March 1996

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Delphi Developer adds a scalable data dictionary, multi object grid, BDE low-level API & help files, ODBC support, local Interbase server (1 user), Reportsmith 32-bit & has 8 manuals (over 3000 pages)

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SoapFlakes

Will relational databases make it to the next century?

The biggest advances in technology come when users press for changes. This happened in the mid-1980s when users wanted to do things that hierarchical databases could not achieve. As a result, client/server relational databases took off and now receive the vast majority of new development effort.

However, users are once again stretching the envelope. This time the proliferation of multimedia data and the increasing need to access it across networks, particularly the Internet and Intranet, is pushing relational databases to their limits.

For the last few years, vendors have been extending the capabilities of relational database management systems (RDBMSs) by adding new data types and mechanisms such as stored procedures and triggers. However RDBMSs are fundamentally designed to store tables of alphanumeric data and handle other data, such as images, by considering each picture as an indivisible binary large object (which rejoices under the happy acronym BLOB). Stored procedures enable the server to search tables but a BLOB is still a BLOB and remains inscrutable.

The difficulties surface if processing needs to be carried out on the BLOBs – say 'find all blue shirts' for an on-line shopping application. The processing must be carried out by the client, all the pictures must be downloaded so that (typically) a 'down and dirty' 3GL routine can check each one for a blue sky. This shuffling of huge chunks of data is unlikely to endear the users to their network manager.

So for multimedia applications, RDBMSs simply cannot cut the mustard. Clearly for bandwidth-limited applications such as web-based services (which most users still access via a 14.4 Kbps modem), as much selection and business logic as possible needs to be carried out at the server end. The alternative is to spend hours downloading the shop's entire catalogue to sort out the five pictures of blue shirts.

Many web sites appear to avoid these limitations but do so by cheating – rather than running against a live database, the web pages are rewritten each week to account for stock changes. However, this is expensive to maintain and necessarily limits the flexibility and scope of the site's search engines. Most commercial web sites and non-web applications must run against a live database to be useful.

So a DBMS is required that understands multimedia data and is flexible enough to allow a wide variety of queries to be performed on it. There are a number of these object-oriented DBMSs (usually abbreviated to ODBMS) on the market. For serious business developers, the challenge is to find one that combines the leading-edge technology of ODBMSs with the availability and scaleability of existing RDBMSs matched with easy-to-use development tools.

None of this, however, means that relational databases will be forced to incorporate OO techniques or fade away. A large proportion of corporate data is ideally suited to RDBMSs and there is no reason to migrate it to ODBMSs. RDBMSs can search this data faster than their equivalent ODBMSs and, for the moment at least, have the clear edge in availability and scaleability.

When relational databases were introduced, about 7-8% of corporate data was stored on hierarchical databases. Today, the proportion is about the same, with another similar amount stored on RDBMSs. Since ODBMSs are designed for a different type of data, it seems likely that this pattern will continue.

Rob Hailstone has 22 years' experience of the computer industry, most of it in database development. He is now product marketing manager for Computer Associates (http://www.cai.com). He can be reached by vox : 01753 577733 or fax: 01753 825464.

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If you are a programmer and wonder what all this means, this is the sort of job advert which you will start to see with increasing regularity. It's not a joke, nor is it a thing of the future. It represents a new breed of developer using Rapid Application Development (RAD) techniques. The accent is on business skills rather than technical ones. These days, it's the main way to produce software which the business will thank you for. This also makes it rather important from a job preservation point of view. The business is fed up with poor software from the development department. 'Yes, it's bug free, but it doesn't help me to do my job most effectively.'

If you still question the validity of this RAD way of working, and whether there is a significant demand for it, here are some serious facts. The Dynamic Systems Development Method (DSDM) Consortium now has over 700 members in the UK, mostly major end user organisations. The Consortium held its first national conference in December '95. We had to turn delegates away when numbers reached 300. DSDM clearly has a phenomenal following. It's because DSDM's RAD method, which can be used with all sorts of RAD tools, is a solution to what the industry recognises is an essential way of developing systems.

DSDM has legitimised terms in the industry which have been greatly misunderstood, misused, and abused principally *RAD* and *prototyping*. These may conjure up images of hacking and temporary solutions. In the wrong hands they certainly can. But DSDM has formalised them and given them a proper place in the professional software developer's armoury. More, perhaps unfamiliar, techniques have been added by DSDM, namely *joint application design*, *timeboxing* and the *evolutionary development life cycle*. Banished are traditional terms, stalwarts some may say, such as *functional specifications*, *program specifications* and *waterfall life cycle*.

If all this sounds too much, I would invite you to take a closer look. It only costs 95 to become an associate subscriber and to receive the DSDM manual. This is highly unusual for a methods manual. It is easy to read and predominantly in business language. You may find this a wise investment, just in case you feel your development efforts aren't in great favour with the business people on the receiving end. Sometime soon, you might just want to apply to the sort of development job that DSDM constitutes, focusing on business rather than technical issues.

Nick Gill is Manager of the Applications & Systems Integration Division of Olivetti UK and Chairman, Promotional Workgroup, of the DSDM Consortium. His phone number is 01233 661003.

Bridging the digital gap

You might have noticed this as well, there is a little 'problem' out there in our much talked about industry. A good story to illustrate it goes like this: Patricia is a health-care consultant who follows the activities of various hospitals to compare their different cost structures. From her home office she connects her laptop to an ISDN line and surfs the Internet at 128 Kbps to access various key statistics from across the world. At the hospital downtown, she connects her laptop to the existing telephone PBX system and shares her findings in a video-conference session with several people both locally and remotely.

To the man in the street this sounds great. We in the industry know better. The fact is that today's worldwide telephone networks carry information internally in all-digital form and at high speed. For computer users, however, gaining access to these high speed internal digital highways is a very difficult matter, due to the proprietary nature of the interface to digital telephone systems.

Currently, most computer-telephone connections use an analogue line limited to 28.8 Kbps at best, and even when certain advanced digital PBX phones provide serial connections, these still do not allow faxing, videoconferencing, or sharing of multimedia information. Telephones and computers will only interoperate at their full potential when a simple to use, low cost enabling technology solution is made available.

Things are, however, afoot to change this situation. The two candidate technologies on offer today are Intel's Universal Serial Bus (USB), and Versit's GeoPort. USB, still under development and originally designed to simplify the complexity of connecting peripherals to Intel-based PCs, has been extended to include telephones as well. However, the actual user need in desktop connectivity is pointing towards much higher bandwidth requirements for multimedia peripherals (such as digital video cameras). This is apparently not yet addressed by USB.

GeoPort is a technology designed to deliver high speed multimedia through telephone networks from any information device. Versit GeoPort improves on a technology developed by Apple to provide a universal, worldwide, PC and Mac software and hardware architecture to connect telephones, computers and other information devices, simply and inexpensively.

GeoPort defines a modular and scaleable software and hardware architecture, providing a complete cross-platform environment specifically designed to give computers full access to the multimedia pipe represented by the telephone. The Time Division Protocol (TDM) protocol ensures appropriate processing of isochronous streams between a GeoPort device embedded inside a phone and a GeoPort host represented by a CPU or an add-in board. The beaconing protocol automatically loads the appropriate driver associated with the GeoPort device connected to the PC.

GeoPort's software architecture defines APIs for accessing and processing either data or real-time information. At the lower level, the GeoPort's Streams Driver provides data streams to the upper level, formed by the *real-time services* (RTS) and the *device handler*. The RTS provides data & fax modem, or even audio & video services to the application, and is controlled through the device handler.

Call control services, typified by TAPI, and TSAPI, interface directly with the device handler for interaction with telephone systems and for controlling the real-time data streams. This architecture enables, for example, inexpensive software upgrades for new features such as simultaneous voice and data capabilities over one single analogue line. It also ensures graceful coexistence with other complementary technologies addressing the universal connectivity issue such as USB for medium speed desktop peripherals, or IEEE 1394 for much higher bandwidth requirement levels.

Unlike USB, GeoPort fully supports DSP-based architecture, providing developers with additional extensions opportunities.

Implementing a GeoPort device in a digital phone, or adding a GeoPort host capability to a PC, is simple, royalty-free, and requires a limited number of components, none of which is proprietary (GeoPort is already included in Apple's PowerMacs). The additional cost in components is a few dollars, and it makes the PC and phone combination capable of sending and receiving faxes, surfing the Internet at ISDN speeds without the need for an additional modem or phone line.

GeoPort is here to let PCs access the multimedia pipe offered by the telephone systems of the future. It will provide developers with the opportunity to market as early as mid-1996 interoperable solutions that will change the way people access information, communicate, and work together worldwide.

The hardware is there and it is now up to you, the software developer, to keep the ball rolling and start developing applications that take advantage of the PC's new ability to communicate through the telephone to the wide-area network from any location and with rich multimedia content.

Phac Le Tuan works at Apple and is Technical Director of Versit, an Apple, AT&T, IBM and Siemens initiative. Versit's home page is at http://www.versit.com.

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DELPHI FACTS

Features	Delphi	PowerBuilder	Visual Basic
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Create standalone EXEs and DLLs	✔	—	—
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Easily build new components and extend IDE	✔	—	—
Fully scalable Client/Server architecture	✔	✔	—
Fast learning curve for increased productivity	✔	—	✔
More than 100 reusable components	✔	—	—
Visual Form Inheritance	✔	—	—
Object Repository for forms and Data Modules	✔	—	—
Data Dictionary	✔	✔	—

and enhanced data-aware components like the *New Multi-Object Grid* and *enhanced DBGrid* to build scalable database applications. Store extended field attributes and reuse them across forms and applications with the *New Data Dictionary*.
Delphi Developer 2 applications run up to between 15 and 50 times faster than applications built with p-code interpreters, like Visual Basic and PowerBuilder, so you won't hit performance barriers.

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with the *New 32-bit Visual Component Library (VCL)* of more than 100 reusable components – including complete VCL Source Code for easy customisation. *New Visual Form Inheritance* lets you create forms once, then share them between applications to reduce coding and easily implement standards and business rules. Store and reuse components, Data Modules, and forms with the flexible *New Object Repository*. Visually browse and modify databases, tables, and aliases with the *New Database Explorer*. Use the *New 32-bit Borland Database Engine*

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December 1, 1995

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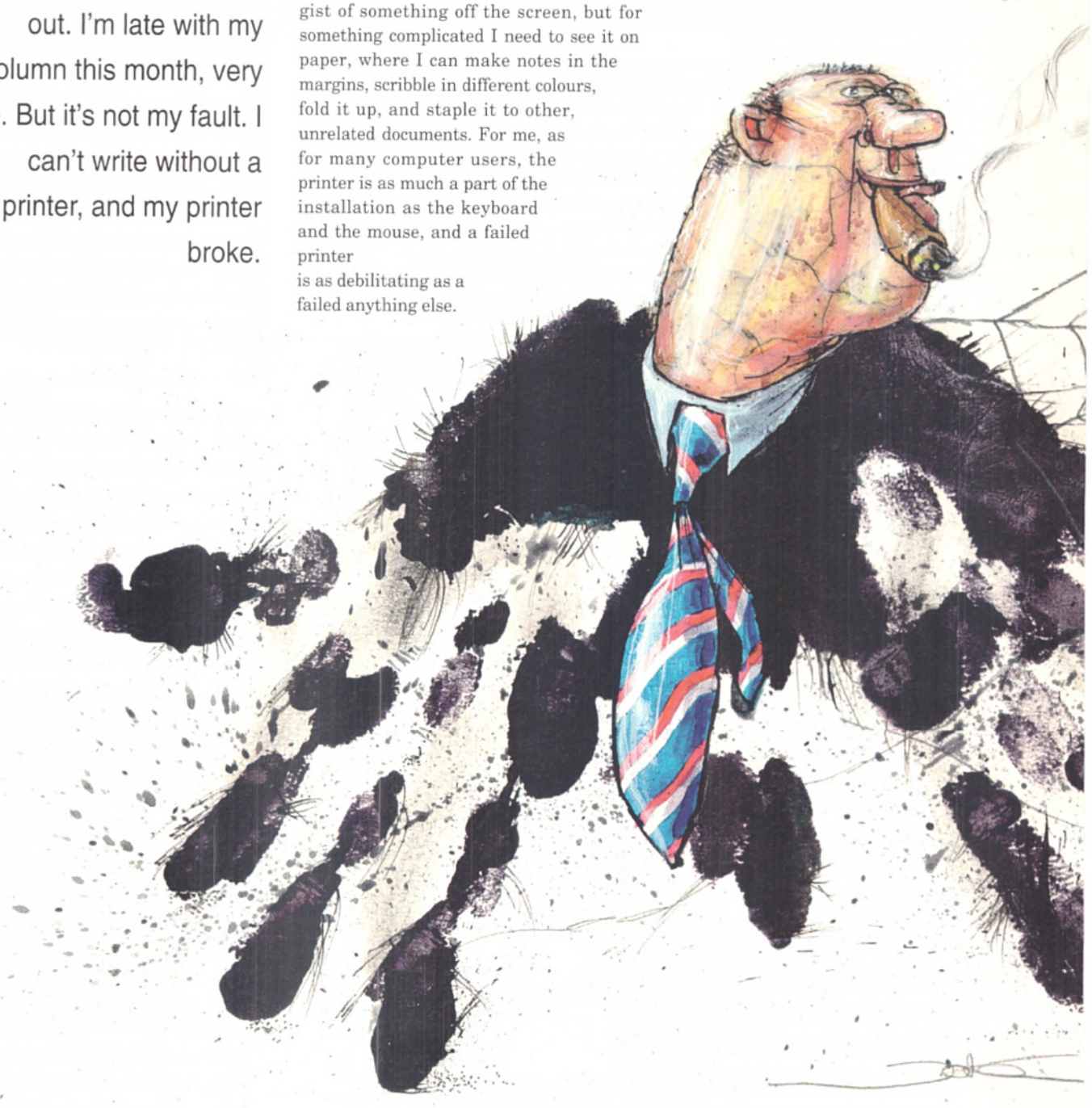
Mayhem!

Gentle reader, you can't see this, but your editor is presently tearing his hair out. I'm late with my column this month, very late. But it's not my fault. I can't write without a printer, and my printer broke.

Although I use my computer for nearly everything I do, I'm not the sort of person who can read everything from the screen. I can get the gist of something off the screen, but for something complicated I need to see it on paper, where I can make notes in the margins, scribble in different colours, fold it up, and staple it to other, unrelated documents. For me, as for many computer users, the printer is as much a part of the installation as the keyboard and the mouse, and a failed printer is as debilitating as a failed anything else.

I don't know if you've ever looked at a laser printer cartridge. It's full of components, some made of exotic materials, all working together. The really elegant parts of the design are the plastic mouldings,



though. I've been getting involved in plastic moulding lately, and discovering how much of an art it is. Even simple parts are full of details, skill and choices, and it fascinates me to try to understand how the designers created the tools they needed to make those parts. But complex parts are magnificent pieces of design, and the parts in printer cartridges are quite stupendous. The more I saw, the more it grieved me to throw used cartridges away.

So I was quite pleased when I discovered companies who re-manufacture cartridges. The idea is that they take expired cartridges, make sure that the main parts are intact, replace all the components that wear out, refill them, and finally sell them at half the price of a new cartridge. I decided to give them a try.

When the cartridge arrived, it looked in every respect like a new one. It was in the same kind of box, was wrapped in the same silver bag, and had the same kind of sealing strip to stop the toner from shaking out. Unfortunately, no matter how hard I pulled, I couldn't get the seal out – it was being covered by a plate that was fitted wrongly. Eventually it just broke off. I removed the plate, pulled on the broken end of the seal with pliers, and put the plate back on. Unfortunately, it had broken again, and I couldn't retrieve the broken piece. Of course, the cartridge didn't work properly. I contacted the distributor and they offered to replace the cartridge. When cartridge number two arrived, the drum cover was broken - it looked as if it had been packed wrongly. No matter, I replaced it with the cover from cartridge number one, and tried it. That didn't work - a broken piece of plastic had fallen inside the cartridge, and it trashed the drum right away. The distributor apologised profusely, and offered me another one.

Cartridge number three arrived, with a new sealing strip. I pulled out the strip (it came out easily), put the cartridge in the machine, and it worked perfectly. For two pages. Then a white stripe appeared. I contacted the distributor. The distributor apologised again and they said they'd send me a new one. Then the makers called, and asked me to look at the sealing strip I'd pulled out. Sure enough, even though it had felt perfectly smooth, this one had broken too. The makers asked for all three cartridges back and sent me a new one.

Cartridge number four arrived, sent by special courier and packed with Styrofoam to keep it safe. The strip came out cleanly (no break this time), all the plastic bits were where they should have been, and the cartridge is still working perfectly three days later. I think they've done it!

It's taken two and a half weeks, during which time I felt crippled, but at least my printer is working again. At the end of this process, I'm trying to decide whether I think remanufactured cartridges are a good idea. On the other hand, there's bound to be some quality problems, because the remanufacturers are working with old components, on a smaller scale than the original manufacturers. On the other hand, precisely because they're smaller, they will be inclined to give a better service; it is true to say that this company took my problems very seriously indeed and bent over backwards to help me – only one employee ever said anything remotely obstructive in all the dozens of phone calls that passed backwards and forwards.

But, I guess the real reason why this idea is worth pursuing is an environmental one. Even without the economics of scale that the giant manufacturers can bring to bear, recycled cartridges are cheaper than the new ones. That means that the environmental cost of recycling cartridges is well below the cost of making them in the first place. Precious little gets re-used these days (all the cars I know of force you to replace the water pump when a bearing fails, for example), and once the manufacturers become more mature and the reliability problems are solved, other industries may well follow suit.

All that notwithstanding, one working cartridge in four is a pretty poor show. I'd like to think I was unlucky. Next time, I think I'll use the company again, but only once – if the quality next time is as poor as it was this time, I'll reluctantly give up on the whole idea. ■

If your printer is broken, I'm sure you'd like to tell Jules about it. You can't write a letter, so you will either have to telephone him on 01707 662698, or email him as jules@cix.compulink.co.uk.
If you would like to give it a try yourself, contact Themis on 01883 33033.

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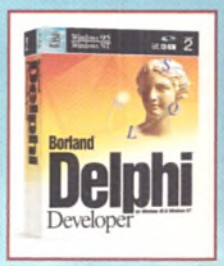
Doc-To-Help 2.0 for Win95

Use MSWord to create Windows Help files effortlessly. Add hypertext links to existing documents and prepare Help files and printed documentation from the one source. Convert Help files to text, graphics etc. components, to bring existing projects into Doc-To-Help usage. New ver. 2.0 for Windows 95 includes Topics Browse Dialog Box, procedural as well as context help and more.



Borland Delphi Developer 2

Delphi Developer is the fastest way to build 32-bit professional multi-user applications for Windows 95 and NT. It is the next step for Delphi 1.0 owners. In addition to the features found in Delphi Desktop, Delphi Developer includes: a scaleable Data Dictionary, advanced Data Aware Components, complete ODBC support, source code to over 100 native Delphi Components, sample OCXs and Windows 95 common controls, and expanded Open Tools API and much more. Includes 16-bit Delphi 1.0 free. ***Upgrades available, call for prices.***

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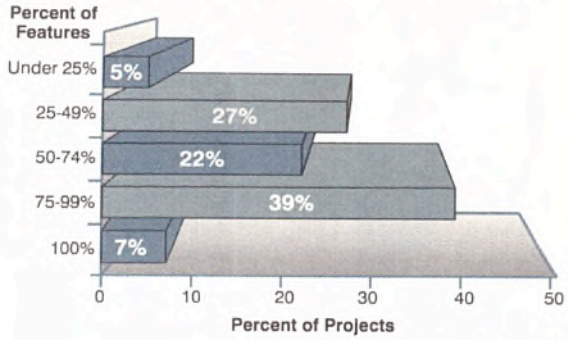
CIRCLE NO. 518

What's wrong with client/server development?

