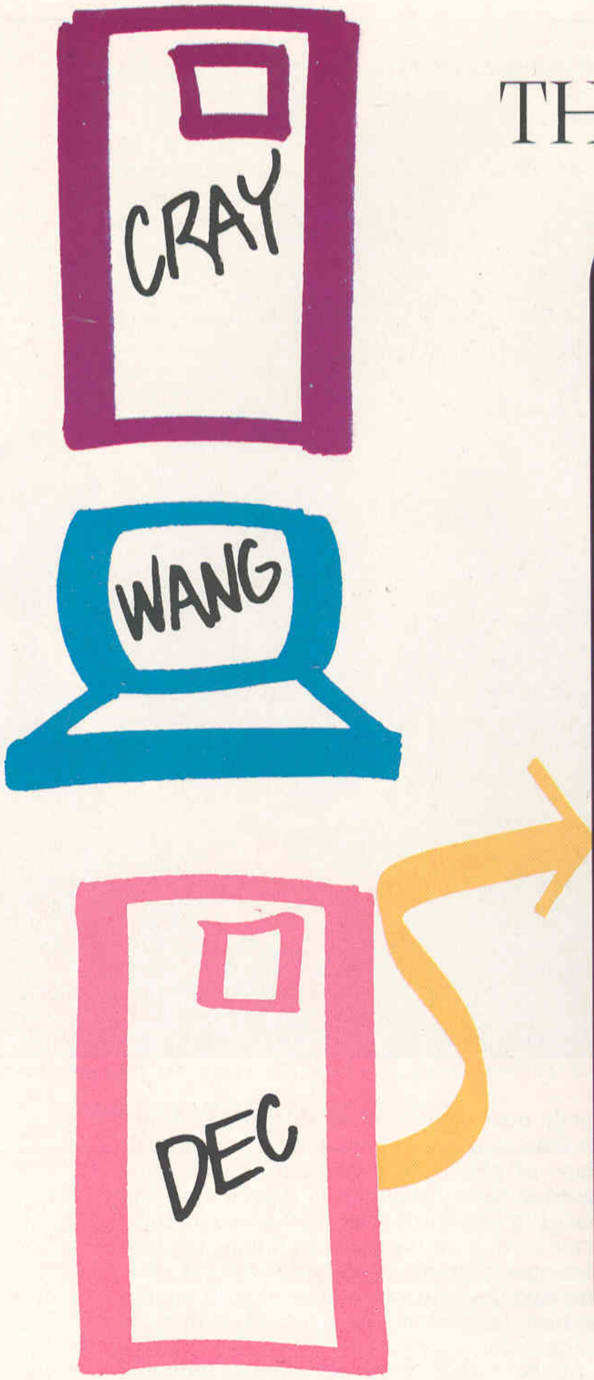
Advances in image production and the addition of a sixth radio telescope at Cambridge to the MERLIN network had resulted in Jodrell Bank accumulating data much faster than its existing VAX plus AP system was capable of processing.

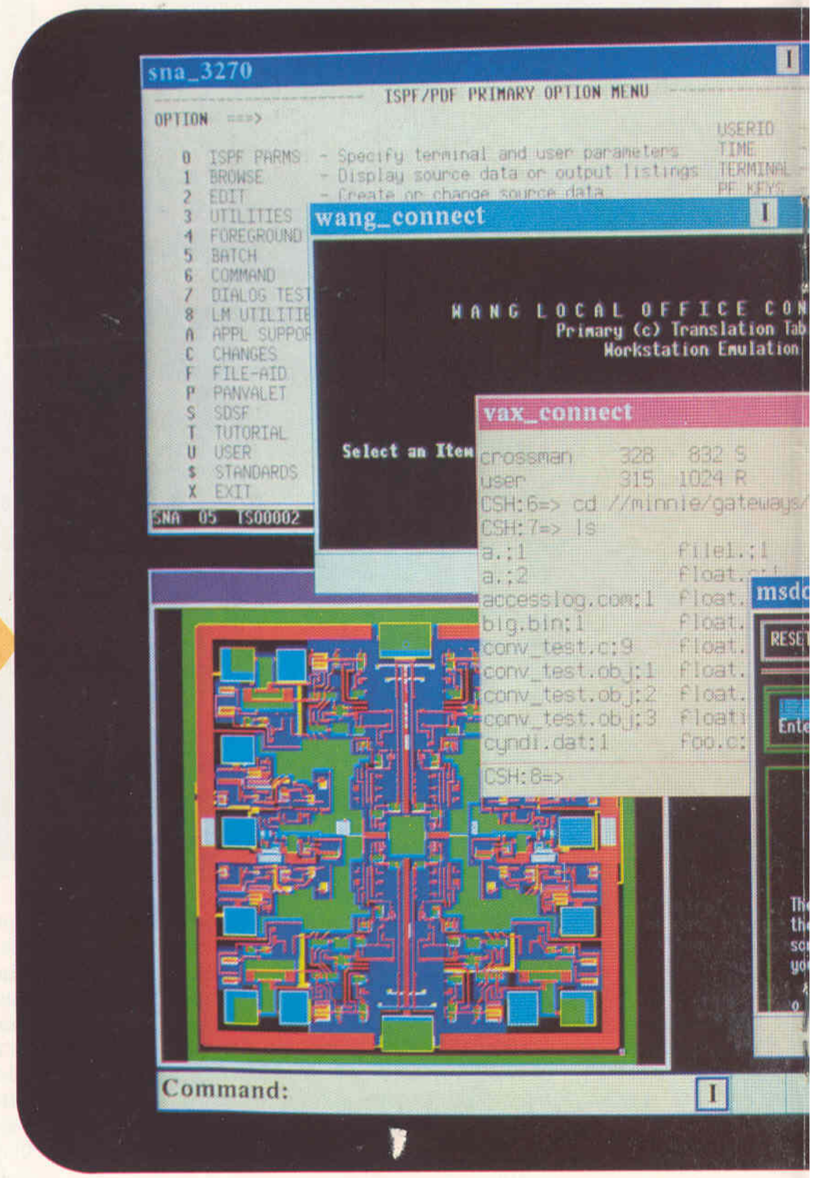
Utilising dramatic increases in computing power from the latest parallel architecture, the Apollo machine will be capable of processing the data at the speed at which it is collected. Maps of objects in space can now be produced in more detail and in significantly less time. For certain projects a telescope as large as the earth itself is created by linking the UK telescopes with others around the world. The new Apollo computer will be able to handle the huge amount of data collected on projects of this scale.

