New Directions in Client-Server Systems

# BUTLER COX FOUNDATION

Findings from the 1991 Study Tour

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The 1991 Butler Cox Foundation Study Tour took place in May in Silicon Valley, California.

What became evident during the tour is that client-server computing is rapidly becoming a viable model for many systems applications. For those concerned with the managerial and technical aspects of information systems, this has significant implications. Not only will new technical options present themselves, but new application opportunities also exist.

This year, we have changed the format of the publication. I hope that you find it to be an improvement.

We have also prepared a presentation, which is available to Foundation members. This will include a structured discussion of the key issues raised during the tour and is aimed at your systems management team. The presentation, which lasts half a day, will be given by Richard Pawson, a consultant with Butler Cox, who attended the tour and subsequently prepared the published findings, which are enclosed.

For further details on the content and fee for the presentation on client-server systems, please contact Victoria Bird in the UK Foundation office on 071 831 0101.

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# New Directions in Client-Server Systems

# Findings from the 1991 Study Tour

The 1991 Butler Cox Foundation study tour took place in May in Silicon Valley, California. We visited 10 companies, ranging from entrepreneurial ventures to established IT vendors. Details of the companies and the visits are provided in the Appendix. The theme of the tour was client-server systems, including developments in the technology and applications, and their relationships with other technologies such as multimedia and object-orientation.

We believe that the messages that emerged from the sessions with the 10 companies will be of considerable value to those concerned both with the technical and the managerial aspects of information systems. These findings were prepared by Richard Pawson, a consultant with Butler Cox, who was a delegate on the study tour. We should like to express our thanks to the companies that hosted the visits and to the study tour delegates, who helped to identify the messages.

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# Findings from the 1991 Study Tour

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# New Directions in Client-Server Systems

Many of the messages that emerged from the sessions with the companies we visited on the 1991 study tour both confirm and extend our earlier findings on client-server systems recorded in Report 80, *Workstation Networks*. The main messages may be grouped under four headings:

- New client technologies are improving the user interface.
- New server technologies are making the mainframe obsolete.
- The relationships between clients and servers are changing.
- Client-server systems are changing the nature of applications and their development.

# New client technologies are improving the user interface

Both the performance of PCs and workstations and the functionality of the software developed for them are growing. One driving force behind these developments is the need to increase the 'bandwidth of communication' between the computer and the user. The objective is to make possible the equivalent of face-to-face communication.

# The increasing performance of workstations is changing the nature of applications

Top-of-the-range workstations already deliver the raw processing power of bottom-end mainframes. Very shortly, they will be competing with supercomputers.

Silicon Graphics, the leading vendor of very-high-performance workstations, showed that performance of its systems has grown at a consistent compound rate of 170 per cent per year. In the late 1980s, this growth resulted from increasing processor clock speeds, from the introduction of reduced instruction set processor architecture, and from techniques for increasing the functions that could be performed in one clock cycle. During the 1990s, continued improvement will come primarily from the use of parallel processors in workstations. Silicon Graphics' top-range model can now process 286 mips (million instructions per second). In a 3-D modelling application, this makes it possible to draw one million shaded polygons per second - sufficient to render complex moving scenes for a flight simulator, in realtime. This gives rise, Silicon Graphics says, to a new category of computer - the project supercomputer - which may be purchased for a single research or engineering project.

Apple's Advanced Technology Group showed how increasing workstation performance changes the nature of applications. Figure 1, overleaf, shows the time it takes to draw three different images with workstations operating at different processing speeds. Image 1 is

Continued improvement in performance will come primarily from the use of parallel processors

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# New Directions in Client-Server Systems



a simple 3-D computer-aided design model of a drinking glass; Image 2 is a rendering of a kitchen scene; Image 3 is a photo-realistic model of a teddy bear (which requires that individual fibres in the fur be modelled). With a 1 mips workstation, Image 3 would take more than a week to process; Apple describes this class of application as 'fanatical'. As the time is reduced, the application progresses through 'possible', 'practical' and 'interactive' to 'realtime'. Apple is already anticipating desktop systems that deliver 1 gips (1,000 mips) by the end of the decade. This roughly concurs with Intel's prediction of a 2 gips microprocessor by the year 2000.