In the UK, 10% of client/server projects are cancelled before completion, 20% are significantly reworked and 40% significantly late, according to a Compuware survey. In another survey conducted by OASIS, it was estimated that 60% of UK organisations have client/server developments underway.



Source: Software Productivity Group, Inc.

Christine Comaford, President of Corporate Computing (now an LBMS subsidiary) considers the main problem to be a lack of good techniques. Labour represents 75% of the cost of client/server development over a 5 five years period (Gartner Group) hence the importance of techniques over tools. For example, a Word generated help file could be more productive than any fancy repository as proven by Pepsi. What Comaford advocates is standards and an advanced data model.

As can be seen from the graph, more than half of completed projects implement less than 74% of requested features. This prompted Comaford to prioritise features in her client/server guidelines. Level 1 is for essential features, level 2 lists variations happening 15% of the time, level 3 describes nice stuff which might result in productivity increase and level 4 is for the 'fluffy stuff'. Features are implemented by priority level and a new version should be released every 4 months.

The client/server guidelines cost about £3500 for five copies. The learning curve should be from four to six weeks with a return on investment estimated at six months.

Contact LBMS on 0171 878 8700. URL: http://christine.com.

Object Technology 96, the annual conference and exhibition of the Object-Oriented Programming and Systems Group of the BCS will be in Oxford from 25 to 27 March. To book a place call **00 353 28 38483**. The programme is at http://www.sis.port.ac.uk/bcs-oops/otmenu.html

Ilog ported **Ilog Rules 3.0** on Windows 95 and NT. Ilog Rules is an object-oriented rules-based syntax to generate intelligent agents and embed them in C++ applications. **00 33 149083500** or **http://www.ilog.fr**

Select Enterprise for **Forté Release 2**, an OO analysis and design tool for client/server development, allows automatic generation and reverse engineering of Forté 4GL code in Forté's TOOL language. Select (**01242 227900**), Forté (01344 482100)

The combined DBMS and application development environment **Open M** has been ported to NT and optimised to take advantage of the 64-bit architecture of the Alpha chip. InterSystems is on **01753 855450**

The European standards organisation ECMA is submitting its ECMA-234, more well known as API for Windows (**APIW**), to the **ISO**. The first APIW product, the TWIN Cross Platform Development Kit, has been developed by Willows Software, author of APIW.

X/Open and OSF join forces

At UniForum 96, X/Open and the Open Software Foundation, the two consortiums focused on open systems, consolidated in a new world-wide organisation: the Open Group. The new organisation has fixed itself some objectives for '96. Deliver new technology specifications in three main areas: open systems, distributed computing and Internet; extend the X/Open brand; develop and implement a 'common documentation project' for all open systems vendors; provide information and tools to assist customer decision making; and collaborate with other organisations such as UniForum, the Object Management Group, the World Wide Web Consortium and the UnixWare Technology Group.

The respective user groups have also been unified in what is claimed 'the largest and most influential assembly of open systems end-users to date'. It new name is The Open Group Customer Council with OGCC as a catchy acronym! The first meeting of the OGCC is planned for this month in San Francisco. In addition to providing user input, the OGCC will direct and monitor the work of the Open Group concerning tactical areas such as security, architecture, distributed systems management, interoperability and the Internet.

Santa Cruz Operation (SCO) which is the first new member of the Open Group will act as an 'official sponsor'. SCO is jointly developing with Hewlett-Packard, a 64-bit standards based operating system with integrated Novell technology.

UK contact for the Open Group is via the X/Open (01734 508311). SCO is on 01923 816344 and at http://www.sco.com. HP is on 01344 369231 and at http://hp.com.

Relational databases most important

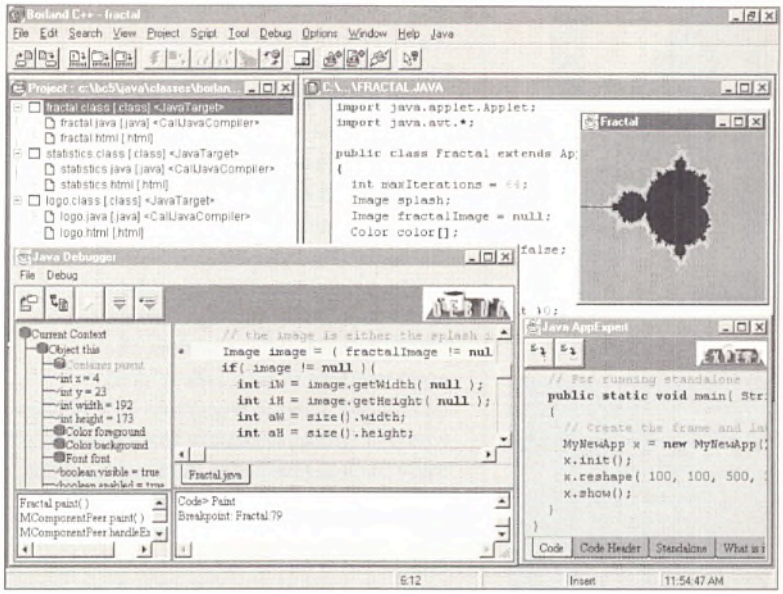
A survey carried out for Interactive Exhibitions by Codd & Date reveals that the most important technology today is 'relational databases'. RDBMSs came first in front of client/server systems, SQL, software reuse, ODBC, data warehousing, object-oriented development, Internet/WWW information access... The respondents were from 'large blue chip corporations in the financial and manufacturing sectors with IT budgets in excess of £5 million'.

This shows that hot technologies like the Internet (ranked 11), multi-media (14) or object-oriented databases (16) might not be that widespread in large organisations. The survey included a question on the relative importance of these same technologies in three years time. Client/server, reuse and object-oriented development moved up a few positions with the client/server in the first place. SQL and data warehousing lost a few places, and ODBC dropped six positions.

Interactive Exhibitions is the organiser of DB World, the next edition will be from 19th to 21st March at Olympia 2, London.

Interactive Exhibitions is on 0181 541 5040. URL: http://www.sofinfo.com/softworld.

Borland goes 32-bit with C++, Delphi and Java



This month should see the availability of Borland C++ 5.0 and Delphi 2.0. BC++ 5.0 includes a new 32-bit Windows 95 / NT hosted development environment (IDE) which can target DOS, Windows 3.1, 95 and NT. The IDE can be completely customised with ObjectScripting, a new 32-bit scripting language. The compiler is a Windows 95 logo-certified product and as such supports features like OLE, registry and long file names. Like Delphi 2.0 (see the full review on p. 24), BC++ 5.0 includes a previous version 16-bit hosted (BC++ 4.52) for developers still developing with Windows 3.1 (BC++ 4.52 doesn't sports any of the new enhancements).

OWL, the ObjectWindows Library has also been revamped and is a single source code base 32- and 16-bit Windows application framework, it is even portable to other compilers such as MS VC++. With it, developers can target any version of Windows without changing their source code. OWL 5.0 emulates Windows 95 controls in its 16-bit version. It now encapsulates WinSock and MAPI. If after all that you're still not convinced by OWL, just use MFC, BC++ 5.0 works with the Microsoft library versions 3.2 and 4.0.

BC++ supports not only all flavours of OCXs, applications can access VBXs in both 16- *and* 32-bit mode. The compiler is a complete implementation of the ANSI/ISO C++ draft specification which includes namespaces and the STL (licensed from RogueWave). The compiler will be shipped with two back-ends, one from Borland (claimed to be 'the fastest PC compiler') and one from Intel optimised for Pentium processors. The basic BC++ 5.0 package includes a visual database development tool (VDBT), Sun's Java Development Kit (JDK) and a GUI debugger for Java. A pre-release of the debugger, written in Java, can be downloaded from Borland's Web site.

Borland will sell its C++ combined with four other tools as the BC++ Development Suite 5.0. The four tools are CodeGuard 32/16, PVCS Version Manager, InstallShield Express and the AppAccelerator. You've probably heard of or used all of them before, accept for the AppAccelerator. This is a 'just-in-time' compiler for Java. It compiles the Java byte code at runtime. Borland claims a performance increase of Java applications by a factor of 5 to 15. This is the first step in Borland's Java strategy (called Latte). A Delphi-like, Java development environment is currently being developed.

◗ *BC++ 5.0 costs £225 (upgrade £119 until 30 June, £145 after).* ◗ *BC++ DS 5.0 costs £315 (upgrade £179 until 31 August, £205 after).* ◗ *Tel: 01734 320022* ◗ *http://www.borland.com*

◗ **Java 1.0** is available for free from **http://java.sun.com**. Final versions are available for Windows 95 and NT on Intel, and Solaris on Sparc. The Mac OS 7.5 version is planned for this quarter.

◗ JavaSoft announced **JDBC** to let Java applications integrate with databases. The JDBC API specification will be released to **http://java.sun.com** on March 8th. SunSoft will bundle the JDBC Driver Manager with future Java products. It is also working on a bridge from JDBC to ODBC.

◗ Addison-Wesley is to publish the 'official series of **books** on Sun's **Java**'. The Java Programming Language (ISBN: 0-201-63455-4), The Java API (ISBN: 0-201-63453-8), The Java Language Specification (ISBN: 0-201-63451-1) and The Java Virtual Machine (ISBN: 0-201-63452-X) should appear in May.

◗ **VB Script**, Microsoft newest variation on VB, will be able to call Java applets. A beta of VB Script should be released this month as part of the I3 Explorer Web browser. Check out http://www.microsoft.com

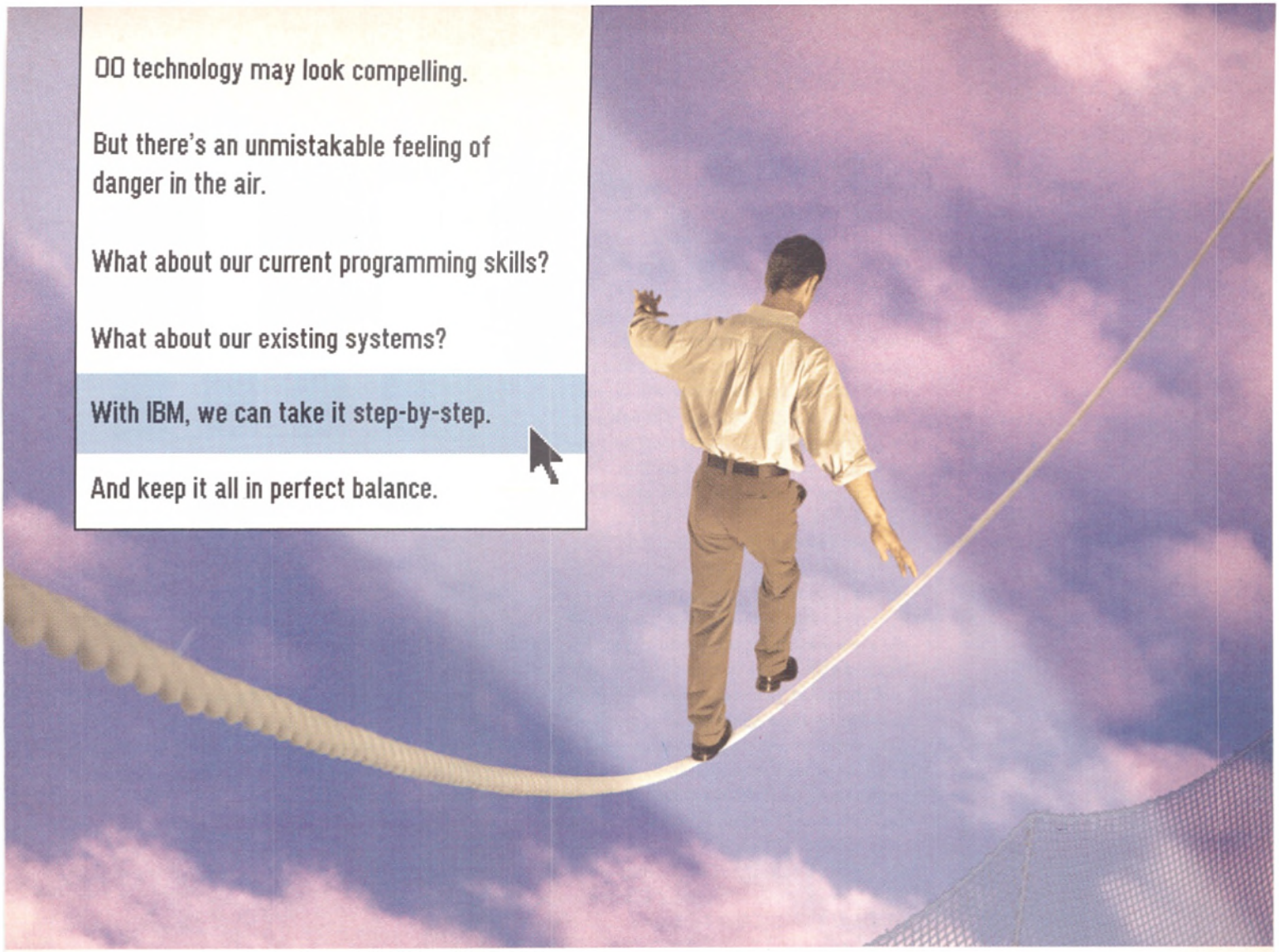
◗ To find more on **Java**, apart from the SunSoft **Web site**, check out: http://www.extreme.indian.edu/java/JDK_SRC/, http://rendezvous.com/java/hierarchy/, http://altair.parsecweb.com/~kbs/index.html, http://www.gamelan.com...

Symantec brings Java to Windows 95, NT and PowerMac

Café is Symantec's Java development environment. Café integrates Sun's Java Development Kit (JDK) into Symantec C++ 7.2. When parsing Java source code, Café creates a repository of information about the Java applets and class libraries. It uses this information to provide a visual representation of the class hierarchy. A class browser lets developers manipulate directly object-oriented elements of their Java programs instead of source files. Sub-projects allow to build Java applets and console applications from within the development environment. A colour coded syntax-editor is included.

At the time of writing the final release was not yet ready but a beta 2 for Windows 95/NT can be downloaded from Symantec's Web site. The Beta 2 supports compressed classes which load from ZIP files. Symantec will be bundling a Macintosh version of Café (with full support of AppleScript) with Symantec C++ for PowerMac

◗ *Upgrade to the final Windows release will cost £129 (RRP) before the 1st of May and £289 after.*
◗ *Symantec C++ for PowerMac registered users will receive Café for free this quarter. The C++ for PowerMac costs £309 with a competitive upgrade at £129.* ◗ *Tel: 01628 592222*
◗ *http://www.symantec.com*



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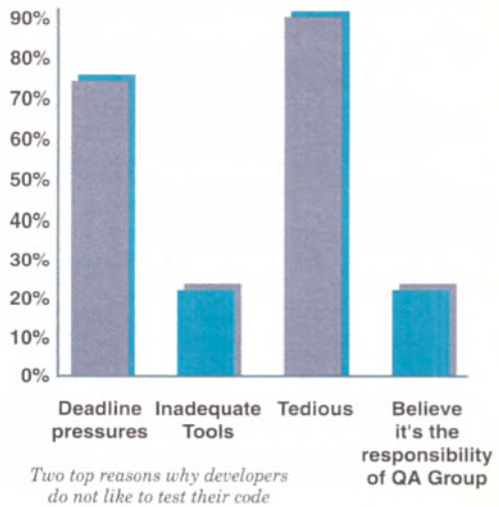
CIRCLE NO. 519

Development practice contradicts quality goal

A market research on software quality in the UK commissioned by CenterLine shows that even though concerns with quality are on the increase, testing policies are still inadequate. A whopping 57% of the respondents admitted that their organisation had knowingly shipped software with bugs! One of the justification for letting bugs slip out of the door is that 76% of developers believe that users are ready to accept software flaws on the basis that they will be corrected in a later release. (check out *http://www.c2.org/hackmsoft* to discover some of the security bugs that have been discovered in Microsoft products, for example.)



Two top reasons why developers do not like to test their code

As can be seen from the graph, it is not the perception that there's no adequate testing tools which stops developers from testing their code, even deadline pressures comes only second. Only 30% of the respondents felt that less than 80% of their software was tested before being released and the same percentage of respondents felt that up to 60% of their applications are not tested adequately. The motto of CenterLine is 'test earlier and more often'.

CenterLine, in the business of testing tools, explains the increased concern by changes that happened in software. Here comes the time of *modern bugs*. Applications are often multi-platforms: testing heterogeneous environments generates a combinatorial explosion of required tests. GUI testing: it's the most visible part of an application but it's harder to debug at an early stage. Distributed applications: some performance related bugs happen only with certain network traffic, hard to simulate. In the past, companies concerned by quality were building their own testing tools, today they show interest in shrink-wrapped testing tools.

Contact CenterLine to get a copy of the report titled 'Software can seriously damage your business' or to enquire on its QualityCenter family of products.

◗ *Tel: 001 617 4983000* ◗ *http://www.centerline.com*

General Magic's software for Windows

General Magic is putting on the Web free to download, a pre-release version of its Magic Cap platform. A pre-release of its Telescript Active Web Tools can be ordered from the Web. First commercial releases of both products are planned for the first half of this year. Magic Cap is a complete communication platform which supports email, fax, paging and telephone. In addition, Magic Cap for Windows can interact with AT&T PersonaLink Services, a public network Telescript-based service providing email, fax services and rich content such as text, digital ink, sound and animation.

The Telescript Active Web Tools are tools to create Web services based on agent technology (for more on agents and Telescript see *EXE* February '95). The tools include a graphical IDE, the Telescript engine, Web Server Class Libraries, the NCSA Web Server, on-line documentation and sample code. The IDE provides a graphical user interface, source-level debugging, a class browser and a compiler. The Telescript engine has a TCP/IP-based infrastructure which provides the foundation for active agents to move between Telescript-enabled Web sites.

◗ *General Magic: 001 408 7744043 http://www.genmagic.com* ◗ *Magic Cap http://www.genmagic.com/MCW/* ◗ *Active Web Tools http://www.genmagic.com/awt*

Pure Software ports its Unix tools to NT

Pure Software, known for its Unix software quality tools, will move most of its products to NT this year following demands from customers going from Unix to NT. The first tool for NT will be Purify/NT, a run-time error detection software. Pure Software considers that there are three main technologies involved in run-time error checkers: malloc wrappers, source code modifiers and object code insertion (OCI), the patented technique used by Purify. Implementations of the technologies have an impact on build-time and run-time performance as well as integration with debuggers. OCI is claimed to be comprehensive, non-intrusive and fast.

Purify/NT can check all code for memory leaks including DLLs and third-party libraries. It supports OLE clients and servers, multi-threaded applications, programs running on multiprocessor machines and the ability to launch the debugger when Purify detects an error.

◗ *Purify/NT is scheduled for the second quarter of this year* ◗ *Pure Software is on 0031 23 5694300*

◗ The ***EXE* Awards** are **postponed**. A joint event is planned with a party to celebrate the **ten-year** birthday of ***EXE*** later in the year. We will announce all details shortly.