Apollo's DSP 9000 mini-supercomputer, which adopts Alliant Computer Systems FX/Series as its hardware base, is the first to apply parallel processing automatically to existing software programs in science and engineering, achieving a peak performance of 94 MFlops or 35.6 MIPS.

Sir Francis Graham Smith, Astronomer Royal, commented: "We really are very pleased to be harnessing computing power of this order for our research at Jodrell Bank. It will transform our capabilities in map-making and is a key element in maintaining our world-leading position in high resolution radio astronomy."

INTRODUCING P
THE WINDOW ON AL





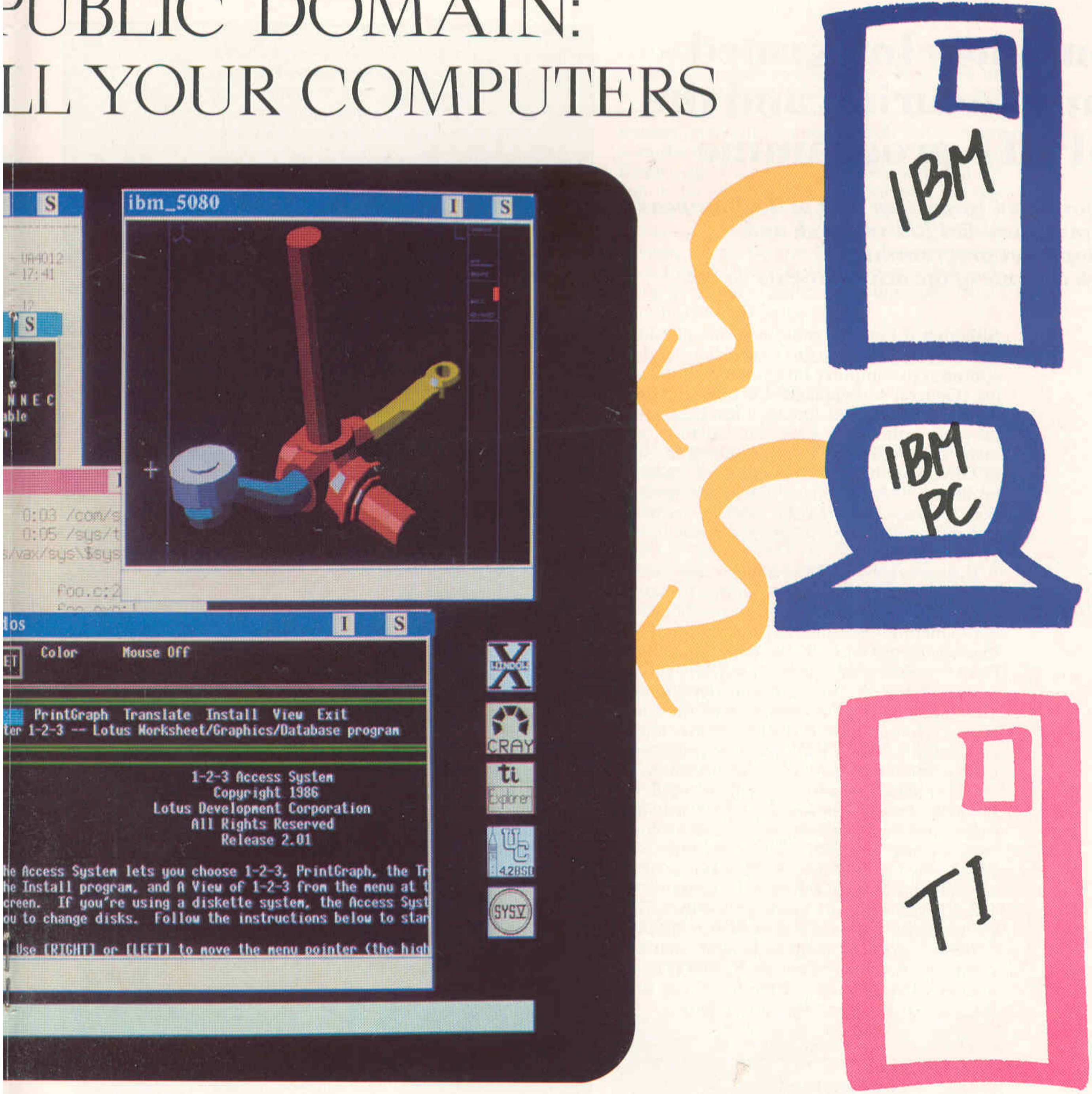
A Domain workstation has always presented you with dedicated 32-bit power, brilliant graphics, and transparent access across high-speed local area networks.

But now a Domain workstation presents you with the files on your VAX system. The corporate data stored in your IBM mainframe. Even the information generated by personal computer users.

Because we've just taken Domain public. Extended its considerable capabilities beyond Apollo's borders to the rest of your company's computing resources. And made it all possible with the single system view you see here.

Today you can log on a Domain workstation and simply click your mouse to call on a symbolic processor for artificial intelligence. A Wang system for word processing. A mini-super for your compute-intensive applications. Even

PUBLIC DOMAIN:
LL YOUR COMPUTERS



our PC co-processor for off-the-shelf software programs.

Without learning new commands or ploughing through manuals you can access remote networks via Ethernet, NFS, TCP/IP, X.25 and others. And work in operating environments as varied as PC-DOS, IBM/MVS, VAX/VMS, plus both UNIX System V and Berkeley 4.2.

Apollo Computer. No technology reaches further than our Domain.

For more information

apollo computer (uk) ltd.