# Image, video and speech are becoming as manageable as text and graphics

Impressive demonstrations of multimedia (computer systems capable of handling text, graphics, image, video and hi-fi sound) have been around for some time. We described some of the early examples in Report 73, *Emerging Technologies*. Besides being expensive, however, such systems have been difficult to develop and very difficult to integrate with conventional applications. This is changing.

Quicktime is a new software architecture that extends the capabilities of the existing Macintosh operating system to handle dynamic data. It is the first system to use the emerging ISO/CCITT JPEG (Joint Photographic Experts Group) standard for still picture compression, capable of compressing the 1M bytes required to describe a full-colour screen image down to 40k bytes. Searching for image files is facilitated by 'thumbnail' sketches – crude representations of each image that can be viewed from the directory without opening the file. Apple showed a pre-release version of Desktop systems will deliver 1,000 mips by the end of the decade Quicktime, which is being supplied to software developers on a 500M-byte CD-Rom that contains sound, video and still images.

Quicktime uses Apple's own proprietary compression algorithm for motion video; more powerful algorithms are available, but this one requires no dedicated hardware, and works across the full Macintosh range. Indeed, Apple's philosophy is to keep as much as possible in software. Apple also showed an impressive prototype speech-recognition system with a vocabulary of 300 words, able to cope with continuous (no-pauses-between-words) speech.

NeXT demonstrated an equal commitment to making multimedia information usable, and showed a multimedia electronic mail system that comes packaged with the NeXT workstation (see Figure 2). To incorporate a colour image into a message, the user simply drags a 'picture' icon into the appropriate part of the text; a recorded voice message can be incorporated in a similar way. NeXT staff use this system to send some 7,000 electronic mail messages per day across their internal network of 1,300 workstations. Interestingly, though, NeXT has not yet managed to integrate this system with its conventional externally accessible voicemail system.

Silicon Graphics went one stage further, showing a package that can incorporate a 3-D model into an electronic memorandum. The recipient not only views the model (of a proposed new product design, for example), but can rotate and manipulate it. Each of

Figure 2	NeXTMail allows images, voice messages and even applications, such as spreadsheets, to be incorporated into electronic mail messages	
	Image: Control of the second seco	
	Lip Service	
	Edit Edit Stop Play Pause Record Erase	

Multimedia electronic mail is becoming a reality

these developments, however, increases the demand for workstation memory and processing power.

## Applications of multimedia technology are increasing

The HyperMedia Group showed several applications of multimedia technology that it had developed for clients, running on Macintoshes or PCs.

DisplayNet is an electronic catalogue aimed at the store-merchandising industry, and distributed quarterly on CD-Rom. The catalogue contains 10,000 product lines from many vendors, and some 5,000 colour images of those products. A store merchandising manager can browse through the catalogue, viewing the images and textual information (the process is speeded by a Quickscan facility, similar to Apple's thumbnail sketches). In addition, the catalogue serves as an electronic ordering system: the buyer can assemble an order by pointing at and clicking on items, and the complete order can be automatically placed via a modem.

Since most store merchandisers do not have the colour Macintosh II, CD-Rom drive and modem required, DisplayNet provides the hardware as part of a monthly subscription fee of \$300. DisplayNet also charges the vendors for featuring their products in the catalogue. (Displaynet is a good example of the applications discussed in Report 77, *Electronic Marketplaces.*)

The HyperMedia Group has developed a general writing tool to enable clients to produce their catalogues. With a CD-mastering charge of between \$1,500 and \$2,000 (plus \$2 per disc), multimedia electronic catalogues are now as cheap as colour printing. The group showed several other applications, including an interactive video training course for spoken business English.