◗ **NetWare Mobile** which enables mobile users to access their NetWare networks from anywhere in the world has been developed in Novell's UK laboratories in **Hungerford**, Berkshire. Novell's **DeveloperNet** has reached its 1,000th subscription worldwide. **0800 960274** or **http:developer.novell.com**

◗ The Database Programmers Retreat will organise **Visual Programming 96** on 11-12 April in London. It will be an in-depth evaluation of Delphi, VB, VO and FoxPro. Booking before the end of March costs **£495**. DPR is on **01452 814303**

◗ ISE is shipping **Professional Eiffel** on **Windows 95** and **NT**. Call 001 805 6851006 or check out http://www.eiffel.com

◗ **Centura** is **Gupta**'s new 32-bit client/server product line. It consists of four products: Team Developer, Ranger, Web Data Publisher and Application Server. **01628 478333**

◗ **Powersoft** Optima++ is a RAD tool for building client/server and Internet application. **Optima++** is based on an OLE component-centric architecture. **01628 597100**

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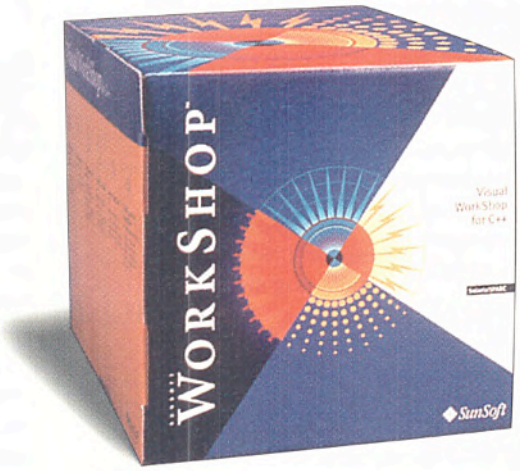

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✎ CIRCLE NO. 520

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Letters

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Software consciousness

Dear Sir,

It is amazing how ready Jules (along with many other people) is to accept the notion that a sufficiently complex computer (with a suitable program) will one day be able to become conscious and even to feel emotions such as pain. *(See Mayhem, February '96.)*

The origin of this idea seems to be that any physical process, such as the operation of the human brain, could in principle be simulated on a computer. Obviously any such simulation would be utterly impractical unless many layers of detail (such as the exact states of each individual atom) could be averaged and omitted, however the thought experiment alone seems at first sight convincing.

Consider, however, some of the paradoxes that such ideas throw up. Suppose, for example, you were to try to debug the program running on a conscious computer. As you stepped through the pain sensing function would there be any one line which would actually cause such a machine to suffer? If you took such a conscious program and ran it on other hardware, would it re-experience the same conscious phenomena?

Despite the fact that many computer professionals seem to accept ideas broadly similar to Jules', nobody that I have met actually worries that their computer or their program might be conscious and might not like being closed down! How would we ever know, since as Jules points out, it would be easy (but unconvincing) to program the computer to print 'Ouch' at an appropriate point.

It is fascinating that the eminent physicist and mathematician, Roger Penrose, believes that the solution to this paradox may be that certain physical processes (including those involved in the phenomenon of consciousness) are inherently non-computational (and therefore impossible to simulate on a computer). In particular, he believes that quantum mechanics is not yet a complete theory, and that the full theory will introduce a non-computable aspect to physical reality. He has elaborated these ideas in two books for (fairly intelligent) laymen – 'The Emperor's New Mind', and the more recent 'Shadows of the Mind'.

David Bailey
Software Development Manager,
Salford Software
Email address supplied

It is equally amazing to me how readily Mr Bailey, and others of his religious persuasion, reject the idea that machines will become conscious. It seems to me that there are only two possible states of reality; that the natural brain is a machine with well-controlled states leading one to another (with or without some degree of uncertainty), or it is not, and processes take place in the brain with no apparent cause at all, and it is these 'uncaused' and 'uncausable' processes – amplified through the undoubted deterministic reactions – which lie at the heart of consciousness.

There is considerable evidence for the first point of view, and not very much for the second. But, let's proceed for the moment assuming the second is true. My Bailey, Mr Penrose, and others claim that these uncaused states lie in quantum physics. Since researchers started mapping the mind and the brain, they've all said that the brain *is* something; a filing cabinet, a photographic plate, a computer, and so on – whatever, in fact, is trendy yet generally incomprehensible. They've all been wrong; brains are brains, and that's all there is to it. So, to claim that a brain is nothing more than a quantum amplifier is as wrong as all the other claims have been, not least because modern computer chips are, in the very same terms, also quantum amplifiers.

If it is a program, consciousness presently runs on only a single platform; wet and squidgy brains. Machine consciousness depends only on modelling brain chemistry (and quantum effects) if one believes that the program can run *only* on that platform. That's indefensible. Mr Bailey's paradoxes are simply wrong. We can apply the same 'paradoxes' to rule-based systems, to neural nets, and even to most of the common configurations in electronics. It is a facet of programming in C that each statement does one and only one thing; even so close a relation as an asynchronous parallel network confounds such ideas as single-stepping through a program, so more exotic hardware and models certainly do. Mr Bailey, what evidence do you have that you and I experience conscious phenomena in the same way; the way you're reasoning, I'm sure we don't!

Daniel Dennett, who knows an awful lot more about consciousness than Penrose (because he's taken the time to perform well-designed experiments) claims that consciousness is explicable in terms of machinery. Penrose and Dennett disagree, and I watch their arguments with considerable interest. I think Dennett is winning, because he's smarter, but both Dennett and Penrose are smarter than me, and I suspect they're smarter than Mr Bailey too. But, in the final analysis, none of the four of us really knows anything for sure, so it's hardly appropriate for Mr Bailey to pour scorn over any one idea. He should keep his quantum amplifier open. – *Jules May*

Free plug

Dear Sir,

I enjoy the letters page of any magazine, and *EXE* is no exception. However, my interest wanes when I discover halfway through a

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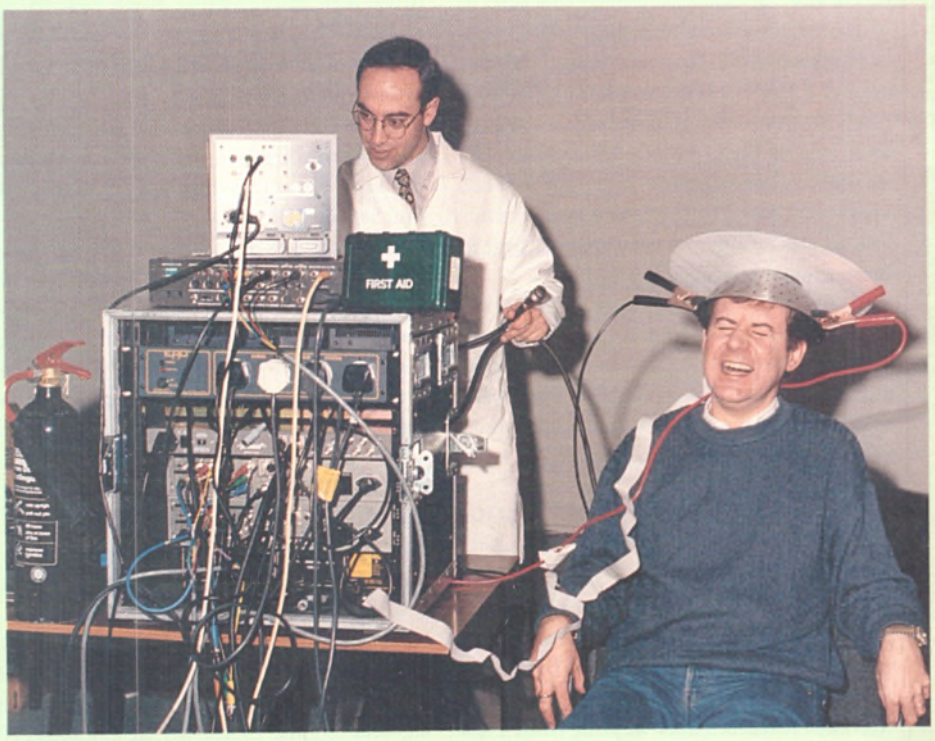

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IF YOU WANT TO LEARN C++, BUT WISH TO ADOPT A SLIGHTLY MORE TRADITIONAL APPROACH, TURN TO PAGE 44

letter that what I am reading is not the honest opinions of Mr. J. Public Esq., but actually nothing more than advertising copy. I find it odd to say the least that a magazine such as yours, which presumably gleans the major part of its revenue from advertising charges, should blithely allow people to plug their products free of charge simply by submitting their copy in the guise of a 'letter to the editor'. This is quite apart from the fact that any views expressed in the letter immediately lose all credibility once the nature of the axe being ground has been revealed.

Could it be that you receive so few letters that you have no choice but to publish these blatant misuses of the system. If so, please say so. I for one have plenty of opinions I could let you have. I also run a business, but I would not be so crass as to mention it's name or nature in a letter.

Dave Midgley
Macclesfield

I must admit that we often do not receive that many letters. Usually we can just fill the letter page. I am not often in a position were I can just chose the best letters. After saying that, I do have feelings similar to yours but it is not my intention to censor any letter. I think that it is doing more damage to the author (and his/her company) than to *EXE*! Letters are only very lightly edited mainly to fit the layout and correct (most) grammar and spelling mistakes.

I welcome any letters, please if you have anything to say do send us letters. Alternatively you might also be interested to write opinion articles for the SoapFlakes section of the magazine (about 600 words).

In a way it's funny you should send this letter now, as this is probably one of the months we received the most letters and had to decide which ones got published and which ones did not! – *Ed*

Search engine for *EXplodE*

Dear Sir,

I have just logged onto to your online *EXplodE* pages and they certainly offer a new dimension in data access.

However, the main reason for my access was to determine previous articles in *EXE* regarding HTML. Having subscribed to *EXE* for at least six years, the floor was rapidly getting filled with past issues as I located various articles. But then I thought why not use an on-line search engine and hence *EXplodE*; but alas the articles do not appear to be electronically indexed. May I suggest a future enhancement?

Robert Allan
Email address supplied

For your information, *EXplodE* is a spin-off of *EXE* managed quite independently by Cliff Saran (cliffs@exe.co.uk). I do not have any more input than you in its design. The only current use of the Web site by *EXE* is to make some code available by ftp.

I have already made the same suggestion some time ago. I think it is a planned enhancement but I couldn't tell you more.

In six years of reading *EXE* you must have had some strong feelings on the magazine. Do not hesitate to send me some comments on *EXE* itself. I always welcome input from readers (even negative ones, as long as they're constructive). – *Ed*.

Anonymous SoapFlakes

Dear Sir,

As a subscriber, I am confused as to the contents of the 'SoapFlakes' Comment Section of your magazine.

Are the contributors canvassed (and paid) for their views? If so, do we really need to have their company names emblazoned on the end of their comment? If, as I suspect, they are not paid for their views on methodologies/languages/tools etc (views which just happen to coincide with what their companies sell), then why should they have what is effectively free advertising?

In either of the above scenarios there is no need for the company name to appear. You should make it a condition of comments being entered in this section of your magazine that company names will not be printed. If people are concerned with the subjects they write in about, they should accept that and still contribute articles.

Jonathan Jones
London W4

Most of SoapFlakes' contributors are not paid. Persons who I meet as representative of their companies and who probably write their SoapFlakes on company time usually do not ask to be paid and are not. I feel it is only fair on the reader to point out any involvement which could bias the views expressed.

The column is open to everyone to contribute, I would gladly receive an article from yourself if you wish to. Employees of companies selling methodologies, languages, tools... have opinions on software development issues which will, of course, influence their companies but also the software industry at large – if they are successful, that is.

I try very hard to convince SoapFlakes' contributors that the best way for them to express their opinion in *EXE* is by writing technical non marketing articles. Not all are convinced, your letter is a clear message in that direction. – *Ed*.

OO & C++

Dear Sir,

Your magazine's content continues its inexorable drift towards being a specialist publication for those interested in object-orientation.

As yet, I have seen no realistic articles on object-oriented databases, something I am particularly interested in. You seem to put too much emphasis on C++ and other such languages which concentrate on classes.

I want a publication that solves the problems of objects over relational database tables.

I therefore will not be renewing my subscription after several years of taking your magazine.

Paul Lancaster
West Sussex

I am sorry that you waited 'several years' to send us a letter. I hope that the article 'The rewards of persistence' in the February issue answered some of your questions regarding OODBMSs. We do cover regularly object-orientation and C++ as both are very important concerns of the software industry but this is definitely not a new trend as witnessed by the more than two-year old subscription flyer pictured above. – *Ed*.

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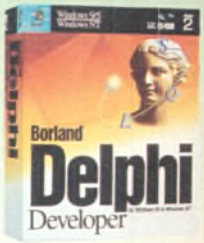

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CIRCLE NO. 522

Components: OLE & alternatives

From application-centric to document-centric, software is getting broken into components. **Karl Dallas** reviews the technologies available for putting together documents from various parts.

An amazing thing happened at Disney World in Florida in January. Lotus, bought by IBM last year for 3.5 billion dollars, took time out at the annual Lotusphere convention to announce a new components strategy that will allow users to embed rudimentary spreadsheets, charts, comments, drawn images, projects, data queries, or file viewers in documents.

Why amazing? Simply because Lotus is going with Microsoft's OLE2 technology rather than IBM's supposedly more powerful OpenDoc, which it has been developing in conjunction with Apple, Novell (who has gone rather quiet on the subject since selling its desktop applications business to Corel), and, most recently, Oracle.

It may be early days yet to start writing off OpenDoc as dead in the water, since Apple is still very much active, has just shipped OpenDoc for the Macintosh and has made available to download betas of its OpenDoc Web browser, unfortunately-named Cyber-Dog. But the Lotus announcement and its pro-Microsoft thrust does bring back to centre stage the whole question of components (or parts, as OpenDoc calls them), and how the rise of OLE2 affects the programming community, especially those working outside Microsoft's Windows bailiwick.

Kevin February

Rough but ready

OLE is a typical Microsoft solution: a bit rough but at least it's ready. And it has the merit of being so user friendly that many lay users don't realise that they're doing anything remarkable, when they cut a range from an Excel spreadsheet, say, and paste it into a Word document. Many don't even know that if they double-click on the embedded image, they can then proceed to edit it, nor that if they link it instead of embedding it, not only will the size of the destination document be held down, but the linked image will be updated each time it is opened.

The roughness comes in when you attempt to open such a document on a system that doesn't have the OLE server application, or one that doesn't support OLE at all, such as a Macintosh or Unix box. If the object has been embedded, then its image will display but it can't be edited. The same thing will happen if the document including the linked file is transferred to a system where the server data can't be found, even if both are running Windows and Word.

The familiar OLE function is basically an 'out-of-process' application: when a client requests an object, an OLE server application obliges. This has always run on the local machine hitherto, but thanks to the 'remote automation' feature of Visual Basic 4, it can now run on a remote machine. (See the box on

VB4 and OLE automation on page 22 for indications on how this works.)

An important new feature of OLE with Windows 95 and NT 3.51 is in-process OLE servers, or OLE DLLs. To an OLE client, these look like a regular out-of-process OLE server, but perform much better since they become part of the requesting application's memory space.)An 'out-of-process' application requires a second program in a separate memory space.)

Software AG is working with Microsoft to enable OLE on Unix platforms, but the lack of an object broker or an object repository, to manage the networked objects, is proving something of a stumbling block. NeXT Computers' NT-based D'OLE, in conjunction with its Portable Distributed Objects (PDO) server, may prove to be a more viable solution, especially since it is already shipping, and at a near-budget price of $499 a system.

Network OLE

Microsoft's own network OLE has been somewhat delayed in coming, though the promised March beta of Windows NT 4.0 will probably include some network OLE capability.

This will use RPC (remote procedure calls) to establish communications between application server objects and client front ends in the same way as interprocess communications between Windows applications on the same computer. Companies like Hyperdesk (now part of Ftp Software) have embodied proprietary forms of network OLE in their products (such as GroupWorks), and of course client-server database systems like Gupta's SQL Windows have had the capability to pass RPCs for some time, but they often require coding in C or C++ to fully exploit RPCs. NT 4.0 will embody the technology where it belongs, in the actual operating system.

Whether this will only run over Microsoft networks, or will also function over other networks such as NetWare, remains to be seen, but initially I would imagine the former.

Meanwhile, the Enterprise edition of Visual Basic 4 has made available a three-tier amendment to the previous two-tiered client-server model plus features like version control, remote automation, a component manager, remote data objects (RDO), and remote data control for RDO access to SQLserver and Oracle tables to make this a true groupware-development technology. The three-tier model separates what it calls business processes (actually OLE automation servers) from both the back-end data services and the front-end presentation to the user

More than one server can carry the sort of rules and processes that will mediate between the server tables and the presentation on the client workstation, so network traffic can be minimised by placing them where most appropriate.

Surprisingly, you can't create VB4 OLE custom controls, or OCXs, with the language. For that you need Microsoft's OLE Custom Control Developer's Kit provided with Visual C++ 4.0. Or better still Delphi 2.0, Borland's new rapid application development system: a faster, more object-oriented and in some ways easier-to-use Pascal equivalent of VB4 which includes a true compiler. A far neater solution than the p-code interpreter still required for Visual Basic (see the article 'Delphi 2.0' on p24). Delphi has its own VCLs (visual component libraries), which are in some ways faster rivals to VB4's OCXs. However, though VCLs deliver better performance than OLE, they can be shared only with other Delphi applications.

Just as Visual Basic's remote data automation objects can take advantage of remote procedure calls, Visual C++ can be used to build remote OLE objects for Visual Basic, making it a good choice for those building client-server applications (especially for developers who want to stay within an all-Microsoft environment).

Not an alternative but a powerful complement to VB4 for programmers building client-server applications is Select Software's Select OMT dedicated modelling toolset. Though it will run with VB3, it works best with VB4 (for instance it is not necessary to iterate through specific operators, using the `for each in` construct allows iteration of an object). It starts by presenting questions about the data to be queried and the answers sought, and ends up by generating the necessary VB code to implement remote automation using James Rumbaugh's object modelling technique.

Oberon & PowerBuilder

One product which allows creation of both OpenDoc parts and OLE components directly, without any intermediate code generation, is the compiler from Oberon Microsystems of Zürich. Oberon Microsystems is also responsible for the Corba-compliant Oberon modular language developed by

Glossary

COM

The ***Component Object Model*** is Microsoft's proprietary, object-based, language-neutral binary interface specification or set of rules for building interoperable software components. It is targeted at the MacOS as well as flavours of Windows. The best-known implementation of COM is in OLE, Microsoft's object linking and embedding technology. DEC's component toolkit, ObjectBroker, includes licensed COM technology, allowing it to act as a gateway between OLE and the Corba technologies. Distributed object support is promised in the object-oriented version of NT, codenamed Cairo. COM does not support the concept of inheritance.

Corba

The ***Common Object Request Broker Architecture*** is composed of five major components: the Object Request Broker (ORB), the Interface Definition Language (IDL), the dynamic invocation repository, and object adapters. In Corba, object interfaces are described in the IDL, a declarative language similar to C++. Orbix, from IONA Technologies, which claims to be the leading provider of Corba technology, runs currently on 20 operating systems from a single code base, including all flavours of Windows, OS/2, Macintosh System 7.5, twelve different Unix systems, OpenVMS AXP, VxWorks, QNX and LynxOS with seamless interworking guaranteed across all supported platforms. Orbix for Windows and Windows NT permits OLE-enabled applications to invoke remote and local Corba objects transparently. One of the most exciting Corba developments recently has been the implementation of the Orbix client in the Java language, opening up Corba to the Internet world. Microsoft has indicated that it is unlikely to support Corba, since the specification is incomplete and still evolving.

SOM

The ***System Object Model*** is a language-neutral and platform-independent software standard advocated by IBM. It uses the Object Management Group's Interface Description Language to define all objects, and supports a wide range of industry standards such as Corba, TCP/IP, DCE, NetBIOS, IPX and SNA. A runtime engine enables objects to bind dynamically while preserving the inheritance flow across object boundaries. Objects may be written in C or C++. Smalltalk and Cobol bindings are under development by vendors, while direct-to-SOM C++ products from Metaware and IBM are available to map the ANSI C++ language directly into SOM. Distributed object support is provided by the DSOM framework, a set of SOM classes shipped with the SOMobjects Toolkit.