Bramley Road, Bletchley, Milton Keynes MK1 1PT.
Tel: (0908) 366188. Fax: (0908) 647688.
RAISING THE STANDARD

South Branch: Tel: (0344) 411800 Fax: (0344) 411908. West Branch: Tel: 021-550 9010 Fax: 021-550 4252.
North Branch: Tel: 061-962 0222 Fax: 061-962 9084. Scottish Branch: Tel: (0506) 416868 Fax: (0506) 411690.

Computer Integrated Manufacturing and the ESPRIT programme

CIM forms an important part of the European Communities' ESPRIT research and development programme. A look at some of the achievements so far.

The ten year ESPRIT (Economic Strategic Programme for Research and Development in Information Technology) initiative, instigated by the Commission of the European Communities in 1984, is now entering its second phase. The three main objectives of ESPRIT are:

— to provide the European IT industry with basic technologies to meet the competitive requirements of the nineties.
— to promote European industrial co-operation in precompetitive R&D in Information Technology.
— to pave the way for internationally accepted standards.

Five main areas of Research & Development were identified: Microelectronics, Software Technology, Advanced Information Processing, Office Systems, and Computer Integrated Manufacturing. The budget for Phase 1 (1984-87) was over £1,100 million (1,500 million ECU), with half of the costs met by the European Communities, and half by the participating firms and institutes.

Phase 1 regroups 220 projects, undertaken currently by 3,000 researchers and engineers, 420 individual firms and institutions participate from all countries in the Community. An annual workplan issued by the CEC gives details of the research that may be supported, and is the basis of calls for proposals. A condition of participation is the involvement of at least two firms from different countries.

The second phase of ESPRIT was scheduled for decision by the Council of Ministers in early April, although this was held up by the UK's disagreement with the latest CEC research funding proposals. Once agreement is reached, a first call for proposals will be made.

Although it took the muscle of one of America's largest companies to establish a standard approach to computer integrated manufacturing (General Motors achieved sales of $102.8 billion in 1986), that initiative has been taken up with enthusiasm across the Atlantic, and many now feel that Europe is taking the lead in CIM and the implementation of standard protocols. This is bourne out by the tremendous success of CIMAP, both in terms of technology and the interest generated by the event.

Europe regards CIM as a major new market for its IT and automation equipment vendors, and at the same time sees the possibilities of consolidating the traditional strength of its manufacturing base, increasingly under siege from overseas competition. Accordingly, CIM is one of the key research and development areas on which the Commission of the European Communities' ESPRIT programme is concentrating. ESPRIT aims to encourage collaboration between European organisations and companies by offering half of the development costs of approved projects in which more than two parties from different countries are involved. With the first, three year phase drawing to a close, and the future of the second phase confused by the failure of the UK Government to agree with other EEC members on the next round of funding, it is perhaps a good moment to look at what progress has been achieved by ESPRIT in the area of CIM, only one of the five broad areas on which it is concentrating (see panel).

Objectives

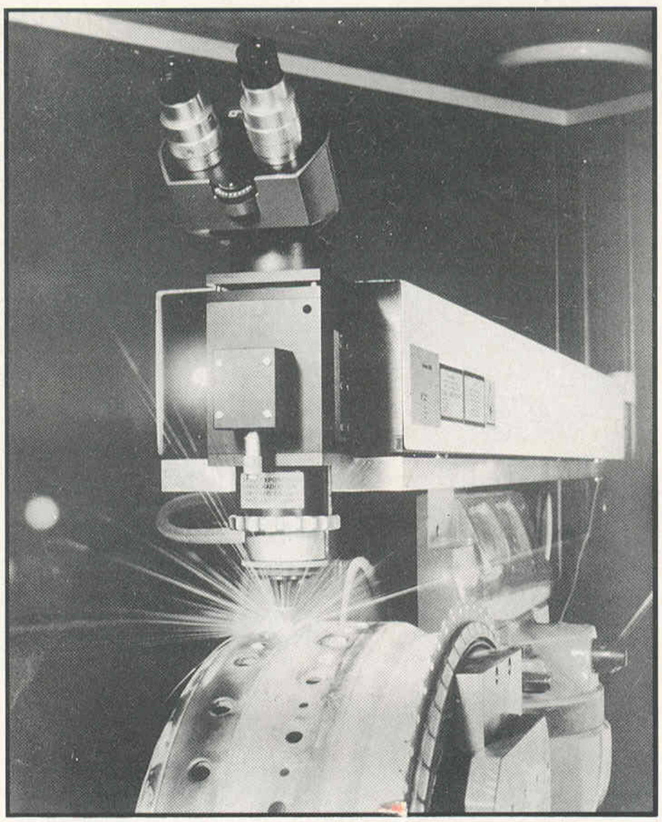
The objectives of CIM as covered by the ESPRIT programme can be divided into two main areas. First, a reduction in the cost of designing, installing and maintaining systems for manufacturers must be achieved. Second, real improvements to the production process must be achieved, in such areas as a reduction in lead times, inventory and unit costs, and improvements in plant flexibility and productivity. Implementation of CIM technologies should also lead to improvements in product quality, plant reliability, faster throughput, and reduced work-in-progress, all helping to maximise a return on the investment.

A conservative estimate by leading edge CIM users attributes 70% of the costs of installing and implementing a new CIM system to the difficulties of addressing the bewildering diversity of function within the manufacturing environment. The problems of interfacing and interworking those functions in an economic manner has yet to be solved. By its nature, CIM is a multi-vendor domain, so the problem is to establish a framework defining those functions and their relationships.

Open Systems

Four major projects are working in this area. Project AMICE (A European CIM Architecture) took as its starting point the results of a previous ESPRIT project, and is developing a public domain generic architecture based on open systems concepts — the project brings together 19 major vendors and users such as Siemens, Selenia, British Aerospace, and Volkswagen. The first specification for the architecture has now been prepared. Project CNMA (Communiations Network for Manufacturing Applications) addresses factory communications, and has brought together major IT users and vendors and users with strong links to the U.S. National Bureau of Standards and the General Motors MAP teams to implement factory communications protocols. An implementation guide, complementing MAP and likely to influence its future direction, has now been issued. The two other projects in this area address the functional integration of robot systems into CIM (results have been used in real production systems at KUKA and Renault Automation), and the definiton of interfaces for CAD systems to allow CAD data to be exchanged between different systems, in collaboration with ISO.