# In client systems, proprietary standards are maintaining their lead

The HyperMedia Group commented on Microsoft's recently announced multimedia extensions to Windows, and on the Tandy MPC, the first product specifically designed to exploit these extensions. Superficially, these developments bring the functionality of PCs closer to that of the Macintosh, but in reality, the latter still has a two- to three-year lead. The HyperMedia Group typically develops a new application on the Macintosh, using Macromind Director, and then transfers it to other vendors' hardware. Because of the difficulties that the group has encountered in this process, it is promoting a new standard (HIFF) for the interchange of hypermedia file formats. It believes that Windows, with the multimedia extensions, is superior only for a few functions, such as audio playback. (This view was confirmed by Stewart Alsop, editor of PC Letter, who gave a special briefing to study tour delegates.)

This situation poses a difficult decision for user organisations: whether to go for maximum functionality on a proprietary system such as the Macintosh, or for more open standards such as Windows and Motif. The decision may get easier – NeXT has already licensed its NeXTStep development environment to IBM (available on the RS/6000 workstation), and Apple declared its intention to make its AppleTalk LAN protocol available on other vendors' systems. Electronic product catalogues are an effective application of multimedia

Even with the new multimedia extensions, Windows still lags behind the Apple Macintosh

# New server technologies are making the mainframe obsolete

To date, servers have not developed as rapidly as the client elements of client-server systems: most large servers are mainframes or minicomputers, and this new role has provided larger computers with a new lease of life. Local area network servers, providing shared files, gateway communications or print spooling, are typically based on high-performance PCs. Now, purposedesigned server machines and software are appearing on the market and these provide a real alternative to mainframes for many commercial systems at a fraction of the price.

# Purpose-designed servers combine the best of microcomputer and mainframe architectures

Mainframes fulfilling a server role are strong on reliability, data integrity, security, systems management, the ability to support many users, and total capacity. They are weak on usability, flexibility, compatibility with workstations, and cost. PC-based servers are the opposite. NetFRAME manufactures purpose-designed servers with the aim of providing the best of both worlds. It has done this by combining a PC processor (the Intel 486) with the channel architecture of a mainframe. The technical ideas behind NetFRAME were explained by its chief designer, Carl Amdahl (whose father, Gene Amdahl, designed the first popular extensible mainframe, the IBM 360).

The NetFRAME architecture employs considerable redundancy and internal error checking. While it does not match the fault tolerance of a Tandem system, the vendor claimed that it has equivalent data integrity to most mainframes. Another useful feature is 'remote control'. NetFRAME requires no local terminal; it can be initialised, monitored and managed from any designated workstation. In Carl Amdahl's words, "This means that you no longer need anyone who can even spell [Novell's] NetWare to be on site". System errors can even trigger a radio-paging message to the network manager, who can then dial into a dedicated telephone/modem port to hear a synthesised voice report, or to review a system dump.

In maximum configuration, NetFRAME's channel architecture can support 80 gigabytes of disc storage, and provide 1,600 users with response times of less than one second, all for \$200,000. With this sort of performance, it is hardly surprising that NetFRAME has shipped nearly 1,000 units. It quoted one US insurance company, Keyport, that had replaced its IBM 9370 mainframe with a NetFRAME supporting a network of 280 PC-386s. The total conversion cost was under \$1 million, plus two man-years of effort. The net result, however, is that the annual systems cost of servicing each policy has fallen from \$45 to \$28 and is expected to fall further.

NetFRAME is not the only vendor in this marketplace, nor is its technology the only solution. Disc arrays and parallelism (discussed in Report 73) are also effective ways of improving server performance. Nevertheless, study tour delegates found NetFRAME's combination of solid mainframe design principles with up-to-date microprocessor technology particularly convincing.

The NetFRAME server combines a PC processor with a mainframestyle channel architecture

Replacing a host system with a client-server architecture can bring enormous savings

# Traditional database servers are responding to changing workstation capabilities

As we reported in Report 80, the leading database suppliers have all introduced server versions of their products, providing access to client applications via the Structured Query Language (SQL). Now, the leading vendors are starting to recognise that if they are to stay in the market, they need to support new kinds of workstation processing, especially multimedia. The first move in this direction is the accommodation of 'Blobs' (binary large objects), which allow an individual field in a database record to point to a binary file representing a full-colour image, or a digitised sound recording. Informix demonstrated this with a real-estate catalogue application.