Alternatives to OLE

D'OLE

D'OLE is NeXT Computer's Object Linking and Embedding-server software, a proprietary application-development environment, allowing developers to link Microsoft OLE applications created on a Windows NT platform with OLE applications on other NT systems across a network. A Windows 95 version is promised for summer '96.

D'OLE applications can also be linked through an intermediate Portable Distributed Objects (PDO) server to Unix-based programs created in NeXT's OpenStep object-oriented programming environment. Via the PDO server, these applications can make live calls to Corba-compliant objects across an enterprise network.

Local machine calls are translated by D'OLE into object requests in NeXT's format, which are then sent through the network to another D'OLE server or to a PDO server on a Unix machine.

At less than 500 dollars per system, this is a remarkably inexpensive solution to something which has so far been an almost unsolvable problem. Since it has just shipped, it has not been possible to evaluate it at press time, but it has an extremely attractive specification.

Intelligent PAD

IntelligentPad is an attempt to mirror the biological functions of natural selection in software development. Richard Dawkins' concept of 'memes' (the equivalent in society of the species' genepool) was taken as a model, with their capability to replicate and to recombine themselves, and to be naturally selected by their environment. The first IPad implementation was in Smalltalk 80, but development versions have been created using SmalltalkAgents, and in C++ using InterViews. Fujitsu and Hitachi Software Engineering are now developing mutually compatible products for PC, Macintosh, and Unix workstations.

A typical IPad could be represented on screen by a bookshelf and books which have all been constructed by pasting various primitives. An opened book could be defined as a composite pad with a scroll bar on the left and a diagram (eg a map) on the right page.

Any primitive can be cut and pasted into any other IPad and still be functional, even when transferred to a 'foreign' system. When a pad is pasted on another pad a linkage is constructed between the subpad ('child') and its 'parent' pad. The child can send either a `set ^connectslot` or `gimme ^connectslot` message to its parent, while the parent pad can send some of its children an `update` message without any parameter when its state changes, to propagate an update event. Other standard messages are `move`, `copy`, `delete`, `hide`, `show`, `open`, `close`, `resize`, and `paste`.

Every independent function has to be implemented as an independent pad so that its generic function may be applicable to any pads. Interoperability between IPads and OpenDoc parts has been announced.

OpenDoc

OpenDoc is a standard set up by IBM, Apple and (initially) Novell, as a vendor-neutral, open standard for compound documents composed of almost any type of data, such as tables, charts, text, 3D graphics, sound, or even video, each of which can be edited in-place. Several people can work on different parts of a document at the same time, and unlike OLE, several embedded objects can be open for editing simultaneously.

To develop the project, the three partners set up CI Labs (Component Integration Labs), which technically owns the standard.

Strictly speaking, because it wasn't designed to be extended through inheritance, OpenDoc isn't an object-oriented framework. But it does act as an object-oriented interface between part editors that can be written in different programming languages and by different organisations on different platforms.

Users can run scripts to co-ordinate the actions of various part editors, either within a document or across a network and even across platforms. This is particularly valuable in workflow applications. A lot of OpenDoc scripting draws upon Apple's work on OSA (Open Scripting Architecture), a series of libraries which includes Apple Events (a standard calling convention allowing applications to call one another over a network or on a single machine), an Events Manager to simplify the process of making and receiving Apple Events calls, and a library which allows different scripting languages to call one another and which can even be used to plug other scripting architectures into OSA. This is how the OLE 2.0 automation interface will be taken on board by OpenDoc.

The beta versions for Windows, and the shipped versions for Macintosh and OS/2, are very impressive in the way in which they activate parts as the mouse cursor passes over them, without any of the double-clicking, right mouse-button menus, or other familiar (and unfriendly) conventions associated with Windows. In this, it works more like X Window than either the Mac or Microsoft Windows GUIs.

Incidentally, CI Labs has been working with the Object Management Group to interoperate with the Corba standard and the X Consortium to build links between OpenDoc and the Fresco compound document standard being proposed for machines running X Window.

OpenDoc parts are contained within frames, and even if these overlap, the overlapping parts can be active simultaneously, which is very important for multimedia documents. The most important thing about OpenDoc, however, is that each part is fully functional, so if a Mac user receives a document with a video player part from a Unix user, it will still work on both platforms, and even allow editing.

Currently, most OpenDoc activity is for the Apple Macintosh, simply because of the availability of the Container Application Library (CALib), which allows traditional Mac applications to add OpenDoc support comparatively quickly.

CALib-based applications can't themselves be embedded, which is possible with 'pure' OpenDoc applications made up purely of 'OpenDoc editors' components.

Apple is currently working on an OpenDoc/OLE interoperability layer, to allow OpenDoc parts to be used wherever OLE is used right now. When this is ready, it will be possible to embed OLE servers into a Mac application without needing any special implementation of OLE support.

OpenDoc addresses problems of storage compatibility between different platforms by creating an open meta-format based on Bento, a compound-document storage format developed at Apple and designed to address the combination of sequential and parts-based data, with support for multimedia, and the ability to work on many platforms. To allow the insertion and deletion of data anywhere in the file without having to move the actual data around, the system maintains a table of contents (not unlike the file allocation table system under DOS).

Visual Basic 4 and OLE automation

Visual Basic's remote automation looks like local OLE automation to the client. OLE on a single machine manages calls between two processes transparently by the provision of a proxy/stub combination for each side of the object connection.

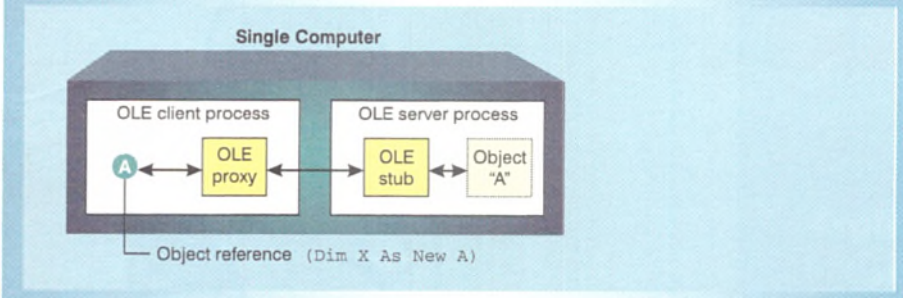

Figure 1 - Remote automation with OLE

Remote automation needs the intervention of an Automation Manager on a remote machine, which relays requests from the remote automation proxy on the local machine to the corresponding remote automation stub object on the server. Return values are marshalled by the Automation Manager, and returned to the OLE client through the remote automation proxy. Neither client nor server is aware of the remote nature of the connection.

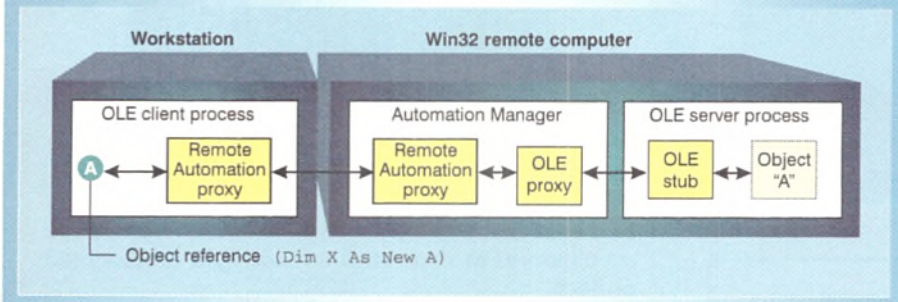

Figure 2 - The role of the Automation Manager

The Application Setup Wizard has an 'Install as OLE automation shared component' option and an 'Install remote OLE automation server components' check box. When these options are set, the wizard generates a SETUP.EXE on floppies to be run on the remote machine to install the OLE server and accompanying files. On that machine the OLE server needs to be registered in the Windows Registry.

VB4 includes a number of utilities for registering, cataloguing, and exporting remote automation components, including a client registration utility, remote automation connection manager, pool manager (which allows an object server to maintain a collection of commonly used objects and implement server load-balancing by specifying limits on the number of requests permissible for any object), and component manager.

Incidentally, VB4 uses the word 'component' not as a reusable part which can be embedded in a document – the sense in which Lotus and others are using it – but as any of the elements used in writing a VB application, including variables, modules, procedures, and control structures. Components to be embedded or linked are known as objects.

Prof. Niklaus Wirth at the Swiss Federal Institute of Technology (ETH) as replacement for Pascal and Modula-2.

Oberon/F, a document-centric integrated development system for Oberon (used by NASA, among others) is a run-time environment for Oberon components, providing an object-oriented framework, simplifying the development of components for interactive applications such as client software. Oberon/F uses platform-independent APIs for development, mainly for the Microsoft Windows and Apple Macintosh environments. Support for COM/OLE and SOM/OpenDoc is in the pipeline.

Currently, the best multi-platform equivalent to OLE is Powersoft's new PowerBuilder 5.0, which allows PowerBuilder objects to be deployed on Windows NT, Unix, or Macintosh, using the company's own object request broker to establish communications between applications and distributed objects. The program compiles to native binary code by first generating C code, then passing that code behind the scenes to the Watcom 32-bit C compiler to provide better performance at the expense of more complex tuning and debugging. Currently, PowerBuilder uses a proprietary form of object brokering, but compliance with the Common Object Request Broker Architecture (Corba) is promised in future.

It would be nice to be able to point to a work-around that made OLE work on non-Windows systems, and so on, but there isn't any such easy fix. There's a lot that can be done with OLE, but it's far from being the ideal solution. One day, hopefully, everyone will be fully Corba compliant, and IBM and Microsoft will have sorted out their differences and made COM and SOM equivalent to each other. When Nelson gets his eye back, as the old saying goes. Don't hold your breath, as the more contemporary slogan says.

OpenDoc, the exception?

While Microsoft seems to be ahead with over 400 OLE-compliant applications, OpenDoc claims a similar number of products in the pipeline, but if no one else joins Apple at the party, it could become another of those innovative ideas that only Mac users get the benefit of. Of course OpenDoc is the better technology, but that's no guarantee of success. Look at Betamax video tape standard, and for that matter OS/2, for examples of superior technology which were trounced by the technically inferior VHS tape and the (still) remarkably buggy Windows. For programmers, here and now, OLE is available today, and what may happen tomorrow is only a gleam in Lou Gerstner's eye. Tomorrow never comes, they say, but perhaps OpenDoc will prove the exception to that unhappy rule. ■

Karl Dallas has been writing about computers since he taught himself Basic on an 8 KB Commodore PET in 1979. He currently runs his own Web publishing and WWW design consultancy business (URL http://www.houstonmedia.com).

Thanks for their help in preparing this article to Eric Soldan, President, 6prime Corporation, who specialises in OpenDoc development, and to Douglas C. Schmidt of Washington University, St Louis, for his expertise in the use of multi-threaded Orbix and ACE in the implementation of concurrent Corba applications.

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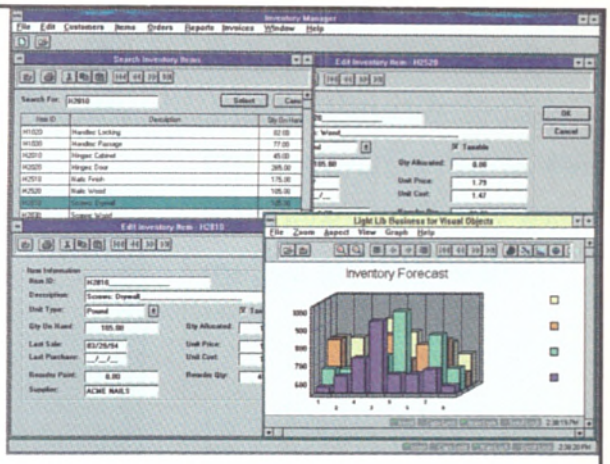

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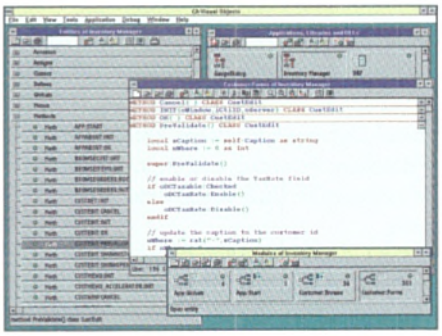

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Delphi 2.0

Borland's new Delphi 2.0 is the 32-bit version of its successful environment. **Dave Jewell** is having a first look at this spanking new development system

In the words of Jon Honeyball, friend and fellow journalist, 'Delphi 2.0 takes down Visual Basic's trousers and gives it the spanking it deserves'. Somewhat colourful perhaps, but none the less true. Ever since the launch of Delphi 1.0, Borland has bent over backwards to avoid openly pitting Delphi against Visual Basic, perhaps for fear of incurring Microsoft's wrath. For example, the latest press release for Delphi 2.0 states that it now executes code up to 50 times faster than 'p-code interpreters'. P-code interpreters? Are we talking about UCSD Pascal perhaps? Of course not – this is just a thinly veiled reference to Visual Basic. The fact is that Delphi 2.0 leaves Visual Basic 4.0 with a very sore bottom indeed.

Three of the best...

Delphi 2.0 is the new, 32-bit successor to Delphi 1.0. With an all-new 32-bit compiler, full support for the new Windows 95 common controls, multi-threading and OCX, it all adds up to a very powerful development system. You can host Delphi 2.0 under both Windows 95 and NT, and create executables which run on both platforms. Like Delphi 1.0, the new system can also be used to create 'straight' 32-bit Pascal programs and 32-bit DLLs such as the .CPL 'applets' used by the Control Panel.

Delphi 2.0 comes in three flavours; firstly, there's 'Delphi Desktop' which, according to the Borland literature, is aimed at the beginning Windows 95 and NT developer. Don't let this fool you – it's a very capable system in its own right. The real emphasis is on the single developer working in isolation. Like the other two variants, it's bundled with a copy of Delphi 1.0 to aid in writing code that's portable between 16- and 32-bit platforms, and includes a copy of the highly coveted Object Pascal Reference Manual which was missing from the original product release. *(The bundled version 1.0 is just that, none of the new features present in Delphi 2.0 are there if you want to generate a 16-bit software. Applications produced by Delphi 2.0 will generally not run on Win32s, for instance the new version of the Database Engine is multi-thread – Ed.)* You also get over 85 standard VCL components, the Windows 95 common controls, a new, hierarchical Database Explorer program for easy database browsing and maintenance and full support for OLE automation and OCX controls.

What you don't get is the VCL source code, a 32-bit version of Winsight (Borland's message monitoring utility), ODBC support or a 32-bit version of ReportSmith. For these, you need to climb the next rung of the ladder – Delphi Developer. This is aimed more at team-based development and also includes an expanded Open Tools API (for plugging third-party utilities into the IDE), a team development interface (which requires InterSolv PVCS for version control management), a special Windows 95 compatible, 'lite' version of InstallShield called InstallShield Express and the single user local Interbase Server. It also comes with the equally coveted reference manual for VCL – yum!

Moving up to the Client/Server Suite 2.0, you'll also receive 32-bit SQL Links, Intersolv PVCS, an SQL version of ReportSmith and other client/server related goodies. Since the Desktop version is aimed at the single developer, I think it would have been more sensible to include Winsight and the VCL source code into the entry-level package.

Form discipline

One of the most intriguing new capabilities of Delphi 2.0 is the long-awaited form inheritance capability. You can now inherit from an existing form all the properties and methods of the form, along with the properties and methods of its constituent controls. You're at liberty to change component properties or add code to the various methods but you can't completely remove a control which is inherited from an ancestor form. If you generate a new event handler for an inherited form (for example, an `OnCreate` handler), Delphi will automatically add the `inherited` keyword to the start of the new handler to represent a call to the ancestor method. Eg:

```
procedure TForm2.FormCreate(Sender: Tob-
ject);
begin
  inherited;
  ...
end;
```

The form inheritance capability works even at design time so that you can create a form with various components and then, within the same project, create a new form which inherits from the first. If you resize the ancestor form, move controls around or add and delete components, the descendant will faithfully mirror every change that is made – it's quite fun to watch.

If at any time you change a descendant property (either of the form itself or in a component), then you effectively 'unhook' that property from the inheritance mechanism. An unhooked property no longer tracks changes in the ancestor form. You can 'rehook' a property by using a right-click menu option ('revert to inherited') on the Object Inspector window, or you can bring up the same menu option on the form window itself. In the first case, only the specified property is reverted. In the second case, the entire

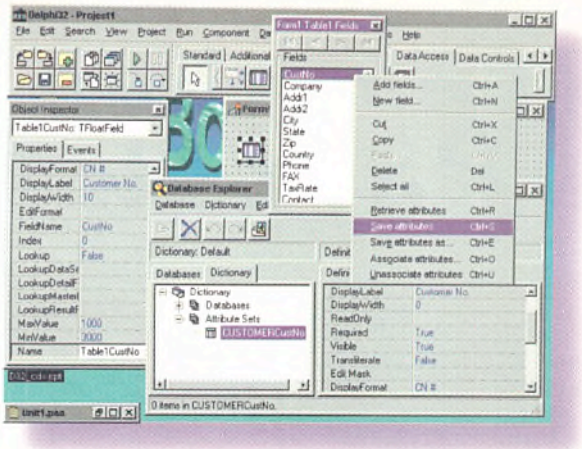

Figure 1 – The Database Explorer can be used to browse and maintain Attribute Sets. Here, you can see some of the attributes for the CUSTOMERCustNo field.

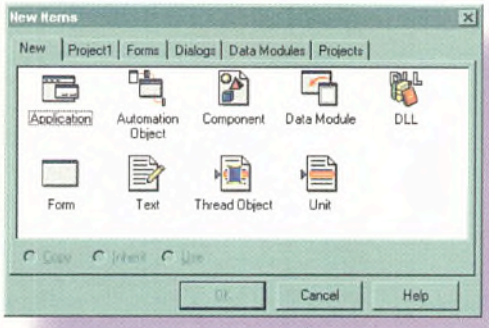

Figure 2 – The new Object Repository acts as a 'grab bag' in which you can store data modules, components, often-used forms and so on.

Under the hood – C versus Pascal

Borland states that Delphi 2.0 now shares its back-end code generator with the company's C/C++ compiler. I thought it would be interesting to do a direct comparison of the code generated by the two different compilers. For the purposes of this comparison, I used Borland C++ 4.53 (the most recent currently available) and a late beta version of Delphi 2.0. I set up the compiler switches (where possible) to generate the smallest possible code.

In the past, the 16-bit Borland Pascal compiler never generated spectacularly good code. It was particularly poor at accessing fields of a data structure through a 'far' pointer, often reloading both the segment and address registers prior to each access. Naturally, all this segment register nonsense disappears in the wonderful world of 32-bit software, but I nevertheless thought it would be interesting to see how the two stacked up when initialising the fields of a structure through a pointer.

The results of this investigation are shown in Listings 1 and 2 on the next page. It would have been possible to simplify the Pascal code significantly – the module instance handle is an implicit global variable in Pascal/Delphi programs, eliminating the need to pass it as a parameter. Also, the Pascal `WITH` statement could have been used to simplify the references to each field of the data structure. However, this is only a semantic convenience and doesn't significantly affect code generation so I left the two routines as alike as possible.

You'll see that, if anything, the Pascal version of the routine is slightly more efficient than the C equivalent. This is primarily because Borland moved over to a register-passing strategy when the compiler was re-written. The compiler detects that there are no local variables in the routine and – since register passing is being used – it doesn't bother to establish a stack frame in the EBP register. This, in turn, means that there's no need to save and restore EBP on entry and exit to the routine.