The problems caused in manufacturing by long lead times from design to product, heavy investment in inventories and work-in-progress, and lack of flexibility to adapt to changing market needs, can largely be attributed to a poor information flow within the organisation as a whole, brought about by the so-called "islands of automation" approach. Closing the control loop between production planning activities and manufacture of products is the aim of the Control Systems for Integrated Manufacturing project. Three implementation sites at Comau in Turin (Italy), Digital in Clonmel (Ireland), and Renault in Cleon (France), are being developed with the aid of Production Activity Control user requirement sets prepared by the project. Information gathered from the shop floor interacting with that held in the planning systems closes the control loop by minimising human intervention and reaction times of the manufacturing systems. A project looking at Knowledge-Based Real Time Supervision began in January 1986, concerned with the real time scheduling of products through manufacturing systems using knowledge-based techniques. So far this project has resulted in knowledge-based simulation systems for modelling production flows at Philips and BICC manufacturing plants.



Machining at Preci-Spark

Testbed

CIM provides a challenging testbed for a number of techniques and products emerging from other IT fields, and is the focus for hi-tech development such as new materials and fibre optics. Another important area addressed by ESPRIT is that these enabling technologies need to be developed jointly with the vendors of IT equipment. There has been considerable investment within ESPRIT in integrated multi-sensor systems for use in flexible manufacturing systems, flexible assembly systems, welded fabrication, and other subsystems for supporting CIM.

The above summary gives some idea of the type of research going into CIM under the umbrella of the ESPRIT programme. Results are already inspiring products from individual vendors, but perhaps more importantly are helping to establish a framework of standards for the implementation of CIM world-wide. If the current argument over funding is resolved in the near future we can expect to see an extension of work in this area, tying in with the successor to the UK's own Alvey research programme — Alvey 2. However, unless agreement is achieved soon, the future of both projects may be threatened.

ESPRIT. The first phase: progress and results is available from:

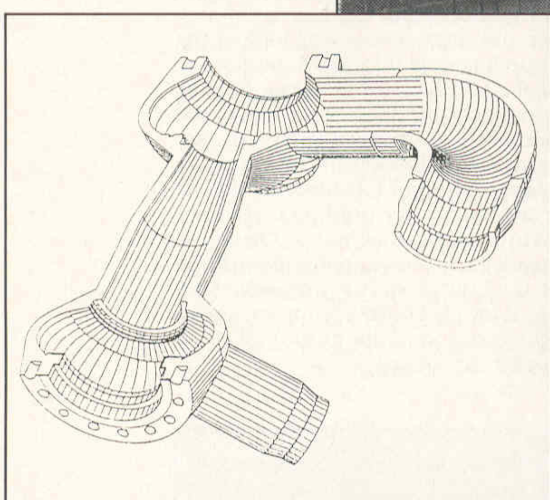
Commission of the European Communities,
DG XIII A-1
200, rue, de la Loi,
B–1049 BRUSSELS
Belgium

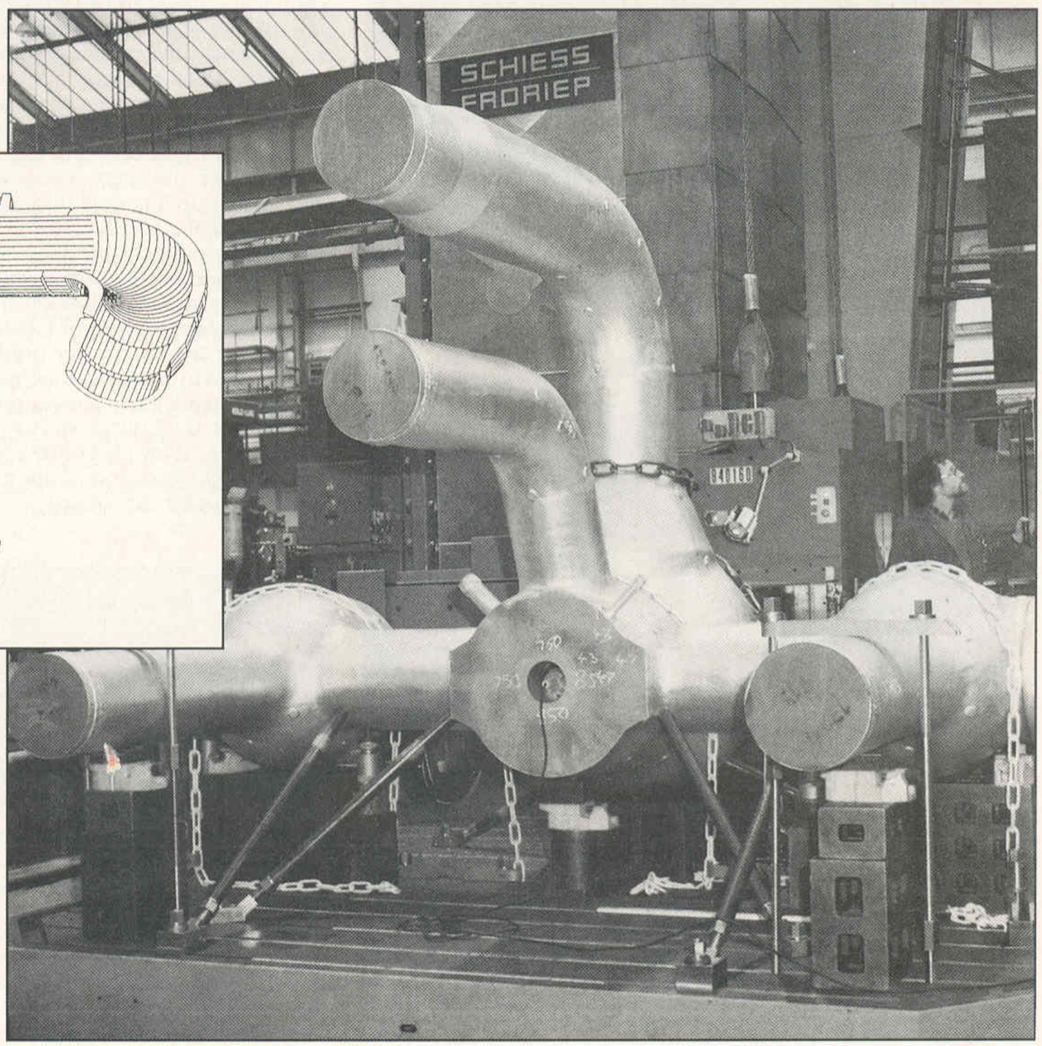
Processing and production — the unifying principles