Both Oracle Corporation and Informix described this capability as a significant move towards object orientation. In reality, although Blobs significantly increase the functionality of relational databases, this is only a very tiny step in the direction of object orientation. Almost certainly, the pragmatic systems environment of the next decade will owe as much to traditional approaches, such as relational technology, as it does to the 'pure' object approach. However, the claim that database systems can slowly evolve from a relational model to full object-orientation should be treated with considerable caution. For the moment, Foundation members should evaluate the two approaches separately, rather than be seduced by the claim of an evolutionary path.

For the major software vendors, client-server architectures offer a very real opportunity to increase price/performance. Figure 3 shows the current situation for the Oracle database running across a variety of hardware: mainframes offer the best absolute performance, but PCs offer the best price/performance. The goal is to offer performance better than a mainframe's, at a price/performance better than that of a PC. Oracle did not make clear how this was to be achieved, but one possibility would be a new generation of purpose-designed servers optimised for transaction-processing applications.

## The range of possible server functions is increasing

The first servers to appear on local area networks were file servers and print servers, enabling several users to share an expensive laser printer, for example. These were followed quickly by communications-gateway servers, and now database servers.

ViewStar Corporation, which develops sophisticated documentprocessing systems to run on client-server architectures, stated that it is now worthwhile asking whether each new function it develops should best be located on a client or a server system. For example, it chose to locate the optical-character-recognition function, which converts scanned documents into ASCII text, on a dedicated server device, accessible by all clients. NeXT, by contrast, located the optical-character-recognition function as a 'desk accessory' resident in each client; in this way, the function is available for instantaneous use within any application. The latter approach is more convenient to use, but the former permits the use of more powerful and more flexible recognition algorithms. Relational databases can now handle image and sound data

It is now feasible to choose whether new functions should run in a client or a server



ViewStar showed how it makes use of a wide range of server technologies, including a Sony optical disc 'juke box' for storing document images, and said that it expects the number of types of server to increase. During the study tour, various possible new dedicated servers were mentioned – for speech recognition, full-text retrieval, high-quality video storage, a shared HDTV display (accessed occasionally by several users to view their designs in high resolution), and a variety of high-performance parallelprocessing servers with architectures suited to particular problems such as realtime image interpretation.

NetFRAME described its application processors – single-board computers that plug into one of the input/output slots in its server box. These are well suited to running shared applications such as a Sybase SQL server, or Lotus Notes – an electronic-mail-based groupware system (described in Report 73).

# The relationships between clients and servers are changing

The relationships between clients and servers will start to change, both in their technical interaction, and in their relative importance. This, in turn, will affect the market and the vendors in that market.

## Servers are starting to act as clients, and vice versa

In the most common configuration, client systems such as workstations pass 'requests' across the network, which are fulfilled by server devices such as printers or database managers. However, servers can also make requests that can be fulfilled by other servers, or by workstations acting as servers. Oracle discussed a

Dedicated application servers will run single shared applications similar concept at the software level, although it called this a client-server/server – a misleading and unnecessary term.

Apple's new System 7.0 operating system, announced during the week of the tour, incorporates 'delegated computing tasks'. When an application encounters a computationally expensive task (such as producing a 2-D rendering of a 3-D model), it can delegate this to a more powerful machine on the network (for example, a Macintosh II FX) that is not being used to capacity. The process can take place transparently, with the result returned to the original machine. In this way, a workstation designed to function primarily as a client system temporarily functions as a server to another client.

# Standards for interaction between clients and servers are emerging slowly

So far, network protocols have primarily been concerned with ensuring that devices can be plugged together, and that files or other data can be transferred between them. Traditionally, applications have run either entirely within the workstations, accessing the server to load files, or within a host system, using the workstation to run a graphical user interface. However, since it is now possible to split an application between several computers, attention is being focused on standards for information access and retrieval, and for communication between parts of an application running on several computers.

A good example of this is the work of the SQL Access Group (SAG), which is attempting to improve the standardisation of SQL (every vendor uses a slightly different dialect) and to standardise the supporting communications. If this new standard is established, it will be possible for client-driven database applications to work transparently with a variety of proprietary relational database packages. Oracle stated its commitment to the SAG standard, but suggested that it will be a long time before real products that conform to this standard appear. Informix added the rider that the emerging network protocols and the conversion between them will consume large amounts of processing power on the network.