One interesting anomaly is the initialisation of the `lpszMenuName` and `lpszClassName` fields towards the end of the routine. The C++ compiler copies the required offsets directly into the 32-bit pointer locations whereas the Delphi compiler uses two instructions to achieve the same effect, over-writing EAX in the process. This discrepancy might be explained by the fact that the Delphi compiler automatically stores string constants into the code segment avoiding string duplication. As you can see, the Delphi compiler *is* capable of generating using the 'all-in-one-go' instruction form – it was used earlier when setting up the `lpfnWndProc` field.

I also performed a number of other tests and came to the conclusion that there is no significant difference in code quality between the current C++ compiler and Delphi 2.0. The only thing that *really* sets the Delphi compiler apart is its ability to deliver the same high-quality code in a mere fraction of the time required by the C++ system.

property reverts to its inherited state. It's a very flexible mechanism which makes it very easy to encapsulate a form's functionality into a 'canned' component.

If you're a seasoned Delphi 1.0 developer, you won't notice a vast number of changes to the IDE. There's a new, 'Win95' page on the Component Palette which provides access to Windows 95 progress bars, tree views, image lists, rich edit controls and all the other new goodies provided by Windows 95. It's possible to set up 'rich text' in the rich edit control using the IDE alone, although in the late beta which I'm using for this review, it can be a rather cumbersome process. A much better idea is to simply import an existing RTF file into the Lines property of the component. Just to show you the various Windows 95 controls working, Delphi 2.0 includes an impressive new demo program called Resource Explorer. Full source code of this demo program is included, including all the meat and potatoes information on how to browse and manipulate resources inside a 32-bit PE executable file. Incidentally, this demo program also includes source code showing how to create a 'splitter' window, something that Borland inexplicably left out of its component roundup. It would be very little work to turn this code into a proper splitter component.

The Component Palette also sports a new 'OCX' page containing a number of sample OCXs, including charting components. Charts seem to be establishing the same relationship to OCX technology that stacks, queues and linked list classes have with C++!

Another interesting new feature is the Object Repository. This is a similar concept to the existing Gallery, but more general purpose. You can store often-used forms into the Object Repository along with DLLs, data dictionaries, thread objects and more. You can add new pages to the Object Repository and rearrange things as you like.

Thread objects? This is the mechanism by which Delphi 2.0 implements multi-threading. To build a multi-threaded object, just select the New Thread Object from the Object Repository (see Figure 2). A new keyword, `ThreadVar`, has been implemented so that you can build thread-local storage into your applications. The new debugger, shipped with Delphi 2.0, fully supports threads. If you're interested in how to build a multi-threaded application using Delphi, take a look at the visual sorting demo which comes as part of the package. This provides a visual display of three different sorting algorithms all in action at the same time, each using a different thread. If you're not sure why QuickSort is so named, then the demo will dispel any doubts you may have about the superiority of this algorithm!

Database issues

With Delphi 2.0, Borland has added a new meta-layer (its terminology) to the database architecture. Effectively, the new Data Modules encapsulate the business rules and data access restrictions that you want to apply to a particular dataset (see Figure 3). By logically separating business logic rules from the graphical user interface on the one hand, and from the underlying database design on the other, it becomes much easier to enforce company policies across distributed applications.

This goes hand in hand with the new Data Dictionary concept. The Data Dictionary provides permanent storage of attributes for each displayed field. This might contain information such as the minimum and maxi-

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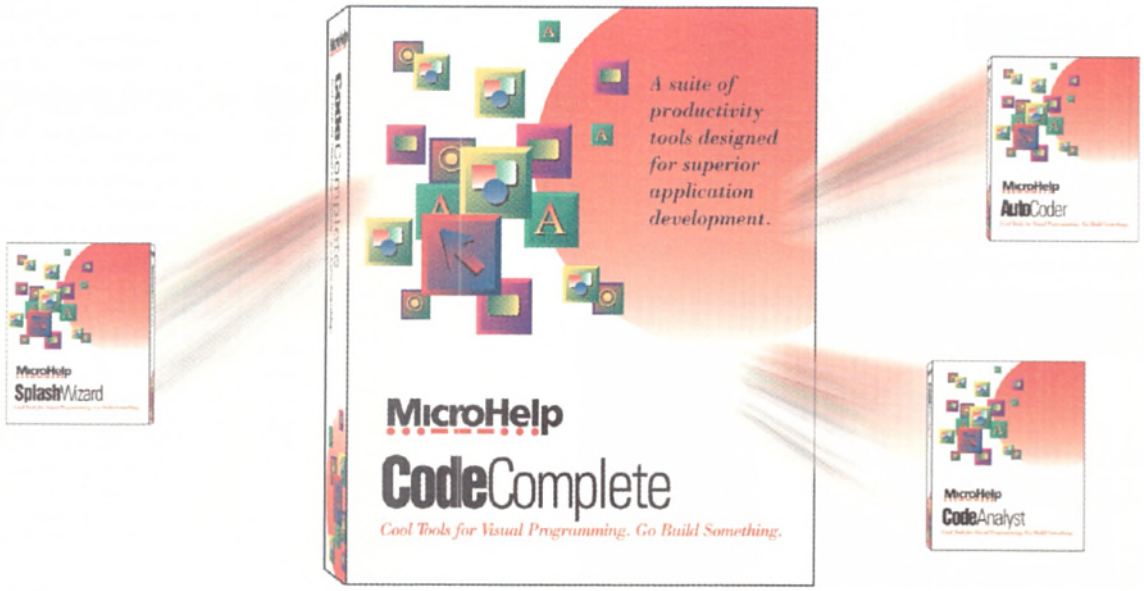

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```
BOOL PASCAL RegisterFarClass (HINSTANCE hInstance, LPWNDCLASS cls)
{
   cls->style = CS_HREDRAW | CS_VREDRAW;
   cls->lpfnWndProc = DefWindowProc;
   cls->cbClsExtra = 0;
   cls->cbWndExtra = 0;
   cls->hInstance = hInstance;
   cls->hIcon = LoadIcon (hInstance, MAKEINTRESOURCE (100));
   cls->hCursor = LoadCursor (0, IDC_ARROW);
   cls->hbrBackground = GetStockObject (GRAY_BRUSH);
   cls->lpszMenuName = "SuperWombat";
   cls->lpszClassName = "SuperWombat";
   return RegisterClass (cls);
}

0000  55                    push  ebp
0001  8b ec                 mov   ebp,esp
0003  53                    push  ebx
0004  56                    push  esi
0005  8b 5d 0c              mov   ebx,+0cH[ebp]
0008  8b 75 08              mov   esi,+8H[ebp]
000b  c7 03 03 00 00 00     mov   dword ptr [ebx],00000003H
0011  c7 43 04 00 00 00 00  mov   dword ptr +4H[ebx],offset DefWindowProcA
0018  33 c0                 xor   eax,eax
001a  89 43 08              mov   +8H[ebx],eax
001d  33 c0                 xor   eax,eax
001f  89 43 0c              mov   +0cH[ebx],eax
0022  89 73 10              mov   +10H[ebx],esi
0025  6a 64                 push  00000064H
0027  56                    push  esi
0028  e8 00 00 00 00        call  LoadIconA
002d  89 43 14              mov   +14H[ebx],eax
0030  68 00 7f 00 00        push  00007f00H
0035  6a 00                 push  00000000H
0037  e8 00 00 00 00        call  LoadCursorA
003c  89 43 18              mov   +18H[ebx],eax
003f  6a 02                 push  00000002H
0041  e8 00 00 00 00        call  GetStockObject
0046  89 43 1c              mov   +1cH[ebx],eax
0049  c7 43 20 00 00 00 00  mov   dword ptr +20H[ebx],offset L1
0050  c7 43 24 0c 00 00 00  mov   dword ptr +24H[ebx],offset L2
0057  53                    push  ebx
0058  e8 00 00 00 00        call  RegisterClassA
005d  0f b7 c0              movzx eax,ax
0060  5e                    pop   esi
0061  5b                    pop   ebx
0062  5d                    pop   ebp
0063  c2 08 00              ret   0008H
```

Listing 1 – Code generated by Borland C++ 4.53

```
function RegisterFarClass (hInstance: HInst; var cls: TWndClass): Bool;
begin
    cls.style := cs_HRedraw or cs_VRedraw;
    cls.lpfnWndProc := @DefWindowProc;
    cls.cbClsExtra := 0;
    cls.cbWndExtra := 0;
    cls.hInstance := hInstance;
    cls.hIcon := LoadIcon (hInstance, PChar (100));
    cls.hCursor := LoadCursor (0, IDC_Arrow);
    cls.hbrBackground := GetStockObject (Gray_Brush);
    cls.lpszMenuName := 'SuperWombat';
    cls.lpszClassName := 'SuperWombat';
    RegisterFarClass := Bool (RegisterClass (cls));
end;

0000  53                    push  ebx
0001  56                    push  esi
0002  8b da                 mov   ebx,edx
0004  8b f0                 mov   esi,eax
0006  c7 03 03 00 00 00     mov   dword ptr [ebx],00000003H
000c  c7 43 04 00 00 00 00  mov   dword ptr +4H[ebx],offset DefWindowProc
0013  33 c0                 xor   eax,eax
0015  89 43 08              mov   +8H[ebx],eax
0018  33 c0                 xor   eax,eax
001a  89 43 0c              mov   +0cH[ebx],eax
001d  89 73 10              mov   +10H[ebx],esi
0020  6a 64                 push  00000064H
0022  56                    push  esi
0023  e8 00 00 00 00        call  LoadIcon
0028  89 43 14              mov   +14H[ebx],eax
002b  68 00 7f 00 00        push  00007f00H
0030  6a 00                 push  00000000H
0032  e8 00 00 00 00        call  LoadCursor
0037  89 43 18              mov   +18H[ebx],eax
003a  6a 02                 push  00000002H
003c  e8 00 00 00 00        call  GetStockObject
0041  89 43 1c              mov   +1cH[ebx],eax
0044  b8 60 00 00 00        mov   eax,offset L2
0049  89 43 20              mov   +20H[ebx],eax
004c  b8 60 00 00 00        mov   eax,offset L2
0051  89 43 24              mov   +24H[ebx],eax
0054  53                    push  ebx
0055  e8 00 00 00 00        call  RegisterClass
005a  0f b7 c0              movzx eax,ax
005d  5e                    pop   esi
005e  5b                    pop   ebx
005f  c3                    ret
```

Listing 2 – Code generated by a late beta version of Delphi 2.0

mum values of a field, preferences for how that field is displayed and so forth. By storing field attributes in this way, you get a more consistent application development environment. Borland also states that network traffic at run-time is reduced because data validation can be optionally performed at the client rather than on the server.

Other goodies for database devotees include an SQL Monitor for tracing calls between the client and the database server. You can use the monitor for debugging SQL statements or for performance tuning by optimising the SQL transactions that are taking place. Various trace options allow you to specify what categories of information are reported. The report log can be saved and printed for subsequent analysis.

There's a graphical SQL Explorer for database browsing and maintenance, and setting up business rules and stored procedures (see Figure 1). It's also used to maintain the Scaleable Database Dictionary.

All versions of Delphi include QuickReport, a light-weight set of Delphi components for organising data into reports. Report Smith is intended for managing large quantities of data, but QuickReport is more appropriate if you want to deal with smaller volumes of information and less sophisticated reporting requirements.

A very useful addition to the repertoire of database controls is the Multi-Object grid. You can place other database controls (more than one of them) into a single cell of the grid and have the cell layout replicated automatically across other cells. If you only want to display a small number of fields from a particular record, this is a great way of showing multiple fields at the same time. It would be nice if Borland had walked the second mile and added that much coveted component – a scrolling listbox of checkboxes. Almost all software installers seem to use a scrolling checkbox list these days, and it would be great if you could just pull one of the Component Palette. Maybe in Delphi 3.0?

Other changes

A little-known Delphi 1.0 feature was the ability to load up a form file as text, making it possible to easily perform global search and replace operations across many different properties at the same time. A new popup menu option can now be used to instantly toggle between graphical and text views of a form. This is especially useful when working with inherited forms, because in text mode you can immediately see which properties are being overridden in the descendant form.

A recurring complaint among seasoned Delphi developers was the 'fall at the first fence' behaviour of the compiler. In other words, the compiler used to stop as soon as it encountered the first error. This has now been changed so that a small scrolling window of warning and errors is displayed at the bottom of the edit window. Double-clicking on a particular error message will take you to the relevant point in the source code. Borland has also put some effort into improving the compiler's error messages which were sometimes rather obscure! One nice little touch is the inclusion of C++ single-line comments

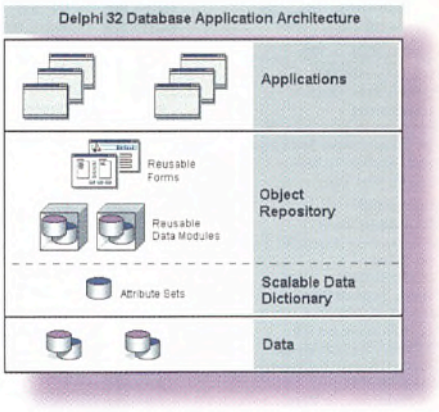

Figure 3 – The Object Repository stores reusable forms and Data Modules. These, in turn, can access Attribute Sets.

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```
var
  MSWord: Variant;

begin
  ....
  { Connect to Word.Basic automation server }
  MSWord := CreateOleObject ('Word.Basic');
  { Use OLE automation to insert Str into the Word document }
  MSWord.Insert (Str);
  MSWord.LineUp (L, 1);
  MSWord.TextToTable (ConvertFrom := 2, NumColumns := 3);
```

Listing 3 – A new Variant type as an aid in OLE work.

```
type
  { TMemoApp defines the automation server object }
  { and its services }
  TMemoApp = class(TAutoObject)
  private
    function GetMemo(Index: Integer): Variant;
    function GetMemoCount: Integer;
  automated
    { OLE-enable the following properties and functions }
    procedure CascadeWindows;
    function NewMemo: Variant;
    function OpenMemo(const FileName: string): Variant;
    procedure TileWindows;
    property MemoCount: Integer read GetMemoCount;
    property Memos[Index: Integer]: Variant read GetMemo;
  end;
```

Listing 4 – Delphi makes it dead easy to create automation servers.

Delphi – the future

Despite the productivity benefits to be gained by moving to Delphi, some people still express reservations. What about the future of Borland? What happens when non-Intel platforms become increasingly popular? Well, I'm no financial expert but Borland is now showing a consistent profit and their financial position is looking a great deal rosier than it was 12 months ago. The portability issue was a significant problem for the 16-bit version of Delphi. The compiler was written largely in assembler code – a tradition that goes right back to the earliest versions of Turbo Pascal for the PC.

With the advent of Delphi 2.0, Borland decided to bite the bullet and they rewrote much of the compiler in a high level language (no, I don't know whether they used C/C++ or Pascal!). I'm told that the bulk of the compiler could now be ported to (say) a RISC architecture very easily and the back-end code generator is written in portable C and shared with the C/C++ development systems.

The front-end development environment is still pure Delphi of course. At this point in time, Borland doesn't want to make a commitment towards any particular hardware platform, but they state that if some non-Intel processor does gain significant market share, then they'll be ready. Having said all that, the recent arrival of 200 MHz Pentium Pro machines suggests that 'Intel Iron' will be dominant for some time to come.

What's perhaps surprising is the fact that after rewriting, the compiler has not lost any of its legendary speed. In fact, Borland states that it's now between 2 and 3 times faster than its 16-bit predecessor. I suspect that this is partly the result of using 32-bit code inside the compiler itself. As I mentioned earlier, execution speed is reckoned to be up to 50 times that of Visual Basic and as an added bonus, the 32-bit compiler will now generate industry standard .OBJ files. This opens up the prospect of creating a mixed language application provided, of course, that the interface between the two remains strictly procedural.

preceded by a double forward slash character.

The compiler has also been changed in a number of other, more significant ways in order to provide support for Unicode applications. In previous versions, the expression `sizeof (Char)` was always guaranteed to return a value of 1. This is now no longer the case. Delphi 2.0 introduces a couple of new character types – `AnsiChar` and `WideChar`. An `AnsiChar` corresponds to an existing single-byte ASCII character while a `WideChar` corresponds to a two-byte Unicode character. When the compiler encounters the `Char` type, it will map this to either `AnsiChar` or to `WideChar` depending on whether or not you're compiling a Unicode application. By default, and for backward compatibility, `Char` is equivalent to `AnsiChar` but Borland has warned that this may change as Win32 becomes dominant. You have been warned – don't make any assumptions in your own programs. You can use the `AnsiChar` of `WideChar` types yourself if you want to 'force' a particular character representation.

As you might expect, Delphi 2.0 also offers a new string type made up of `WideChar` characters. It's called a `WideString`. You'd typically use `WideStrings` if you were writing a Unicode application. Perhaps more interesting than Unicode, though, is the new implementation of long strings. Traditionally, Pascal strings are made up of a length byte followed by that number of bytes. Although this is an efficient implementation (operations on null-terminated 'C' strings invariably require a forward scan to search for the end of the string) it has the significant disadvantage that strings can't be more than 255 bytes long.

In order to address this shortcoming, Borland introduced the idea of a long string which can be of virtually unlimited length. A long string is allocated on the heap and (since we're talking 32-bit programming here) no special magic is required when the size of the string exceeds 64 KB in size. By default, when you use a variable of type `string`, you'll get a new, dynamically allocated string. However, you can use a compiler option `{$H-}` to give you old-style strings where necessary. All the VCL components in Delphi 2.0 use long strings, but not of the Unicode compatible type.

OLE support

As mentioned, Delphi 2.0 provides full support for OLE 2.0. As an aid in OLE work, Delphi 2.0 introduces a new type, `Variant`, which provides tight integration with the OLE interface through being able to change its type at run-time. Effectively, you can use the same variable to connect to many different types of automation server. See Listing 3 (extracted from Borland's sample code).

This also introduces another new language feature – the ability to specify one or more named parameters when making a call to an OLE automation server. You can see this capability being used in the `TextToTable` call. Parameters which aren't named simply retain their default values (as defined by the server). This functionality is similar to the default parameter mechanism built into the C++ language.

This elegant (and above all, simple!) approach to OLE doesn't just apply to talking to OLE servers. It also applies to writing them. Delphi makes it dead easy to create both in-process and out-of-process automation servers. To create a new automation server, you use the *Automation Object Expert*. This sets up a new object which inherits from `TAutObject` and takes care of the nitty-gritty OLE registration issues. To expose properties and methods, you simply use the new `automated` keyword. This is illustrated with the snippet in Listing 4.

All automation servers created with Delphi 2.0 are guaranteed to be Network OLE compatible.

The 'bottom' line

With Delphi 2.0, Borland appears to have consolidated its position as purveyor of the most versatile, high-performance RAD development system currently available. Whether you require complex client/server capability, or whether you're merely knocking up a shareware utility in the back bedroom, the incredible breadth and richness of the environment has something for everyone. It's intriguing to use the development tool to create sophisticated database front-ends, and then in the next breath use it to build a tight, no-nonsense 32-bit non-OOP DLL which thunks down to a custom 16-bit DLL. ■

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Delphi 2.0 costs £249 for the Desktop edition, £399 for the Developer one and £1279 for the Client / Server version. (For a time limited period upgrades are available at respectively £95, £159 and £649.)