In 1964 Sir Charles Parsons designed and built the world's first practical steam turbine-generator. Five years later he founded the Heaton Works, near the quayside at Newcastle upon Tyne. Today, that works is still used by NEI Parsons, and is one of the world's best equipped turbine-generator manufacturing facilities, covering a total area of 200,000 square metres. NEI Parsons sells turbine generators world-wide for use in power stations, and in 1956 developed the generators (and much other plant) for the first nuclear power station at Calder Hall in England.

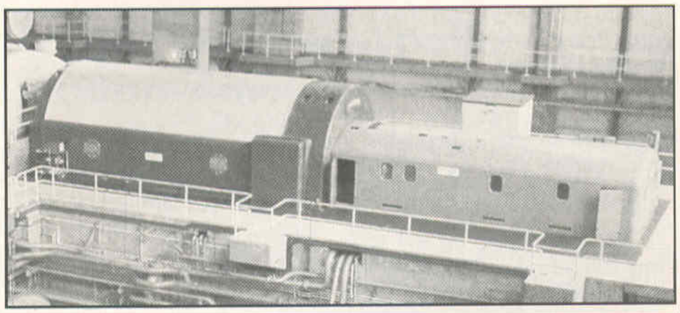
The production of turbine generators is really a mature technology today — although demand continues for larger capacity. NEI Parsons designs each turbine-generator to produce the optimum performance for the specific circumstances under which it will be used, so it needs a flexible designing capability. It is also important to reduce manufacturing time as much as possible in order to maintain a competitive position in home and overseas markets. To this end, the company has invested heavily in machine equipment, including Computer Numerical Control (CNC) machines, which it is backing up with a comprehensive computerised control system based around technical workstations.

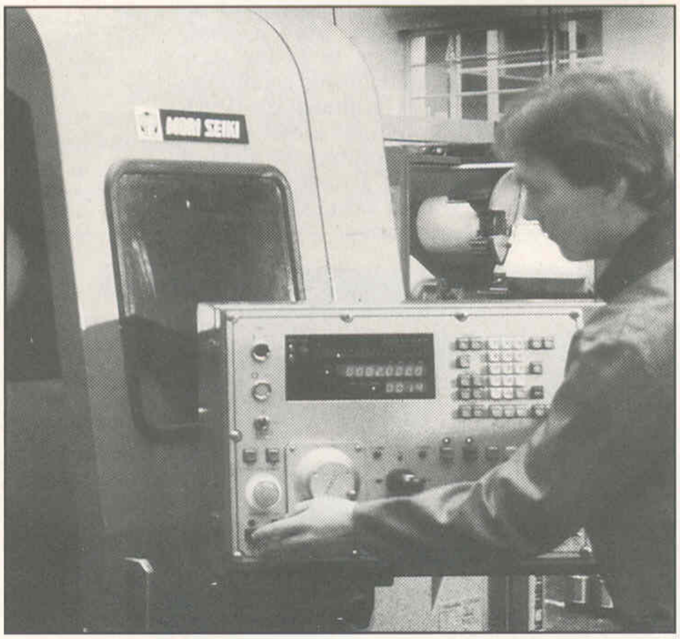
Computer Integrated Manufacturing is often thought of in terms of very specific functions within the manufacturing environment. At NEI Parsons it is recognised that CIM is more to do with management than concepts like artificial intelligence. Computer-aided design and manufacturing must overlap with management information and control systems if all is to run smoothly. The computer section at NEI is working closely with





A steamchest controls the flow of steam into a turbine. Although each is uniquely optimised to suit a specific situation, they can be designed on computer from a library of standard components (inset). Right: a steamchest on a CNC Horizontal Milling and Boring machine.





Top: one of four 500MW turbine generators at Ratcliffe-on Soar. Bottom: a CNC lathe.

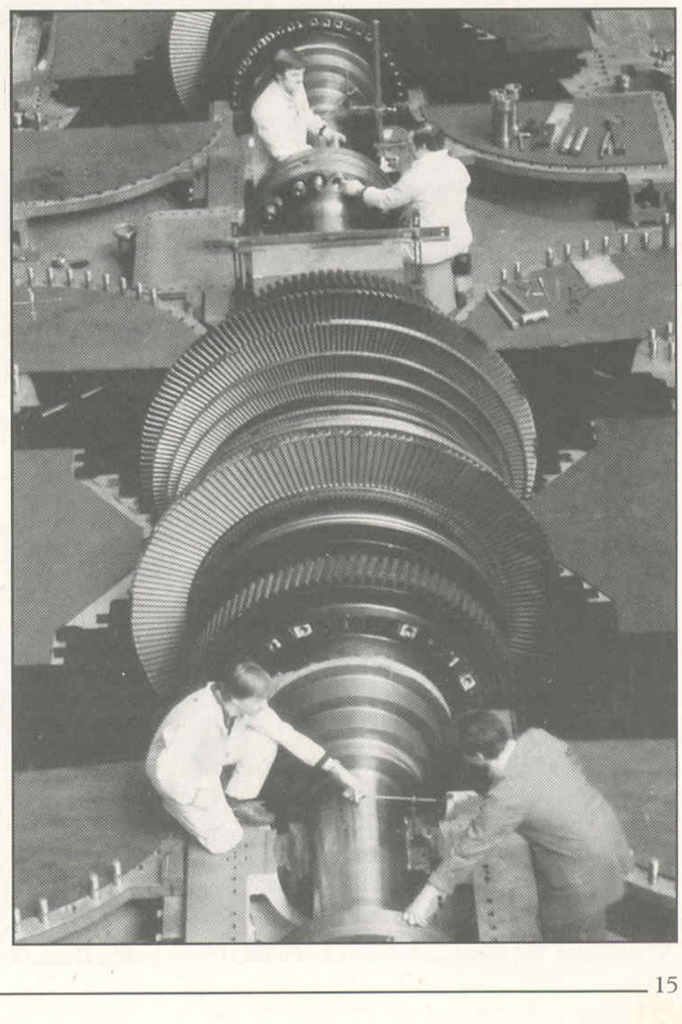
Leeds University to implement what is termed 'structure editing', The eventual aim is to provide all the information about a product on the computer; not just the geometric form, but also aspects such as process planning, quality, tooling, numeric control tape production, stress and flow analysis etc. This needs to be accessible in a structured way and widely available to those working on a particular project.