An equivalent object-oriented initiative, discussed by both Parc-Place and Servio on the tour, is the Object Management Group. The Object Management Group is trying to lay down standards for communications (requests) between objects. If the standard is adopted, it will make it easier to build applications from libraries of objects from several vendors, and to split applications across several computers.

The major software vendors have been keen proponents of open hardware standards, because such standards reduce the number of product variants that they have to support. Now, the market is starting to demand open standards for applications, to allow user organisations to integrate software modules from different suppliers. This may be bad news for those software vendors whose strategy has been to offer an integrated range of packages that work to a proprietary standard. Delegates noted, for example, that Oracle Alert (which Oracle discussed on the tour, and which is described below) requires both the Oracle database and Oracle's electronic mail product. 'Delegated computing tasks' make use of all surplus processing capacity in a network

Open application standards will be bad news for some software vendors

## Application and network standards reduce the need to standardise workstations and servers

As well as giving users greater choice of vendor, emerging standards for application interworking and network protocols have another effect – they reduce the need to standardise workstations and servers.

On the client side, it is increasingly feasible for one user to choose a PC, another a Macintosh, and another a Unix workstation, while all run the same applications, and interact with the same servers. ParcPlace's Objectworks/Smalltalk development environment permits applications to be transferred between a Macintosh, a PC running Windows 3.0, or a Unix workstation running Open Look or Motif, without modification.

The increasing specialisation of servers means that the choice of server operating system becomes less important, although servicing and support issues will continue to create some constraints. If the server interface remains the same, it matters not whether the server runs MVS, VMS, OS/2 or Unix because the impact of any changes in the operating system will not affect the client elements of applications.

Many organisations are considering whether to make the painful and expensive transition from a proprietary mainframe to a Unix mainframe. For some, this is now the wrong question. They should be considering whether to put more power on the desktop and to split the mainframe into several dedicated servers, each of which can run whichever operating system is best suited to the task. This change was acknowledged by Informix, a relational database vendor that has done very well out of the growing popularity of Unix, but is now producing products for other operating systems such as OS/2.

# Client-server systems will increasingly be driven from the client side

In the days of mainframe hosts and terminals, information systems were driven from the centre, with one of the key questions being how many terminals the host could support. Tomorrow's information systems will put the user at the centre, with the main question changing to 'how many servers can support a workstation?' In his industry briefing to study tour delegates, Stewart Alsop (editor of PC Letter) stated that the large systems vendors have not appreciated this. Although many of them are starting to acknowledge the trend towards client-server architectures (he heard an IBM executive refer to the 370 as a 'server' for the first time recently), the strategy of most vendors is based on the assumption that the server is the most important part of the system.

Stewart Alsop noted that the increasing freedom of choice for the customer is likely to produce a change in the marketplace. Very few companies will succeed in manufacturing and selling complete systems – indeed, this would be at odds with the very nature of client-server architectures. Vendors can specialise in products – delivering value for money on commodity products (workstations and servers), or designing niche-market products – or they can

Switching to Unix may now be less important than switching to a client-server architecture

Vendors will be forced to specialise in products or services specialise in delivering a service to the customer, integrating and installing a set of components selected by the customer, and providing continuous support.

# Client-server systems are changing the nature of applications and their development

Client-server systems are starting to be employed for mainstream applications such as accounts and management information systems. As the power and robustness of the components increases, it is even possible to foresee the emergence of a new class of servers optimised for online transaction-processing applications.

However, the new architecture is also starting to change the nature of applications: new applications become possible, and others become more popular. The way that such applications are developed is also starting to change, and this has considerable implications for the future of systems development within large organisations.

# Interpersonal computing and workflow management are growing rapidly

Interpersonal computing was the phrase used by NeXT to characterise the applications that it sees its systems enabling. The phrase was meant to convey the synergistic effect of combining personal productivity aids, electronic messaging, and shared information and resources. (This is called groupware by other vendors, and was described in Report 73.) NeXT reported that its own internal use confirmed that interpersonal computing results in faster and better diffusion of information within the company, higher aesthetic standards for documents and presentations, and the virtual elimination of paper flows.