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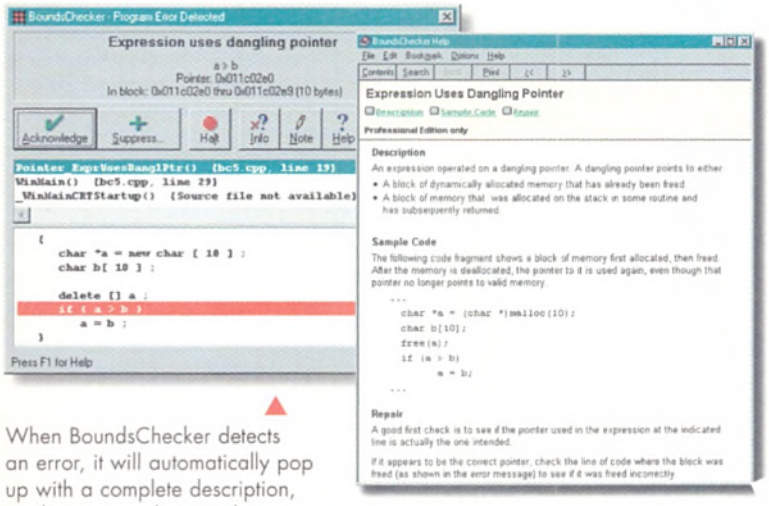

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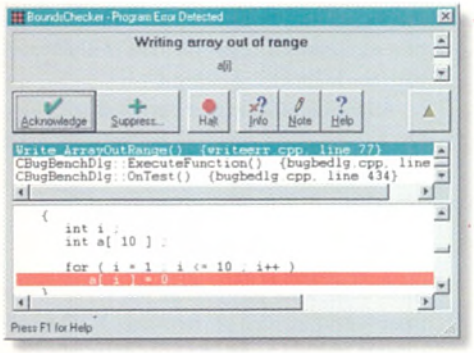
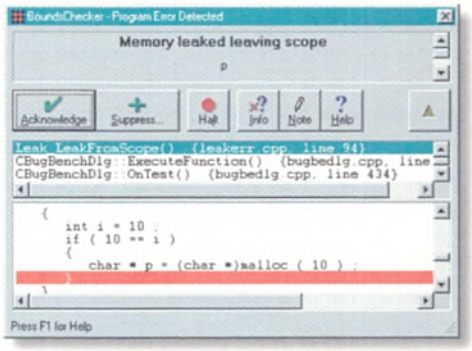


Here the array has a range of 0 to 9 rather than 1 to 10. As a result, some piece of memory would have been overwritten leading to unpredictable behavior.



Here memory was not freed before leaving the function, resulting in a memory leak. BoundsChecker detects this error instantly, because as soon as the function ends, it knows the leak has occurred. As a result, the problem is identified as it happens!

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Monitoring usage

One nice thing about modems and ISDN terminal adapters is the row of flashing lights on the front panel. **Peter Collinson** couldn't see his ISDN box so he developed a Tcl/Tk application for his Unix machine.

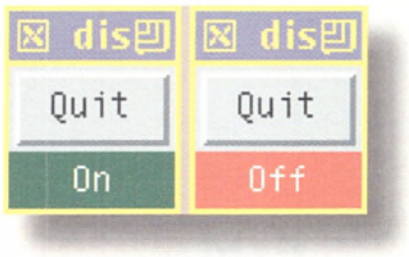

Figure 1 - The initial application showing the two possible states...

I first wrote about programming with Tcl/Tk a bit over two years ago (*EXE* November '93). I found that it was time for another blast, if only because I've been doing some Tcl/Tk programming recently. It's always better to write about things that are fresh in the mind. The examples below demonstrate some aspects of Tcl/Tk that I didn't cover in the last article. I will also go through the development process of an application, and will be bringing in some Unix aspects too.

The application that I have been programming recently is one to monitor the use of my ISDN link. I fancied the notion of a box on my screen that would tell me whether the link is up or down. There is a little green light on the ISDN terminal adapter, but the light is not situated in a very convenient place, so I felt that something on the screen would be more useful.

The first problem was determining the state of the link. Well, my ISDN line is driven by a Telebit Netblazer and it writes records to the Unix `syslog` system. I've told the daemon, `syslogd`, to write these records to a file, and the data on the state of the link is therefore available to me. (See 'Logging faults' in *EXE* December '95).

As one does, I started by creating the object to be displayed. It's usual with a window manager to provide some way of getting out of an application; I generally supply a button marked *Quit*.

Then for monitoring the state of the line, I decided that I should have an area under the *Quit* button. It would be red with lettering saying 'Off' or green with lettering saying 'On' depending on whether the ISDN line was connected or not.

The start of the Tcl/Tk script to establish the interface is:

```
#!/usr/local/bin/wish -f
button .quit -text Quit \
        -command {destroy .}
label .state -foreground white
pack .quit .state -expand yes -fill x
```

The first line tells the Unix `exec` system call that the file is a script to be interpreted using the `wish` program. This is Tcl/Tk's interpreter. The `-f` flag prohibits interactive startup of `wish`. Without the `-f`, you are presented with a prompt on the terminal and can type commands into the application.

The second line of the script creates a button saying *Quit*. When the button is pressed, the `destroy` command is applied to the top level window. This is the conventional way to kill an application in Tcl/Tk.

The third line creates a label object called `.state`, whose foreground colour is white. Notice that we don't specify anything else about the label, we're going to do that further down the script. The last line places the two objects on the screen, one under another, and permits them to expand horizontally to fill the space available in the window.

These few lines set up the basic image that I intend to use. But I have not yet set up the initial state of the label. Here's some procedures to do that:

```
proc chstate {text bg} {
  .state configure -text "$text" \
        -background $bg
}

proc on {} {
  chstate On darkgreen
}

proc off {} {
  chstate Off red
}
# call off initially
off
```

Once a named widget like `.state` has been established, you can change any aspect of it using its name as a command and giving the `configure` option. In the `chstate` procedure, I am changing the text and background colours depending on the procedure's parameters. The parameters to a procedure behave like any other Tcl variables, they are local to the procedure and are accessed by putting a dollar symbol before the name. For

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convenience, I have then defined `on` and `off` procedures that call `chstate` to do the right thing. Finally, I've called the `off` procedure just so things are in a known state at the start of the program.

Well, that's all is needed to generate the GUI. See Figure 1 to see how this looks like in both states. The window manager adds the somewhat unsightly top lines. If I used this application, I would probably instruct the window manager to suppress the top lines in the application.

The send command

We now have a GUI and we can go on to code parts of the program that read the data. We want to read lines from the end of the `syslog` output file, see if they indicate a state change and call the `on` and `off` procedures accordingly. Here we hit a snag.

There are file reading operations in Tcl/Tk but they are synchronous. We do not want, when reading at the end of the file, to sit waiting for new data to be appended by the `syslogd` daemon. If we use `read` in the script above, then the code will be blocked on the `read` command. We will not be able to react to button presses for the Quit button, or in fact, any other X Window event.

As is normal on Unix when another thread of control is needed, we create a process. But we need some way for our new process to communicate asynchronously with the GUI process. This is done using Tcl/Tk's very interesting `send` primitive.

The `send` command allows you to specify a command or a sequence of commands to be sent to another Tcl/Tk process and executed there. The other process is identified by its name. There are some primitives that permit one process to find out the names of all the Tcl/Tk processes running on the system should that be necessary.

For example, we can call either the `on` or `off` routines in our application above by saying: `send display on` or `send display off`. This code assumes that the application is called `display`. This is exactly how I changed the state of the running process to generate Figure 1. I started `wish` running interactively, was given a prompt and typed in the first of the two statements above.

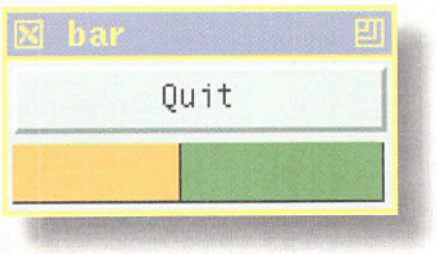

Figure 2 - ...A second attempt

The `send` command can be used to debug Tcl/Tk scripts. You simply send a command to the script that causes it to dump some pertinent values. This can seem a little counter-intuitive because the information will be output by the script that you are debugging, not by the script that originates the command. It fails if the script is blocked for some reason.

On my system, all log files created by `syslog` are truncated to zero at midnight.

There are security implications to the `send` command. Any application that uses your display can send scripts to any other Tcl/Tk application on that display. The script can use the full power of Tcl/Tk to 'be you' on that system, reading files or running programs it wouldn't have access to otherwise. To avoid possible security problems, Tcl/Tk insists that you run some authentication mechanism on your display. The most common one is the 'MIT Magic cookie authentication' mechanism, it comes as part of X server and is used by X server to see if some other process should have the right to place a window on your display.

Most of the co-operating scripts that I have seen pass data into another process by simply setting a variable or calling a procedure. More complex data can easily be passed using a Tcl list to generate a first-in first-out queue of events.

Reading syslog data

We need to construct a simple application that reads the data from the file created by `syslog`, decodes the state of the connection and uses the `send` primitive to affect the state of the `display` application.

As usual, it's a little bit more complicated. We cannot simply read the file because it's being continually updated. We would like to stay glued to the end of the file tracking the new data as it arrives.

Happily, there's a handy Unix program that will do this for us. If we give `-f` parameter to the `tail` command, it will attach itself to the end of a log file delivering any new data that is added.

It's trivial in Tcl to run a program and obtain its output, it's much the same as opening a normal file. Our `reader` application looks like:

```
#!/usr/local/bin/wish -f

wm withdraw .

set f [open "|/usr/ucb/tail -f logfile"
r]
while { [gets $f line] >= 0 } {
  if [string match *ONSTRING* $line] {
    send display on
  }
  if [string match *OFFSTRING* $line] {
    send display off
  }
  if [string match *REBOOT* $line] {
    send display off
  }
}
exit 0
```

The script starts with the magic line `#!` to establish `wish` as the interpreter. The `wm` line tells the interpreter that the script will not be using a screen window that would otherwise be established for the application.

We then invoke the `tail` command, opening its output for reading. The program enters an infinite loop reading the data from the file, checking if a start, stop or reboot operation is logged and sending commands to the `display` application to make it reflect the state of the ISDN connection. I have not burdened you with the actual strings to be decoded, they are just inserted in the `match` statements. The asterisks in the `match` statements behave as you might expect, matching anything.

We have two scripts to monitor the line. Some work is needed to make them more robust. For example, the `reader` application should terminate if the `display` program is not running. For brevity, I intend to ignore the issue of robustness.

It's nice to make the `display` script start the `reader` script, so the user just types a single command to set things running. More importantly, we would like the `reader` script to disappear when we hit the *Quit* button on `display`. Because we are using `tail` as a sub-process, we'd like that to go away as well. In fact, if we kill the `tail` process, the `gets` command in `reader` will terminate.

We can pass the process id of the `tail` process from `reader` into `display` by adding:

```
eval send display
   "set childpid [pid $f]"
```

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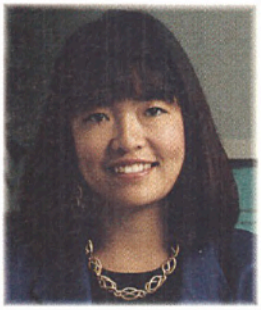

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after the **open** line. This is a little tricky to understand. We want to pass the command that contains a specific process id (PID) into **display**. We need to obtain that PID before executing the **send** command. The **eval** statement at the start of the line is used to pass the statement through the local interpreter once. This will evaluate the **pid** command creating an appropriate **send** command. The command that we send to **display** will contain the PID of **tail**.

Finally, we need to modify **display** again. We add:

```
exec reader &
```

to the end of the script and change the start to read:

```
#!/usr/local/bin/wish -f

set childpid 0
proc quit { } {
  global childpid

  if { $childpid > 0 } {
     exec kill -TERM $childpid
  }
  destroy .
}
button .quit -text Quit -command quit
```

Now, when we poke at the *Quit* button, the **quit** procedure is called. It sends a terminate signal to the **tail** process and removes its own window.

And comes midnight

There's a further snag. On my system, all log files created by **syslog** are truncated to zero at midnight. (The truncation is done by using **mv** to rename any existing file.) Then, I create an empty copy of the files and send the HANGUP signal to **syslogd** to ask it to re-open its output files. So suddenly at midnight, the **tail** command in **reader** is looking at a file that is no longer relevant.

I have had a series of different attempts to get around this problem. Ideally, I would like **syslogd** to be able to send data directly to the **reader** program making it event driven. The **-f** option to **tail** makes it continuously poll the file every second to see if it has changed and I dislike this. Sadly, there is no way to make **syslogd** send data to a program.

I then tried a new idea, making **syslogd** write ISDN data to a named pipe (a FIFO). The thinking was that **reader** would not need to use **tail**. It could simply open the named pipe for reading and obtain logged data when it arrived from **syslogd**. The **reader** process would be truly event driven. I implemented this and it all seemed to work until I stopped **reader** and noticed that **syslogd** hung.

The problem is that output to a named pipe blocks when there is nothing there to read the data. The pipe holds a certain amount of text and then the program that is attempting to write to the pipe will block. This is not too good when that program is **syslogd**. Since I cannot guarantee that the **reader** process will always be running, I abandoned this possible solution.

It's good to show numeric data so that you can get a better idea of what is happening.

I have now adopted a solution of implementing **tail** in Tcl, allowing for the fact that the file may suddenly be truncated. It turned out to be much easier than I expected. The code is:

```
#!/usr/local/bin/wish -f

wm withdraw .
# global filename
set fn logfile

# get the size of a file
proc fsize { file } {
    file stat $file info
    return $info(size)
}
```

The **fsize** procedure does a Unix **stat** operation on a file, based on its name. Results are returned in an associative array, so you can use a name as an array index to get the value that you need.

Here is the decoding code, placed into a procedure for convenience:

```
# action routine
proc decode { line } {
  if [string match *ONSTRING* $line] {
    send display on
  }
  if [string match *OFFSTRING* $line] {
    send display off
  }
  if [string match *REBOOT* $line] {
    send display off
  }
}
```

The following few lines implement the **tail** operation:

```
set f [open $fn r]

while { 1 } {
  set sz [fsize $fn]
# give me the current read position
  set ix [tell $f]

# file has shrunk?
  if {$ix > $sz} {
    close $f
    set f [ open $fn r]
    continue
  }
# more to read?
  if {$ix < $sz} {
    gets $f line
    decode $line
    continue
  }
  after 5000
}
```

The main **while** loop maintains an index (**ix**) into the file to tell the script how many bytes have been read. If the file size is suddenly less than this value, then I assume that the file has been truncated. I can close the old (opened) file, re-open the new file and continue. If there is data to be read, I read one line and loop. The final **after** statement is like the Unix **sleep** command, it will resume execution when five seconds have elapsed.

Because I am no longer using **tail** as a sub-process to **reader**, I can handle the killing of the **reader** process entirely in **display**. The **exec** command will return the PID of the child that it starts. I can rewrite the end of **display** to say:

```
set childpid [exec reader & ]
```

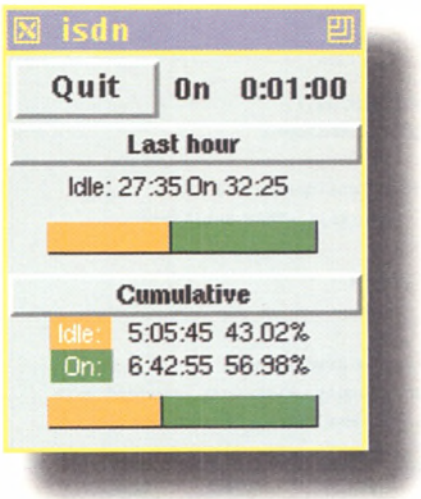

Figure 3 - The current working application

Getting Tcl/Tk

There is a Web page aimed at Tcl/Tk aficionados, it's *http://www.sunlabs.com/research/tcl.*
You can get the latest releases of Tcl/Tk from *ftp.smli.com.* There are mirrors on *sunsite.doc.ic.ac.uk* in */computing/programming/languages/tcl/tcl-archive/ftp.smli.com.* Another interesting Tcl/Tk site is *ftp.aud.alcatel.com* which contains the Tcl contributed archive in the public directory */tcl.*

The definitive book on Tcl/Tk is *Tcl and the Tk Toolkit* by John K Ousterhout. It's published by Addison-Wesley and is ISBN 0-201-63337-X. You should beware that recent versions of the toolkits have made the book a slightly out of date.

More developments

I ran this application for a short while, but began to get dissatisfied. It's more useful to be able to see some history of the connection. I decided to implement a more complex display that would show a two-colour rectangle where the sizes of each section of the rectangle would indicate the proportion of time in the last hour that the line was idle or connected.

Storing the state is simple. I have a timer that calls a procedure every five seconds, storing the current state in an array. The array is then used to compute the total time spent in each state.

The data is displayed using a Tcl/Tk canvas widget. You can place many different types of object in a canvas ranging from a single line to a colour bitmap. Each item can be tagged with a name used to reconfigure the item at a later time. Here's the start of the new **bar** application:

```
#!/usr/local/bin/wish -f

# this is the total rectangle size
# width and height
set wi 140
set ht 15

# pid of reader
set childpid 0

proc quit {} {
  global childpid

  if { $childpid > 0 } {
    exec kill -TERM $childpid
  }
  destroy .
}

# create display area
button .quit -text Quit -command quit
canvas .bar -width $wi -height $ht
..bar create rectangle 0 0 0 0\
          -fill orange2 -tag barOff
..bar create rectangle 0 0 0 0\
          -fill green4 -tag barOn
pack .quit .bar -expand yes -fill x
```

I've created two rectangles on the canvas, but have not initialised their co-ordinates. I plan to do that later when I have some data to display. Updating the image is done by the following procedure:

```
proc drawbar {} {
  global wi ht
  global hist

  set on 0
  set off 0
  for {set i 0} {$i < 720} {incr i} {
    switch $hist($i) {
    on  { incr on }
    off { incr off }
    }
  }

  set tot [expr $off + $on]
  if { $tot == 0 } {
    return
  }
# the .0 forces floating point division
  set boff [expr ($off * $wi) / $tot.0 ]

  .bar coords barOff 0 0 $boff $ht
  .bar coords barOn $boff 0 $wi $ht
}
```

The first part of this routine counts the number of 'off' and 'on' variables stored in the history array **hist**. These are then scaled to the width of the displayed bar. The last two statements reconfigure the tagged rectangles with new co-ordinates. (The two pairs of numbers are the corners' co-ordinates of the rectangle.) The canvas will be redrawn using the new co-ordinates giving the appearance of a coloured sliding bar.

We have to remember that the **reader** process is programmed to send on and off procedure calls to the **display** application, so those lines in **reader** will need recoding:

```
# called from reader to set current state
# initialise as unknown
set state unknown
proc on {} {
  global state
  set state on
}

proc off {} {
  global state
  set state off
}
```

We round off the script with the timer routine and a little initialisation. The timer routine is called every five seconds. It has a pointer, **hpos**, to the history array and uses it to load the current state.

```
proc timer {} {
  global hist hpos state

  set hist($hpos) $state
  incr hpos
  if {$hpos >= 720 } {
    set hpos 0
  }
  drawbar
  after 5000 timer
}

# initialise history array
for {set i 0} {$i < 720} {incr i} {
  set hist($i) unknown
}
# set initial position
set hpos 0
# call timer to start things off
timer
set childpid [exec reader &]
```

All of this code is fairly simple. You can see the output in Figure 2. Of course, there are still some problems with the algorithm. The most important one is that it takes some time to get going, since it only reads the on/off state from the file maintained by **syslogd** and computes the display in real time. To improve the application, I could read the time-stamps from the **syslog** file and use those to compute the history. The problem with this approach is that the clock on the Netblazer which is generating the information is not well synchronised with the clock on the host that is displaying the data. So for the moment, I am happy to accept this limitation.

Secondly, it's good to show numeric data so that you can get a better idea of what is happening. My actual application does this. You can see the result in the final 'product' in Figure 3. ■

Peter Collinson is a freelance consultant specialising in Unix. He can be reached electronically as pc@hillside.co.uk, by phone on 01227 761824 or on the Web at http://www.hillside.co.uk.