The design of a steamchest is a good example. A steamchest might be from between 10-15 feet long, and controls the flow of steam into the turbine. There may be up to five in a large machine. Each steamchest is unique — it is optimised for a particular turbine to take into account circumstances such as the ambient temperature. However, it was found that by dividing a steamchest into small, individual components, each could be designed almost entirely by using a library of standard components stored on the computer. Taking the process further, the manufacture of the steamchest needs to be processed planned. For instance, roughing, boring, and finishing may be carried out on one half of the steamchest before it is turned around to allow work on the other half.

A system in development at NEI brings together all these elements into a tree structure. There are a lot of ways of looking at each component — by moving down the various branches of the tree for steamchests, all the information on the various elements, operations, and machining sequences could be linked to the CAD and solid modelling information on the workstation. Added to that could be information on place (where the job is) and people (who is available to work on the job).

The view at NEI Parsons is that the workstation is likely to become the unifying tool in this philosophy. The company has invested heavily in Apollo workstations, and has a number of generations in use throughout the works, linked together with a fibre/optic backbone running the DOMAIN networking system. With so much information about a particular job coming from different areas around the works, the most feasible solution would be to have local file servers scattered around the network, controlled locally and with local processing power, but with information available network-wide for others who need it. A major step towards the feasibility of such a system has resulted from Apollo's recent announcements to support NFS and Ethernet, aiding transparent file access in a multi-vendor environment, and the network computing

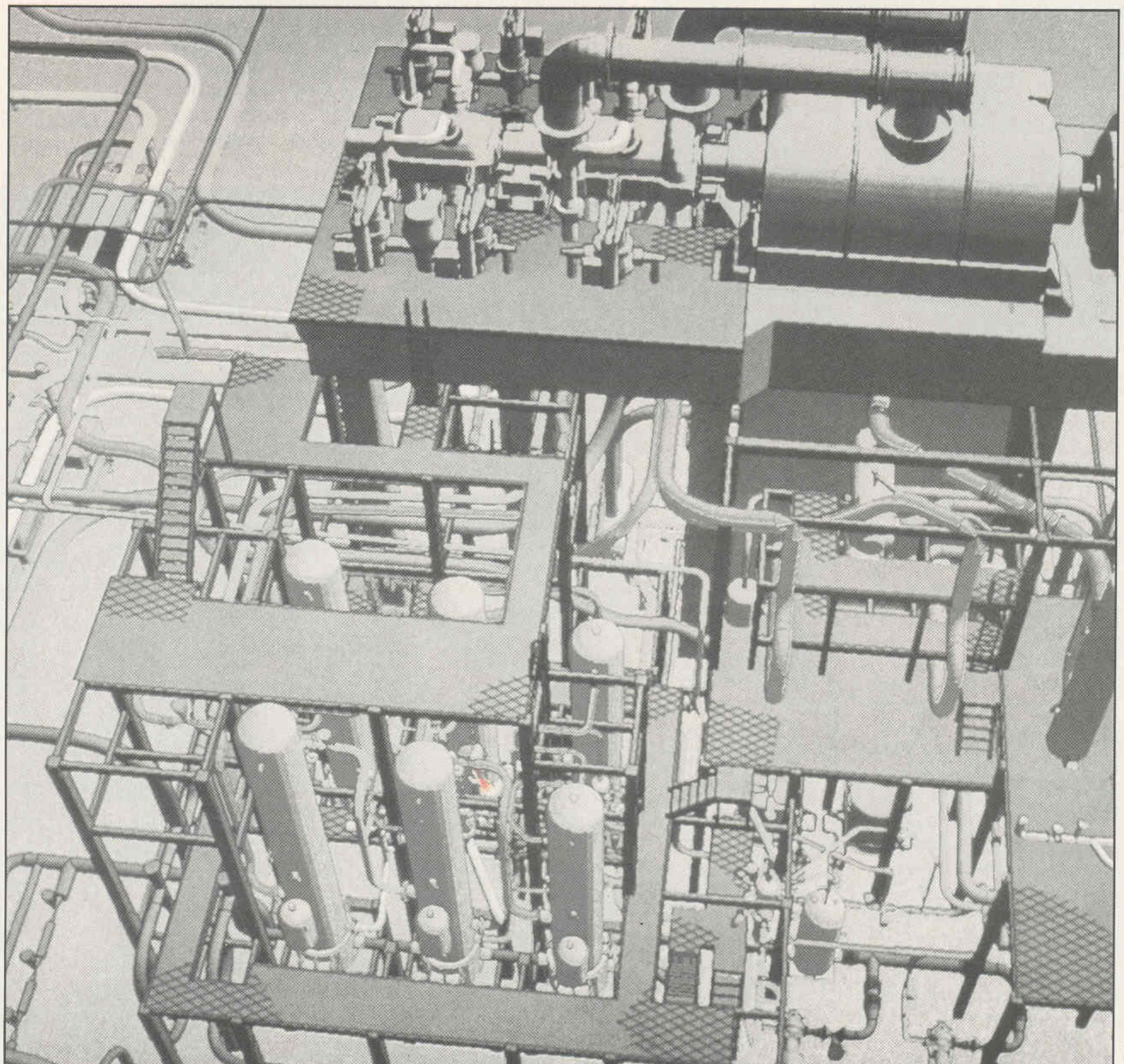
Assembling a turbine generator



concepts which do the same for the processing side. Another important factor is the price of the PC. Prices per terminal on the shop floor have, for the last four years, remained fairly constant at around £2,500 per seat (although in that time the processing power has trebled). When, in the near future, PCs can be implemented at costs significantly below this, that market is likely to explode.