Workflow management is also associated with the reduction of paper flows. It is not new: most of the early electronic document management (also called document-image processing) systems allowed workflows – the routes that documents had to take through the organisation – and the actions to be taken at each step to be specified. Newer document-management systems, such as ViewStar's, permit new workflows to be specified quickly and easily by the user rather than by specialised programmers.

This trend has two effects. First, document and workflow management is starting to be applied to the operation of a whole department or branch, rather than merely to the primary documents such as orders or invoices. Second, the ability to establish new workflows and change existing ones, without large-scale systems development, is playing an enabling role in business process redesign. We explored this in Report 79, *The Role of Information Technology in Transforming the Business*.

Another related idea is 'exception management' – a new application that Oracle claimed to be pioneering. Oracle Alert is an innovative package that combines a relational database with electronic mail. Users can specify a series of conditions or events that could occur within the database, such as 'whenever a stock level Servers designed for online transaction processing may soon appear

Workflow management software is a key enabler for business process redesign 'Exception management' is a powerful new class of applications

Object-oriented programming makes very rapid application development possible comes within 5 per cent of its minimum level' or 'whenever a purchase order is raised for more than \$500'. When such an event occurs, the user is instantly sent an electronic mail message, containing the details. The electronic mail message can even contain a menu of possible responses, which can be actioned by the package. This is a potentially very powerful application and we expect to see similar announcements from other vendors. On a technical note, there is a good match between the requirements of this application and the object-oriented development approach.

# New workstation-based application generators are encouraging more end-user application development

New workstation-based application generators are emerging that genuinely enable end-user application development. These new packages are graphical, and some of them employ object-oriented development approaches. They are much easier to use than most fourth-generation languages.

Wingz, demonstrated by Informix, was initially marketed as a sophisticated spreadsheet package that allowed macros to be written in a language called Hyperscript. These macros could be edited, and then attached to on-screen buttons. Informix now markets the package as a 'media application environment'. It showed an impressive application for real-estate agents, that acted as the front end to a database of properties, including photographs. Informix envisages Wingz being used to develop customised frontend applications, and for user-developed prototypes that can be passed over to the systems development department instead of a conventional paper specification.

NeXT confirmed that its object-oriented development environment has changed the way that applications are constructed. It now makes sense to start with the user interface. The 'events' generated by the functions on the user interface will then dictate how the rest of the application should be developed. NeXT showed a powerful sales-information system that it had developed for its own use. It took one person six weeks to generate the back end by importing the data from its Tandem-based ledger systems to a relational database, and just two weeks to create the client application. The application converts combinations of buttons on the screen into SQL commands for interrogating the database.

Oracle Card is another such client-based application generator, which essentially mimics the operation of Apple's Hypercard (which we first reported in our Position Paper on Hypertext) to provide a graphical way of browsing through the database.

# The object-oriented development approach is well suited to client-server systems

Object-orientation is difficult to understand and the difficulty is exacerbated by the spurious use of the term to refer to anything from modular programming to the incorporation of images into databases. However, several of the vendors we visited on the study tour, including NeXT and ViewStar, made use of genuine objectoriented programming. One major advantage they reported was speed of implementation and system modification. NeXT, for example, said that it had written a basic word processing package (with the same functionality as MacWrite) in just 2,000 lines of code, compared with perhaps 100,000 lines for the original version. The key to reductions of this magnitude is re-usable objects.

It is possible to perform the design and analysis stages of systems development in an object-oriented fashion, and then implement the application using conventional and fourth-generation languages. However, this approach may not deliver the full benefits of re-usability and reduced maintenance. ParcPlace, a vendor of object-oriented languages, suggested that the use of such hybrid development approaches is unsatisfactory. The real benefits, it says, come only from a 'cradle-to-grave' object-oriented approach. Figure 4, taken from the ParcPlace presentation, illustrates the different approaches.