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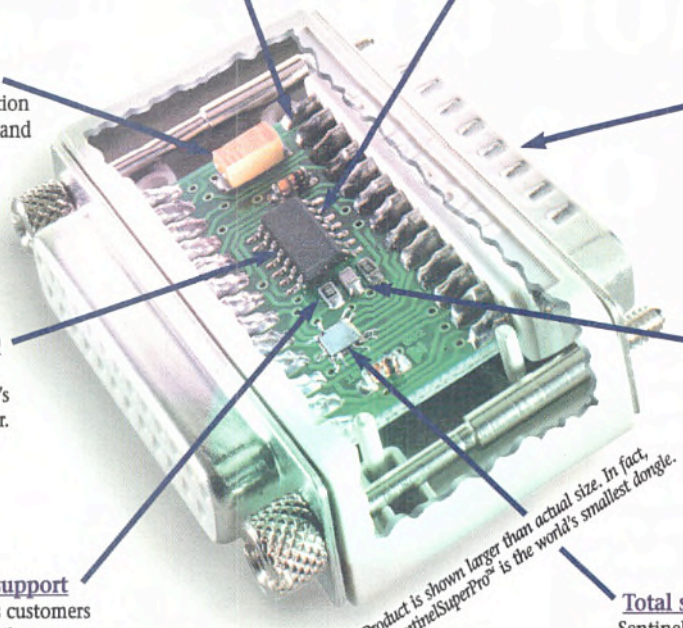

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Two for the price of One

The release of Windows 95 last year promised the end of 16-bit programming. Or did it? **Michael Marshall** discusses how he supports simultaneously Win16 and Win32 versions of his application.

August 1995, Redmond. In a flurry of media hype and hysteria unseen since the Beatles invaded America or Neil Armstrong returned from the Moon, Microsoft unleashed Windows 95 onto the world. Many people purchased the successor to Windows 3.x on day (even night) one, but many more have no plans to upgrade to Microsoft's newest money-spinner. For every Windows 95 enthusiast, there is probably another Windows 3.x user who loathe to upgrade, for one or more reasons:

- Many personal computers cannot run Windows 95 adequately without upgrading memory or CPU.
- Staff needs to be re-trained to use Windows 95 (another cost).
- Applications need to be upgraded to 32-bit versions (yet another cost).
- Coll's Law: 'Never buy or use version 1.0 (or x.0) of *anything*.'
- There is no good reason to upgrade: 'If it ain't broke, don't fix it.'

Even companies planning to upgrade will be doing so over a period of months. During this transition, only some applications will be upgraded. This means that many companies will have combinations of software for Windows 3.x, Windows 95, and perhaps Windows NT. If you're an in-house support person with such a company, you have my deepest sympathy.

I develop a shareware application called Jot, which started life as a purely Windows 3.x program written in C++ using Borland's ObjectWindows Library (OWL) application framework. At the time I wrote it, I had no plans to port Jot to other platforms since nobody was asking about it – Windows 95 was still vapourware at the time. As beta versions of Windows 95 became available, some of my users requested a 32-bit version. I considered migrating Jot to Win32, but when I mentioned these plans to some of the other users, they indicated that they did *not* plan to upgrade to Windows 95 or NT in the near future; for the reasons discussed above they were sticking with Windows 3.x. Many of the new registrations are *still* asking for the 16-bit version of Jot.

The message was clear: there is still a market for 16-bit applications. How should I implement this decision as a developer? One approach would be to develop separate Win16 and Win32 versions of Jot, but the need for sleep (and my day job) ruled out *that* option pretty quickly. I could have developed a Win32-only Jot, and used the Win32s package for Windows 3.x users. This might have worked, except that Win32s doesn't support all of the facilities Jot uses, which combined with Win32s' overhead would not have pleased the Windows 3.x customers; they need a dedicated Win16 version. This left me with one remaining option: the *common code* approach.

The common code approach

The solution: a single set of source which is compiled on multiple platforms (Win16 and Win32 in Jot's case) to generate a version of the application dedicated to that platform. Each version will be functionally identical (except for minor platform-dependent issues discussed shortly), and the data files created by one version will be readable by any other.

The primary benefit of this approach is that most of the work is concentrated at the beginning of the project. Once you modify the application to be portable and platform-independent, supporting new platforms or new features requires minimal extra effort. Without *common code*, you have to merge changes to one version of code into the other versions, which adds development time and increases the risk of introducing subtle errors. If you are creating a new project, you can make the code portable from scratch with no additional effort – and reap the benefits immediately.

A disadvantage of the *common code* approach is that you must limit the application's feature list to functionality supported by *all* platforms. For example, the Win16 API does not support Win32's threads or memory mapped files, so you cannot use them in a *common code* application. You can, of course, provide platform-specific features, but the extra work (and potential code reorganisation if you add something like threads) greatly reduces the benefits of *common code*. Also remember that if two versions of an application have identical functionality, the customer will not need to

cross-train staff when upgrading. The support staff mentioned at the beginning of the article will appreciate that.

Only a small portion of an application's code will require modification to be portable. Most of the Win16 and Win32 APIs are compatible, but some features are not portable; this is usually because they are obsolete on one of the platforms. The communications and configuration APIs are very different on Win16 and Win32, making code using these facilities difficult to port. Later in the article we'll discuss ways around this problem.

So, can the *common code* approach work in the 'real world'? I say 'Yes!' and hold up my Jot program as binary proof of its effectiveness. From a dedicated Win16 program I made the source code portable, and ended up with Win16 and Win32 versions that were even better than before. I probably spent no more than a few days (equivalent full-time work) porting the code, and even located a few minor bugs in the process. Since then, successive releases have included new functionality without requiring additional work for multiple platforms. The *common code* approach will let me continue supporting my Windows 3.x users until I decide I no longer wish to support Win16.

The *common code* approach is also useful in non-Windows developments. In my day job, I have been working on a large Unix application which uses a *single* code base (hundreds of files, tens of thousands of lines of code) to support Solaris 2.3, SunOS 4.1.4, HP-UX, and even Windows NT! The platform-specific code is reasonably small and well isolated, so that when we'll need to support a new platform (AIX is next on the list), we will provide some new platform-specific code, tweak some more code, and include relevant compiler flags into the makefile. A few iterations of this, and we will have a new version of the application, and code that's a little bit better. From Solaris to SunOS it only took a few days to port the entire code base, and it worked correctly the first time.

Message
EM_GETSEL
EM_LINESCROLL
EM_SETSEL
WM_ACTIVATE
WM_CHANGECBCHAIN
WM_CHARTOITEM
WM_COMMAND
WM_CTLCOLOR
WM_DDE_ACK
WM_DDE_ADVISE
WM_DDE_DATA
WM_DDE_EXECUTE
WM_DDE_POKE
WM_HSCROLL
WM_MDIACTIVATE
WM_MDISETMENU
WM_MENUCHAR
WM_MENUSELECT
WM_PARENTNOTIFY
WM_VKEYTOITEM
WM_VSCROLL

Table 1 – Messages altered under Win32

	List Box	Edit
Windows NT	Unlimited	Unlimited
Windows 95	32,767	64KB
Windows 3.x	8,160 (maximum)	64KB

Table 2 – Listbox/Edit limits

```
\\// AUTODIAL.H
// Copyright (c) 1996 Michael J Marshall

#ifndef _U_AUTODIAL_H
#define _U_AUTODIAL_H

struct TUAutodialImp;

class TUAutodial
{
public:
  TUAutodial();
  ~TUAutodial();

  bool open(int port, unsigned speed);
    // Open the specified port at the specified speed.
  void close();          // Close the port.
  bool write(const char *str);  // Output string to port
private:
  TUAutodialImp *m_Imp; // Implementation is separate...
private:
  // Do not implement these methods:
  TUAutodial(const TUAutodial&);
  void operator=(const TUAutodial&);
};
#endif
```

Listing 1 - Autodial.h

Making code portable

Enough of the preaching, now we need to start discussing the details. The first step, of course, is to make your code portable, if it isn't already. Start off by compiling the 16-bit code with the 32-bit compiler in verbose mode. You will end up with a long list of warnings and errors about parameter mismatches, incompatible integer sizes, and lots of other non-portable constructs. Fix everything on the list, and you will be 75% through the porting process. The compiler will only be able to detect the most obvious problems, which means the subtle faults you'll have to search for manually. Here are some of the most important things to look for.

The ANSI C/C++ specification ensures that the `short` and `long` types have the same sizes under both Win16 and Win32; the `int` type, on the other hand, is equivalent to `short` under Win16, and `long` under Win32. In most cases, this distinction is not important, but it is *very* important when dealing with binary files and data structures. Do not use `int`/`unsigned` when reading and writing binary files and other external data sources, use `short` and `long` values or just use plain text (though beware of out of range values).

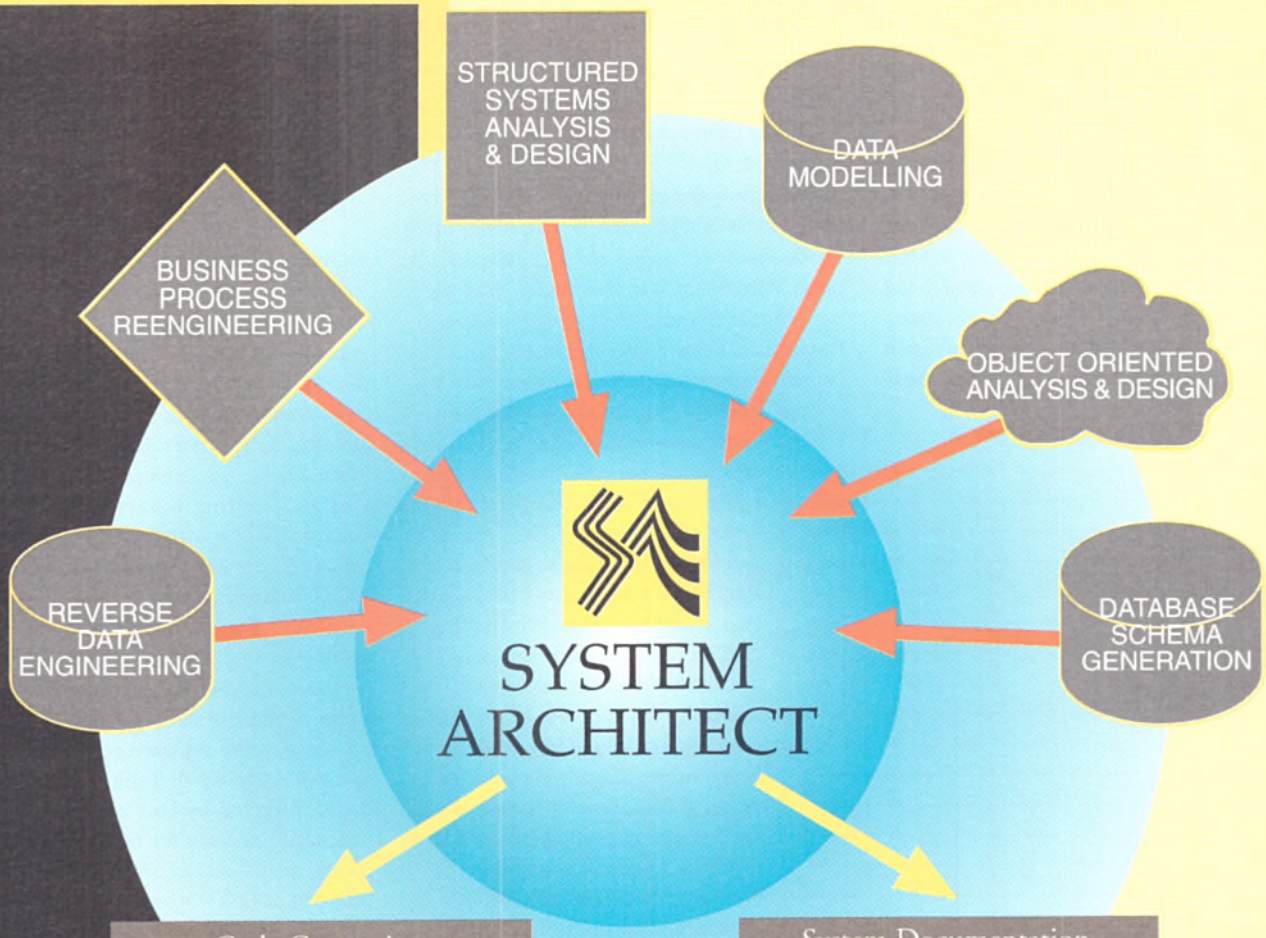
Under Win32, all `HANDLE`s (eg `HMENU`, `HWND`, `HBITMAP`) are 32-bit wide. The `WPARAM` type used in messages is also 32-bit wide. Because of these changes, a number of messages were replaced or had their parameters repackaged; Table 1 lists the messages affected by this repackaging. Any message handlers for these messages will need modification. Also note that the `WM_CTLCOLOR` message is replaced by `WM_CTLCOLORtype` messages.

Like Christmas cake, the dreaded 64 KB limit seems as though it will be with us forever. Even though we're porting to Win32, we still need to respect any limits imposed by the Win16 architecture, which generally means no object larger than 64 KB. Otherwise the Win32 version of the application might generate a data file which the Win16 version cannot read. You may have to use constants to enforce such limits. Take a look at Table 2, which lists the capacities of the list box and edit control under Windows NT, Windows 95, and Windows 3.x. As the table highlights, if the Win32 version of an application stored 10,000 items from a list box to a data file, the Win16 version would be unable to load that data. The application should therefore enforce the lowest limit, ie 8,160 items. For Jot, I've had to include code to enforce a limit on the document size because of Win16 list box restrictions, although fortunately users will rarely encounter this limit.

Some API functions such as `GetWindowOrg()` and `GetTextExtent()` return a `DWORD` that holds two values in the `HIWORD` and `LOWORD`. These functions are, of course,

Operation	Win16 API	Win32 API
Opening the port	OpenComm	CreateFile
Closing the port	CloseComm	CloseHandle
Configure the port	BuildCommDCB, SetCommState	GetCommState, SetCommState
Read from the port	ReadComm	ReadFile, ReadFileEx
Write to the port	WriteComm	WriteFile, WriteFileEx

Table 3 - Communication APIs



Code Generation

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non-portable (and obsolete in Win32) and you should replace them with extended functions (eg `GetTextExtentPoint()`) which return values in a more appropriate data type such as `POINT` or `SIZE`.

C++ and application frameworks

C++ is my language of choice for Windows programming as it is becoming more portable (thanks to ISO/ANSI) and provides excellent facilities for encapsulating Windows functionality. Most of the hard work has been done by Borland, Microsoft, and others in the form of application frameworks, which encapsulate the Windows API in numerous classes. The big benefit for *common code* development is that most frameworks provide a common interface for all supported platforms; most if not all code can be compiled on any platform without changes. Many of the porting issues discussed in the previous section are dealt with by the framework, further reducing the burden on the programmer.

Borland's OWL and Rogue Wave's zApp framework are good examples of application frameworks suitable for *common code*.

```
// autodial.cpp
// Copyright (c) 1996 Michael J Marshall
#include <owl/owlpch.h>
#pragma hdrstop
#include "autodial.h"
static void Message(const char *text,
        UINT flags = MB_ICONEXCLAMATION|MB_OK) {
  TWindow *win =
        GetApplicationObject()->GetMainWindow();
#if defined(__WIN32__)
  // Take advantage of Win32's error facilities
  char msg[128];
  wsprintf(msg, "%s\nError Code: %lu", text,
          GetLastError());
  win->MessageBox(msg, "Autodial", flags);
#else
  win->MessageBox(text, "Autodial", flags);
#endif
}
struct TUAutodialImp {
  bool  m_Valid;
#if __WIN32__
  HANDLE  m_hComm;
#else
  int   m_hComm;
#endif
  TUAutodialImp();
  ~TUAutodialImp();
  void close();
  bool open(int port, unsigned speed);
  bool write(const char *str);
};
TUAutodialImp::TUAutodialImp() {
  m_hComm = 0;
  m_Valid = false;
}
TUAutodialImp::~TUAutodialImp() {
  if (m_Valid)
    close();
}
bool TUAutodialImp::open(int portNum,
                         unsigned speed) {
  char port[10];
  wsprintf(port, "COM%d", portNum+1);
#if defined(__WIN32__)
  m_hComm = ::CreateFile(port,
              GENERIC_READ|GENERIC_WRITE,
              0, 0, OPEN_EXISTING, 0, 0);
  if (m_hComm == INVALID_HANDLE_VALUE) {
    Message("Unable to open the port");
    return false;
  }
#if 0 // Use the system default queue sizes?
  if (!::SetupComm(m_hComm, 1024, 1024)) {
    close();
    Message("SetupComm failed");
    return false;
  }
#endif
  DCB dcb;
  // Retrieve current port settings
  if (!GetCommState(m_hComm, &dcb)) {
    close();
    if (::GetLastError() ==
                  ERROR_CALL_NOT_IMPLEMENTED)
      Message("This facility is unavailable
               under Win32s", MB_ICONSTOP|MB_OK);
    else
      Message("GetCommState failed");
    return false;
  }
  // Only modify those fields we need to
  // Configure to speed 8N1
  dcb.BaudRate = speed;
  dcb.ByteSize = 8;
  dcb.Parity = NOPARITY;
  dcb.StopBits = ONESTOPBIT;

  if (!::SetCommState(m_hComm, &dcb)) {
    close();
    Message("SetCommState failed");
    return false;
  }
#else // __WIN32__
  // Open comm port
  m_hComm = ::OpenComm(port, 1024, 1024);
  if (m_hComm < 0) {
    Message("Unable to open the port");
    return false;
  }
  DCB dcb;
  char cfg[40];
  wsprintf(cfg, "%s:%u,N,8,1", port, speed);
  if (::BuildCommDCB(cfg, &dcb) < 0) {
    close();
    Message("BuildCommDCB failed");
    return false;
  }

  if (::SetCommState(&dcb) < 0) {
    close();
    Message("SetCommState failed");
    return false;
  }
#endif // __WIN32__
  m_Valid = true;
  return true;
}
void TUAutodialImp::close() {
#if defined(__WIN32__)
  ::CloseHandle(m_hComm);
#else
  ::CloseComm(m_hComm);
#endif
  m_hComm = 0;
  m_Valid = false;
}
bool TUAutodialImp::write(const char *str) {
  if (!m_Valid)
    return false;
  size_t len = strlen(str);
  DWORD nwritten;
#if defined(__WIN32__)
  if (!::WriteFile(m_hComm, str, len,
                   &nwritten, 0)) {
    Message("Error writing to the port");
    return false;
  }
#else
  nwritten = ::WriteComm(m_hComm, str, len);
#endif
  return (nwritten == len);
}
//=======================================
TUAutodial::TUAutodial() {
  m_Imp = new TUAutodialImp;
  CHECK(m_Imp);
}
TUAutodial::~TUAutodial() {
  delete m_Imp;
}
bool TUAutodial::open(int port, unsigned speed) {
 return m_Imp->open(port, speed);
}
void TUAutodial::close() {
  m_Imp->close();
}
bool TUAutodial::write(const char *str) {
  return m_Imp->write(str);
}
```