A number of elements are already in place. A Factory Information Control System (FICS), developed in-house, is already in use, offering production control and planning facilities. The CAD systems offer 2D drafting, plant modelling and pipe routing, as well as 3D solid modelling; geometrical modelling projects are being carried on in conjunction with Leeds University. There is also a Locam process planning and time estimation system, and flow and finite analysis running in the Mathematics Services Department, currently looking to extend its processing power with an Apollo DSP9000. An IBM 3083 mainframe and Prime minicomputer are also used for commercial and stock control functions and may at some stage be linked to the Apollo network via Ethernet. The CNC machines can be pulled in to the information system, allowing information such as what job is on the machine, and final dimensions to be incorporated.

The computing efforts so far have resulted in a three-fold productivity increase in the two and a half years since Apollos have been installed. A major part of the benefit is identified as moving applications from a single computer and putting them in to the shop floor — sometimes in quite hostile conditions. The computers have also facilitated the development of standard procedures across a number of operations, and improved the flow of work throughout the plant. Exciting possibilities of further integration exist, and are well on the way to implementation.



A three dimensional computer picture of a large turbine-generator and auxiliary plant.

Results endorse Apollo announcements

Recent product announcements and technical enhancements have resulted in a sharp rise in sales and earnings for the first quarter of the year, according to UK Managing Director John Parkinson.

Compared with the first quarter of last year, operating revenues are up 50% to $123,420,000. Net income increased to $6,430,000, more than ten times the $539,000 recorded last year.

Parkinson attributed the rise to recent announcements such as the February unveiling of its Network Computing System (NCS), an evolutionary approach to transparently capturing data resources on a computer network from a single workstation. "It is gratifying to see that our continuing product innovations and development have had such a dramatic impact on the success of Apollo," he said. Announcements over the last few months have emphasised Apollo's commitment to standards and open systems.

The company has taken a lead in establishing the Networking Computing Forum, and is participating in the establishment of the X Window System from MIT as a graphical computing standard.

Acknowledged as the market pioneer in workstations after introducing the first product in 1980, Apollo has since recorded more than $1 billion in sales, and now has full sales, services and manufacturing facilities world-wide, including offices in 20 countries.

DTI launches mobile CAD roadshow

The Department of Trade and Industry launched a CAD/CAM 'roadshow' in March to promote the UK Computer-Aided Engineering (CAE) software industries. EXPOCADCAM '87 is a mobile exhibition which will have visited 15 different sites in Europe once the project ends in early June. Companies involved include Racal Redac, Program Products, Moss Systems, Cimtel, and Denford, and products cover CAE from product concept, through design and analysis to production, scheduling and documentation.

International orders for Moss

Moss Systems Limited, the Horsham-based civil engineering software house, has achieved a major breakthrough in the Chinese and US markets with its new combination of an interactive three-dimensional survey and design system and engineering graphics workstation.

A £4.2 million order, which includes 20 interactive Moss Systems running on Apollo DN 3000 workstations, has been received from the US Government for the Western Area Power Authority. It is the first installation of the system by a power authority and marks the company's biggest single order. The new systems will be used for mining work and highway design.

Apollo bases European manufacturing in Scotland

Apollo is to site a major new manufacturing facility in Scotland. A new 97,000 square foot factory will be built on an 11-acre site in Livingston. By the end of 1987, it will be supplying the whole of Europe, including the UK, with the complete range of Apollo products.

John Parkinson, managing director of Apollo Computer (UK) Ltd said: "European sales have continued to accelerate and already account for 40 per cent of our total business, so the establishment of a European manufacturing facility is a natural progression. As managing director for the UK, I am particularly pleased that Scotland has been chosen as the site for the new plant."

Apollo has had a repair centre, as well as a sales and service office, in Livingston since 1984. Alisdair Ferguson, managing director of manufacturing said: "Our new $5 million facility is to be built near our existing centre at Kirkton Campus in Livingston New Town. Livingston has proved to be an ideal site with good road, rail and air links, competitive overheads and, above all, a skilled electronics labour force. We have grown significantly during the two years since the repair centre was established. Initially we planned to employ 150 people over a three-year period. However, today the workforce already exceeds 180 staff, who will be moving to the new site at the end of next year. With the development of our manufacturing facility we would expect our workforce to continue to grow, thereby creating new jobs in the Livingston area." Ferguson added that he would be looking at local sources for many of the components required in the manufacturing process.

Robert Watt, chairman of Livingston Development Corporation said: "Yet another of our recently established high-tech companies has proved the potential that exists in Livingston for continuing growth and has been stimulated to make this major expansion in such a short time. It is one of 70 electronics companies from Britain and overseas who are thriving on various locations in the town and have made Livingston a pace-setter for the electronics industry. Apollo's growth has been remarkable so far and we look forward to the provision of more valuable jobs as its expansion plans unfold."

The new factory will be Apollo's first manufacturing base to be sited outside the U.S.

Racal-Redac and Apollo sign largest UK contract

Racal-Redac, one of Apollo's major customers, has reached an agreement with Apollo for the supply of more than 1,000 DN3000 technical workstations over the next 18 months. The $25 million deal is Apollo's largest ever UK contract, and reflects the level of confidence Redac place in increasing their lead position in PCB design.

The units will be sold by Redac world-wide as a turn-key electronic design automation package based on its Visula software. Redac has sales offices in all major European countries, throughout the United States, Japan and Australia and current Visula business on the Apollo platform is ahead of any of its major US competitors.

Peter Lever, European marketing director for Racal-Redac said: "We have been very pleased with the performance of the DN3000 and applaud Apollo's moves towards industry standards such as UNIX and Ethernet. We are also working with Apollo's high-end DN580 workstation and see significant graphics performance improvements which we believe will add further benefit to our customers."