Hybrid development is less satisfactory than 'cradle-to-grave' object-orientation



Complex collections of objects require at least as much careful management as complex conventional databases, and this is the role of object database management systems (ODBMS), of which Servio's GemStone is an example. (Two other ODBMS vendors, Ontologic and Object Design, were visited during the 1990 study tour.) These systems provide functions such as locking, mirroring and security that would be found in a conventional database management system.

Servio recognised that its ODBMS could not match the performance of a conventional RDBMS for very large applications. In some of its most successful implementations, data is routinely extracted from a relational system and placed into a smaller ODBMS, to be accessed by the purely object-oriented applications.

Both ParcPlace and Servio claimed that the benefits of objectorientation were even greater on client-server systems than on standalone applications, because of the ability to move objects between, say, a workstation and a server, according to which has the most processing power available. All data used by the application is contained within objects, and all processes that can be applied to an object are contained within that object. Communication between objects is through messages, which contain simple parameters only – they are not allowed to carry complex data structures or even pointers to them. The problem then becomes equivalent to any other message-routeing problem.

In conclusion, the 1991 Foundation study tour showed that clientserver systems are becoming a reality. They capitalise on the trends in workstation performance, fully exploit new approaches to systems development, and are well suited to the move towards multimedia and visual approaches. With commensurate developments in server technology, and in standards for communication between them, client-server systems are now starting to pose a very real threat to traditional host-based systems, even those based on large mainframes.

Object-orientation brings more benefits to client-server than to standalone systems

# Appendix: Details of the companies and the visits

# **Silicon Graphics**

Silicon Graphics markets high-performance workstations. Its principal markets are scientific visualisation and engineering, for applications ranging from military mission simulators to computational fluid dynamics. Its strength in these markets comes principally from the workstation performance, which derives from two factors – early exploitation of Risc architecture, and the use of custom integrated circuits to perform as many graphical functions as possible in hardware. It has licensed some of its technology to IBM, and has recently reached strategic agreements with Microsoft and Compaq.

Silicon Graphics demonstrated some impressive applications, several of which involved realtime rendering of complex moving scenes. It also showed some prototype work on very high fidelity sound processing – part of a broader move into the multimedia marketplace.

# **Apple Computer**

The visit to Apple was hosted by its Advanced Technology Group, and coincided with the (delayed) launch of its new System 7.0 operating system and the release to developers of Quicktime, a new set of techniques for managing image and video objects. As part of a general discussion concerning its communications policy (including the recent decision to make the AppleTalk protocol available on other vendors' systems), Apple commented on its recent lobbying of the US Federal Communications Commission for the allocation of part of the radio spectrum for radio-based local area networks.

Apple demonstrated an impressive speech-recognition technology that could cope with continuous speech and that is intended primarily for high-level commands such as, "Fax this to the members of the standards committee and copy it to Fred". However, this is still some way off being a product. Apple also explained its approach to visualisation and modelling, including the use of 'behavioural modelling' to improve the realism of animated scenes.

## NeXT

NeXT is a relatively new entrant into the workstation market and is aiming its products at 'professional' users as opposed to scientific and engineering applications. It is committed to what it describes as 'interpersonal computing'.

It demonstrated a range of applications that used the powerful graphical user interface on the NeXT workstation, including an electronic mail system that handled voice messages and images. NeXT also discussed the various layers of the NeXTStep software development environment, showing how it was possible for users without programming experience to build simple applications.

Of particular value was a presentation by the company's systems director, concerning the use of NeXT's technology within its own business. Its network of 1,300 workstations, which handles 7,000 electronic mail messages a day, is supported by a staff of five.

# NetFRAME

NetFRAME was founded in 1987 by Carl Amdahl and Enzo Torresi, co-founder of Businessland. It specialises in high-performance servers accessed by PCs, and interconnected by a local area network. NetFRAME explained the technical concepts behind the NetFRAME architecture – in particular, the combination of a microprocessor with the channel architecture of a mainframe. The performance, security and fault tolerance of the design makes it a viable alternative to a mainframe- or minicomputer-based server for many applications, and NetFRAME described some impressive case histories during the visit.

# HyperMedia Group

The HyperMedia Group is a specialist production house for multimedia applications. The group has worked for several of the major vendors – for example, on the recent launch of the Tandy MPC, the first PC to exploit the multimedia extensions to Microsoft's Windows. During the visit, the group demonstrated an electroniccatalogue application now being used in the retail merchandising market, and an interactive learning system for teaching business English.

# **ViewStar Corporation**

ViewStar markets electronic document management systems that can run on hardware from a wide range of vendors and that make full use of the ability of client-server architectures to split an application between several computers. ViewStar described the main trends in electronic document management, and in particular, the shift towards workflow management. Its system is fully object-oriented, and the principal benefit of this to the user is the ability to define and implement new workflows and new applications very quickly. ViewStar also demonstrated the use of its system for managing technical drawings and documentation, using the workflow procedures to control engineering changes.

## **Oracle Corporation**

Oracle, a well established vendor of relational database technology, described the trends in relational databases, and its view of their relationship to the emerging world of object-orientation. It declared its intention to provide an 'open family of portable software', explaining that this meant addressing both the open standards for hardware and the emerging standards for interaction between applications. Since its recent strategy has been to build upon its existing technology base by moving into packaged applications, this means that it must embrace the idea of its packages running on a competitor's database system. Two relatively new packages were introduced – OracleCard, a Hypercard-style front end to the database, and Oracle Alert, an exception-management application that links a database to electronic mail.

# Informix

Informix is the leading supplier of relational databases that run under Unix. It claimed that its system is now viable for 'missioncritical' applications, and quoted case histories from Hyatt and DHL in support of this.

It has recently incorporated the ability to handle Blobs (binary large objects), which will enable multimedia applications and traditional databases to be better integrated. It demonstrated Wingz, which was originally marketed as a powerful spreadsheet, but which is now promoted as a multimedia end-user application development environment.

## Servio Corporation

Servio Corporation markets GemStone, an object-oriented database that supports both the C++ and Smalltalk languages. Servio claimed that the object-oriented approach is now becoming viable for mainstream commercial applications, although it is still not robust enough for high-volume transaction processing. It is helping to define open standards for handling objects.

## ParcPlace

ParcPlace is a spin-off from Xerox Parc (Palo Alto Research Center), and was created to exploit the commercial potential of the Smalltalk-80 object-oriented programming language. It cited several very large users of its tools, including one oil company that is developing a corporate-wide management information system. Particularly impressive was the Objectworks package that permitted an application to be transferred from a PC running Windows to an Apple Macintosh or to a Unix workstation running Motif, without modification.

ParcPlace claimed that object-orientation is a 'cradle-to-grave' method, and that a hybrid approach to development will not deliver the same benefits. It did, however, acknowledge the need to interwork with existing technologies, especially relational databases.

# **PC** Letter

In addition to the 10 visits described above, study tour delegates were given a special briefing by Stewart Alsop, editor of PC Letter, an industry newsletter. Stewart Alsop provided an informed view on a variety of issues, including the relationship between IBM and Microsoft, the relationship between the PC and workstation markets, and the prospects for the principal vendors of network operating systems.

# BUTLER CO FOUNDATIC

# **The Butler Cox Foundation**

The Butler Cox Foundation is a service for senior managers responsible for information management in major enterprises. It provides insight and guidance to help them to manage information systems and technology more effectively for the benefit of their organisations.

The Foundation carries out a programme of syndicated research that focuses on the business implications of information systems, and on the management of the information systems function. rather than on the technology itself. It distributes a range of publications to its members that includes research reports, management summaries, directors' briefings and position papers. It also arranges events at which members can meet and exchange views, such as conferences, management briefings, research reviews, study tours and specialist forums.

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The list of members establishes the Foundation as the largest and most prestigious 'club' for systems managers anywhere in the world. Members have commented on the following benefits:

- The publications are terse, thought-provoking, informative and easy to read. They deliver a lot of messages in a minimum of precious reading time.
- The events combine access to the world's leading thinkers and practitioners with the opportunity to meet and exchange views with professional counterparts from different industries and countries.
- The Foundation represents a network of systems practitioners, with the power to connect individuals with common concerns.

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