The DN3000 was introduced in February of last year to bridge the gap between the ease of use of the personal computer and functionality and computing power of the dedicated workstation. More than 7,000 units have already been sold, making it the leading personal workstation in the market today.

The Visula-based package is aimed at electronic design engineers and PCB layout specialists. Using fourth generation relational database software techniques, Visula is capable of addressing the complete factory automation market-place for electronics.

Datron integrates CAD/CAE systems

Datron Instruments, the Norwich-based precision test and measurement equipment manufacturer has been conducting in-depth investigations into CAD/CAE systems which enable the Company to fully integrate its method of engineering — from concept to manufacture.

After two years of research Datron has reached agreement with Mentor Graphics Corporation who will provide dedicated software and associated hardware in a three-phase programme over the next twelve months. The Mentor system will enable Datron to update and fully integrate its existing engineering and manufacturing databases providing faster and more accurate working designs and documentation.

The contract, worth over £650,000, will include the provision of Apollo DN 3000 personal workstations, for use at Datron's Norwich and Freemont, California facilities. Already Phase I has been completed with five workstations, together with associated peripherals (including a laser printer), having been installed in Norwich.

David Armstrong, Datron's Engineering Manager commented: "As this is a very significant investment in our future we investigated a number of companies, but it was Mentor Graphics who provided the most cost-effective solution to meet our current and future requirements — particularly in the analogue area which is especially important in our business.

"Within the electronics industry we are known for our pioneering developments and therefore our innovatory circuit designs, right first time, can be extremely time consuming to achieve without on screen simulations. We believe that once fully up and running this system will be invaluable to us both as an engineering and manufacturing tool."

ADVANCED GRAPHICS Magazine

Standards for Graphics

Write to: Answerboard, Advanced Graphics Magazine, 32-36 Little Horton Lane, Bradford BD5 0AL with your questions on graphics and technical computing.

Last issue, Answerboard dealt with the question: "What is the current status of international standards concerning graphics systems?" Here we present an alternative view.

Q

Dear Sirs,

Your response to R. Molesworth of ICL on Graphics Standards is inaccurate and misleading in a number of respects. The description that follows summarises the situation following the meeting of ISO/TC97/SC21/WG2 at Egham.

GKS is the only International Standard in the area of computer graphics (ISO 7942), it is also a British Standard (BS 6390). It consists of a set of functions for 2D computer graphics programming. It is a basic graphics system that can be used by the majority of applications that produce computer-generated pictures.

To use GKS, 'language bindings' define how the GKS functions appear in a particular programming language. Standard GKS bindings for Fortran, Pascal and Ada are nearly finalised. There will be no significant changes to the Fortran or Ada bindings before the standards are finally ratified. In addition standard GKS binding to 'C' is under development within ISO, but this binding will conform to the standard version of 'C' currently being developed, which is different from the 'C' in current use.

Many GKS products are on the market and are generally based on the Fortran binding. 'C' GKS products are also available with the 'C' interface typically based on the Fortran one. Work is under way to set up a GKS validation service which, in the UK will be run by NCC. ICL themselves market GKS for PERQ and VME environments.

One other finalised (but not yet published) standard is ISO 8632, the Computer Graphics metafile, a file format for the storage and transfer of picture description information. It will become a British Standard in the fullness of time.

IGES is an American Standard and may become a British standard used in the engineering industry to transfer drawings. Further ISO work in this area is aiming to standardise product descriptions.

An extended GKS, GKS-3D, is timetabled to become a standard in March 1988. PHIGS is another standard timetabled for completion in 1988. PHIGS, like GKS-3D, is a 3D system. These two standards are incompatible where this is technically justified, however, are as compatible as possible given their different intended markets. GKS-3D is simply a 3D extension to GKS. PHIGS provides central hierarchical storage of graphics (and application) data that can be edited. To call PHIGS and GKS (or GKS-3D) competitors is like calling Pascal and Ada competitors — each has its own market. Language bindings for GKS-3D and PHIGS are under development.

CGI is another standard under development. It is designed to be an interface between those parts of a system that are device independent and those parts that are device dependent. It can be considered to be (and will be implemented) both as software and hardware interfaces.

I would advise caution to anyone buying a product based upon any of the unfinished standards (GKS-3D, PHIGS and CGI). In all cases technical content of these standards has changed considerably in the past year and is likely to do so again (less likely in the case of GKS-3D). In all cases products are likely to be based on old versions (this is even a problem, to some extent, with GKS-3D implementations). Suppliers will have to change their products to match the finally agreed standard, impacting applications based on those products, or the user will be left with a continually increasing base of non-transportable software using a non-standard product.

I accept that some of the differences between the statements above and your article are of opinion rather than fact. However, I do feel that there were errors of fact in your article and that the all important distinction between working drafts of a standard and the ratified document itself was entirely missed.

As a rider I would like to ask my own question. Laser printers make very good graph plotters, but where can I find one that can be driven using HPGL, the industry standard plotter language?

C Cartledge
Chairman of BSI IST 21/2 — the Graphics Panel

A

HP-GL is a language for driving plotters that was originally developed by Hewlett Packard to support its own range of equipment. It has subsequently been supported by other plotters so that they can be used on software that was designed to drive HP devices.

Like most plotter support protocols HP-GL is essentially vector oriented. Laser printers on the other hand are basically page oriented raster devices and will need a special set of conversion routines to take vector information and produce output. This conversion may be done in the printer itself or by converting the HP-GL data to a common format such as Adobe Postscript which is widely supported on many devices. This latter course would certainly give the best choice of printing devices and should not require too much software effort.

As far as I can ascertain the only laser printer that will currently support HP-GL is the latest offering from Hewlett Packard; the Laserjet 2000. This is a high speed device that will support both A4 and A3 formats. Current price is of the order of £17,000. For up-to-date information in this rapidly changing field I would recommend that one of the specialist printer suppliers such as Pragma is contacted since they supply a range of manufacturers equipment.

The question of compatibility between laser printers and plotter protocols is not limited to HP-GL. There appear to be no laser printers that support Calcomp, Benson or Tektronix protocols, all of which are widely used in vector plotting devices.

Printed in England by Optichrome Limited, Woking, Surrey