Listing 2 - autodial.cpp

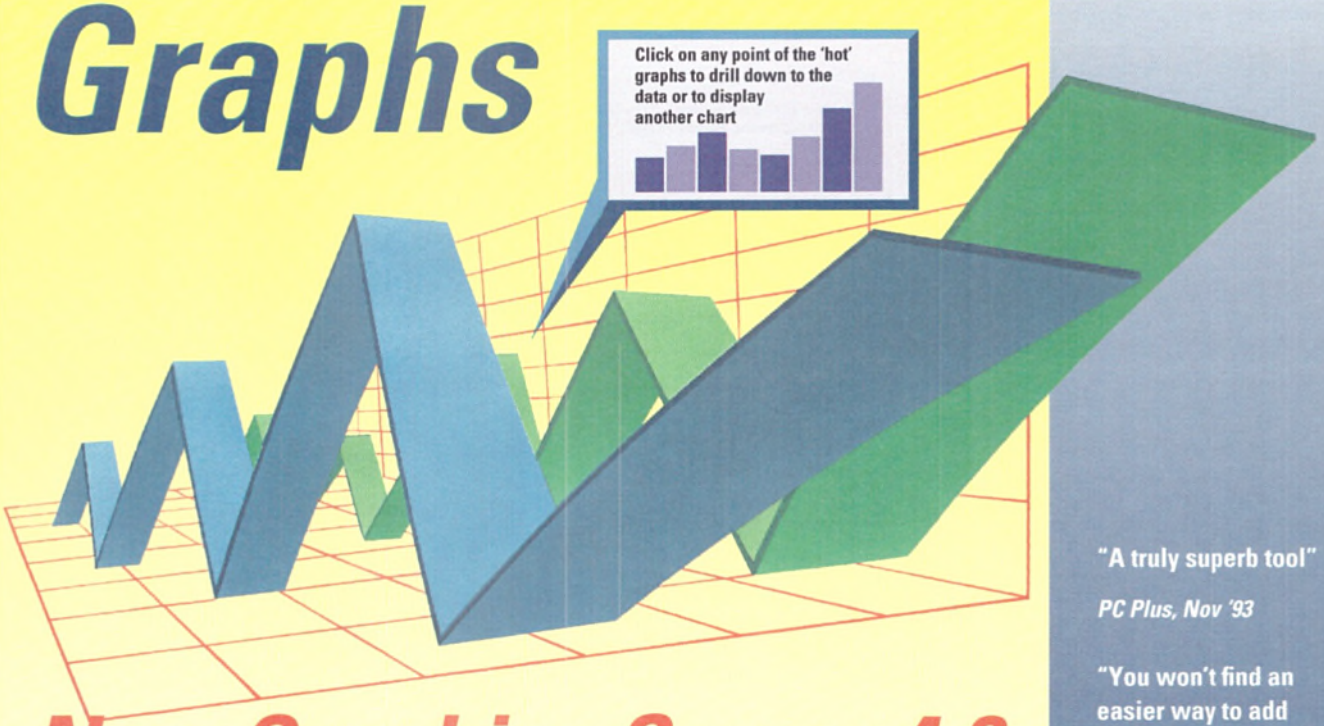
```
// CONFIG.H - Copyright (c) 1996 Michael J Marshall
#ifndef _U_CONFIG_H
#define _U_CONFIG_H

#include <cstring.h>
#include <owl/profile.h>

class TUConfigKey {
public:
  enum { StringLimit = 256 };
    // limit on size of strings in the configuration
  TUConfigKey();
  virtual ~TUConfigKey();

  virtual bool load(const char *name, string &value) = 0;
  virtual bool load(const char *name, short &value) = 0;
  virtual bool load(const char *name, unsigned short &value) = 0;
    // These methods retrieve a single value from the Registry/Profile

  virtual bool store(const char *name, const char *value) = 0;
  virtual bool store(const char *name, short value) = 0;
  virtual bool store(const char *name, unsigned short value) = 0;
    // These methods store a single value into the Registry/Profile

  bool isValid() const;
    // Returns true if the object was configured successfully
protected:
  bool m_Valid;
private:
  // Do Not Implement
  TUConfigKey(const TUConfigKey&);
  void operator=(const TUConfigKey&);
};
//=====================================
class TUProfileKey: public TUConfigKey {
public:
  TUProfileKey(const char *section, const char *file = 0);
    // If file is 0, refers to WIN.INI
  bool load(const char *name, string &value);
  bool load(const char *name, short &value);
  bool load(const char *name, unsigned short &value);

  bool store(const char *name, const char *value);
  bool store(const char *name, short value);
  bool store(const char *name, unsigned short value);
protected:
  TProfile m_Profile;
};
//=====================================
#if defined(__WIN32__)
class TURegistryKey: public TUConfigKey {
public:
  TURegistryKey(HKEY root, const char *subKey = 0, bool readOnly = true);
    // Normally, readOnly is true when loading, false when storing.
    // Check isValid() to verify that the requested access was permitted.
  ~TURegistryKey();

  bool load(const char *name, string &value);
  bool load(const char *name, short &value);
  bool load(const char *name, unsigned short &value);

  bool store(const char *name, const char *value);
  bool store(const char *name, short value);
  bool store(const char *name, unsigned short value);
protected:
  HKEY m_hKey;
};
#endif
//=====================================
#endif
```

Listing3 - config.h

Language

Visual C++
C/C++
SQLWindows
Visual Basic
Turbo Pascal
Powerbuilder
FoxPro
Windows4GL
Access

Programmable Graphs



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PC Magazine, Sept '93

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Unfortunately, the Microsoft Foundation Classes (MFC), though strong for Win32 programming, let the developer down terribly when it comes to *common code* development: MFC for Win32 is incompatible with MFC for Win16. To make things even worse for the MFC programmer, the Microsoft 16-bit compiler is an entirely separate product that does not support the same C++ features as the 32-bit compiler (such as templates and exceptions). I have never understood why Microsoft took this approach – I suppose they believed their own hype and thought nobody would need to develop 16-bit applications anymore.

I develop Jot using Borland C++ compiler and OWL, which provides the same language features and classes for both Win16 and Win32. The next release of the compiler (5.0) is rumoured to continue this trend, and may even provide many Win32 features (such as some of the Common Controls) to Win16 programs!

Hiding the differences

After the porting exercise, there will still be some changes required which are platform-dependent, such as the handling of `WM_CTLCOLOR` messages. If the code affected is small enough, a simple `#if / #else / #endif` pre-processor directive can do the job without cluttering the code.

When larger tracts of code are platform-specific, isolation and encapsulation are the best tactic for developing *common code*. The first example I will discuss concerns the communications APIs, which provide Jot's dial-

Bibliography and resources

The Microsoft Developers Network (October '95) has a lot of additional information about porting; differences between Windows 95 and NT; SDK documentation; and a lot more.

Here are some Web pages relevant to this article:

- Jot is a replacement for Windows Cardfile– *http://www.compulink.co.uk/~unicorn/jot.html*
- Borland C++ – *http://www.borland.com/Product/Lang/Cpp/Cpp.html*
- Microsoft Visual C++ – *http://198.105.232.4:80/visualc/*
- Symantec C++ – *http://www.symantec.com/*
- Watcom C++ – *http://www.watcom.com/c/c.html*
- zApp – *http://www.roguewave.com/rwpav/products/inmark/zApp/zApp.html*

All the source code referenced in this article is available on Cix, by postal mail (send an SAE labelled 'WinPort' to *EXE Editorial*) or by ftp at *ftp://ftp.exe.co.uk/pub/exestuff/winport*.

```
// config.cpp - Copyright (c) 1996 Michael J Marshall
#include <owl/owlpch.h>
#pragma hdrstop
#include "config.h"
#if __WIN32__
// Registry helper functions
static bool RegRead(HKEY key, const char *subKey, void *buf, size_t len,
                    DWORD type = REG_SZ)
{
  DWORD lenBuf = len;
  DWORD typeBuf;
  LONG result = RegQueryValueEx(key, (char*)subKey, 0, &typeBuf,
                                (LPBYTE)buf, &lenBuf);
  if (result != ERROR_SUCCESS)  return false;
  if (typeBuf != type)          return false; // Incompatible types
  return true;
}
static bool RegWrite(HKEY key, const char *name, const void *buf,
                     size_t len, DWORD type = REG_SZ)
{
  LONG result;
  result = RegSetValueEx(key, name, 0, type, (const BYTE *)buf, len);
  return result == ERROR_SUCCESS;
}
#endif
//============================================================
TUConfigKey::TUConfigKey(): m_Valid(true) { }
TUConfigKey::~TUConfigKey() { }
bool TUConfigKey::isValid() const {
  return m_Valid;
}
//============================================================
TUProfileKey::TUProfileKey(const char *section, const char *file)
  : m_Profile(section, file) { }
bool TUProfileKey::load(const char *key, string &value) {
  char buf[StringLimit];
  bool ok = m_Profile.GetString(key, buf, sizeof(buf));
  if (ok && buf[0]) {
    value = buf; return true;
  }
  return false;
}
bool TUProfileKey::load(const char *key, short &value)
{
  int n = m_Profile.GetInt(key, value);
  value = short(n);
  return true;
}
bool TUProfileKey::load(const char *key, unsigned short &value) {
  unsigned n = m_Profile.GetInt(key, value);
  value = (unsigned short)n;
  return true;
}
bool TUProfileKey::store(const char *key, const char *value) {
  return m_Profile.WriteString(key, value);
}
bool TUProfileKey::store(const char *key, short value) {
  return m_Profile.WriteInt(key, value);
}
bool TUProfileKey::store(const char *key, unsigned short value) {
  return m_Profile.WriteInt(key, value);
}
//============================================================
#if __WIN32__
TURegistryKey::TURegistryKey(HKEY key, const char *subKey, bool readOnly) {
  DWORD access = KEY_READ;
  if (!readOnly)  access |= KEY_WRITE;
  LONG result = ::RegOpenKeyEx(key, subKey, 0, access, &m_hKey);
  if (result != ERROR_SUCCESS) {
    if (readOnly) {
      m_Valid = false;
      return;
    }
    DWORD disp;
    result = ::RegCreateKeyEx(key, subKey, 0, 0, 0, KEY_ALL_ACCESS, 0,
                              &m_hKey, &disp);
    CHECK(result == ERROR_SUCCESS);
    if (result != ERROR_SUCCESS)
      m_Valid = false;
  }
}
TURegistryKey::~TURegistryKey() {
  if (isValid())::RegCloseKey(m_hKey);
}
bool TURegistryKey::load(const char *name, string &value) {
  if (!isValid())  return false;
  char buf[StringLimit];
  bool ok = RegRead(m_hKey, name, buf, sizeof(buf), REG_SZ);
  if (ok)  value = buf;
  return ok;
}
bool TURegistryKey::load(const char *name, short &value) {
  if (!isValid())  return false;
  DWORD buf;
  bool ok = RegRead(m_hKey, name, &buf, sizeof(buf), REG_DWORD);
  if (ok)  value = short(buf);
  return ok;
}
bool TURegistryKey::load(const char *name, unsigned short &value) {
  if (!isValid())  return false;
  DWORD buf;
  bool ok = RegRead(m_hKey, name, &buf, sizeof(buf), REG_DWORD);
  if (ok)  value = (unsigned short)buf;
  return ok;
}
bool TURegistryKey::store(const char *name, const char *value) {
  if (!isValid())
    return false;
  return RegWrite(m_hKey, name, value, strlen(value)+1);
}
bool TURegistryKey::store(const char *name, short value) {
  if (!isValid())  return false;
  DWORD buf = value;
  return RegWrite(m_hKey, name, &buf, sizeof(buf), REG_DWORD);
}
bool TURegistryKey::store(const char *name, unsigned short value) {
  if (!isValid())  return false;
  DWORD buf = value;
  return RegWrite(m_hKey, name, &buf, sizeof(buf), REG_DWORD);
}
#endif  //__WIN32__
```

Listing 4 - config.cpp

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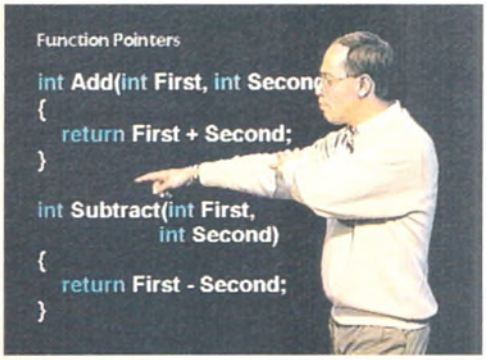

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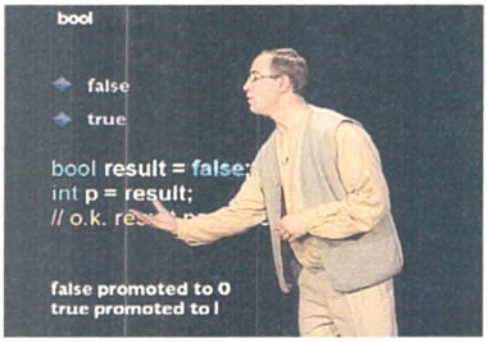

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out facility. Table 3 lists some of the most important communications operations and the Win16 and Win32 API functions that handle them. Readers familiar with UNIX will notice that the Win32 communications I/O use the same functions as disk file I/O. The differences are significant, and are best handled by encapsulating the communications operations within a class. The `TUAutodial` class (see Listings 1 & 2) is the result.

The class' interface is platform-independent, which keeps the Jot code using it portable. Inside the implementation, I just used `#if / #else / #endif` to conditionally compile the correct platform-specific code; for a larger class, a better implementation could use separate source files for each platform (eg `adial16.cpp`, `adial32.cpp`) which are then included by the master file:

```
// adial.cpp
#if defined(WIN32)
#  include "adial32.cpp"
#else
#  include "adial16.cpp"
#endif
```

The Win32 version of the autodial code needs to perform some extra checks when an API fails; if the system error code is `ERROR_CALL_NOT_IMPLEMENTED`, we are running under Win32s, and should notify the user that the requested facility (in this case communications) is unavailable with Win32s; this is one of the reasons I could not use Win32s for my Jot development.

The other example for this article is configuration, an important area for all but the most trivial applications. Win16 applications have to use .INI files, but Win32 applications are supposed to use the Registry. (Actually, a Win32 program *can* use .INI files if it wants to, it is just not recommended.) As with the communications APIs above, the differences between Win16 and Win32 can be encapsulated within a generic interface. The result is the `TUConfigKey` class (see Listing 3), an abstract base class that provides a generic interface for reading and writing configuration data. This interface only supports loading and storing of strings and *short* integers, but you can easily extend it to support more complex types such as `SIZE` or `COLORREF`. The reason only short integers can be used is because Win16's `GetProfileInt()` can only return a 16-bit value, so that imposes a limit on the public interface; I leave storing long integers as strings under Win16 as an exercise for the reader...

I derive two classes from `TUConfigKey`, `TUProfileKey` for accessing .INI files, and `TURegistryKey` for accessing the Registry (see Listing 4). The `TUProfileKey` class is based around OWL's `TProfile` class, which provides an already-implemented interface to .INI files – there is no point in re-implementing this functionality. The `TURegistryKey` class can access its data in read-only or read-write mode, depending on whether the application is using the key for loading or storing.

To demonstrate how these classes are used, a sample program `cfgtest.cpp` can be used to store some simple data in a key and retrieve it. This code is available by ftp or mail (see the box Bibliography and resources). Again, the Win32 version of this application needs to be aware of Win32s. The `GetConfigKey()` function creates a key appropriate for the environment – a `TURegistryKey` for NT and Windows 95, and a `TUProfileKey` for Windows 3.x or Win32s. The rest of the code is oblivious to which platform it is running on.

Compiling the test programs

Two test programs, `dialtest.cpp` and `cfgtest.cpp`, each with their own makefiles (`dialtest.mak` and `cfgtest.mak`) and support files are available on the ftp site. The makefiles both reference a common makefile,

```
# dialtest Makefile

APPNAME=dialtest
SOURCES=dialtest.cpp autodial.cpp

!include umacro.mak
```

Listing 5 - dialtest.mak

```
\# UMACRO.MAK
# Generic Makefile Macros
# Copyright (c) 1996 Michael J Marshall
# Defines:
#  WIN32 - enables win32
#  APPNAME (required) - output will be
APPNAME.exe
#  SOURCES (required) - names of source files
.swap
# Modify for local setup
BCROOT=c:\bc45
BCLIBDIR=$(BCROOT)\lib
BCINCDIR=$(BCROOT)\include

INCLUDEPATH=$(BCINCDIR);.
LIBRARYPATH=$(BCLIBDIR);.
!if $d(WIN32)
  KEY=win32
!else
  KEY=win16
!endif
CDIAG = -D__DEBUG=2 -D__TRACE=1 -D__WARN=1
OD=d
# Precompiledf header settings
CPCH = -H=$(KEY)$(OD).csm -H"owl/owlpch.h"
       -D_OWLPCH
# Names of the miscellaneus files
RESFILE=$(APPNAME).res
RCFILE=$(APPNAME).rc
DEFFILE=$(APPNAME).def
# Make a list of objects from the source names
OBJECTS=$(SOURCES:.cpp=.obj)
!if $d(WIN32)
# Define Win32-specific compiler settings
  BCC=bcc32
  BRCC=brcc32
  TLINK=tlink32
  TLIB=tlib
  IMPLIB=implib
  CFGFILE=bcc32.cfg
  STDLIBS = owldwfi bidsdfi import32 cw32i
  C0 = c0w32
  LDBG = -v
  CPCH = $(CPCH) -Hc
  COPTS = -3 -d -k -Od -v
  CFLAGS = -W -D_RTLDLL -D_OWLDLL -D_BIDSDLL
$(COPTS)
  LFLAGS = -Tpe -aa -c $(LDBG)
!else
# Define Win16-specific compiler settings
  BCC=bcc
  BRCC=brcc
  TLINK=tlink
  TLIB=tlib
  IMPLIB=implib -c
  CFGFILE=bcc16.cfg
  STDLIBS = owldwi bidsdi import crtldll
  C0 = c0wl
  LDBG = -v -Vt
  COPTS = -3 -d -k -Od -v
  CFLAGS = -WS -D_RTLDLL -D_OWLDLL
           -D_BIDSDLL $(COPTS) -ml
  LFLAGS = -Tw -c -C -A=16 -Oc -Oi -Oa
           -Or $(LDBG)
!endif
#=====================================
# RULES
#=====================================
all: $(CFGFILE) $(APPNAME).exe
# Rule to link the application
$(APPNAME).exe: $(OBJECTS) $(RESFILE)
  $(TLINK) @&&|
$(LFLAGS) -L$(LIBRARYPATH) $(BCLIBDIR)\$(C0)+
$(OBJECTS)
$(APPNAME).exe
$(APPNAME).map
$(STDLIBS)
$(DEFFILE)
$(RESFILE)
|
.rc.res:
  $(BRCC) -r -i$(INCLUDEPATH) $<
.cpp.obj: $(BCC) +$(CFGFILE) -c $<
$(CFGFILE): @copy &&| -I$(INCLUDEPATH)
  $(CFLAGS)-w $(CDIAG) $(CPCH) $(CCFEXE)
  | $(CFGFILE) >NUL
```

Listing 6 - umacro.mak

`umacro.mak` (see Listing 5 & 6), which provides macros and rules for building the test applications for both Win16 and Win32. The test programs and makefiles were written for Borland C++ 4.53 and its tools.

To build a Win16 version of a test program, type:

```
make -f <makefile>
```

And to build a Win32 version of a test program:

```
make -f <makefile> -DWIN32
```

The resulting programs have diagnostic and debug code included, and are linked dynamically to the system libraries. If you build one version of a program, and wish to build the other version, don't forget to delete the .exe, .obj, and .res files first.

Next month

I am out of space this month; next time I will finish my discussion of *common code*, and provide some functions and classes to implement useful Win32 functionality for Win16 applications. ■

When he's not writing articles for EXE, developing Jot, or reading Dilbert, Michael J Marshall is a software engineer for Connection Software in London. Michael writes C/C++ under Windows and UNIX. He can be reached at michael@xon.co.uk and at http://www.compulink.co.uk/~unicorn/.

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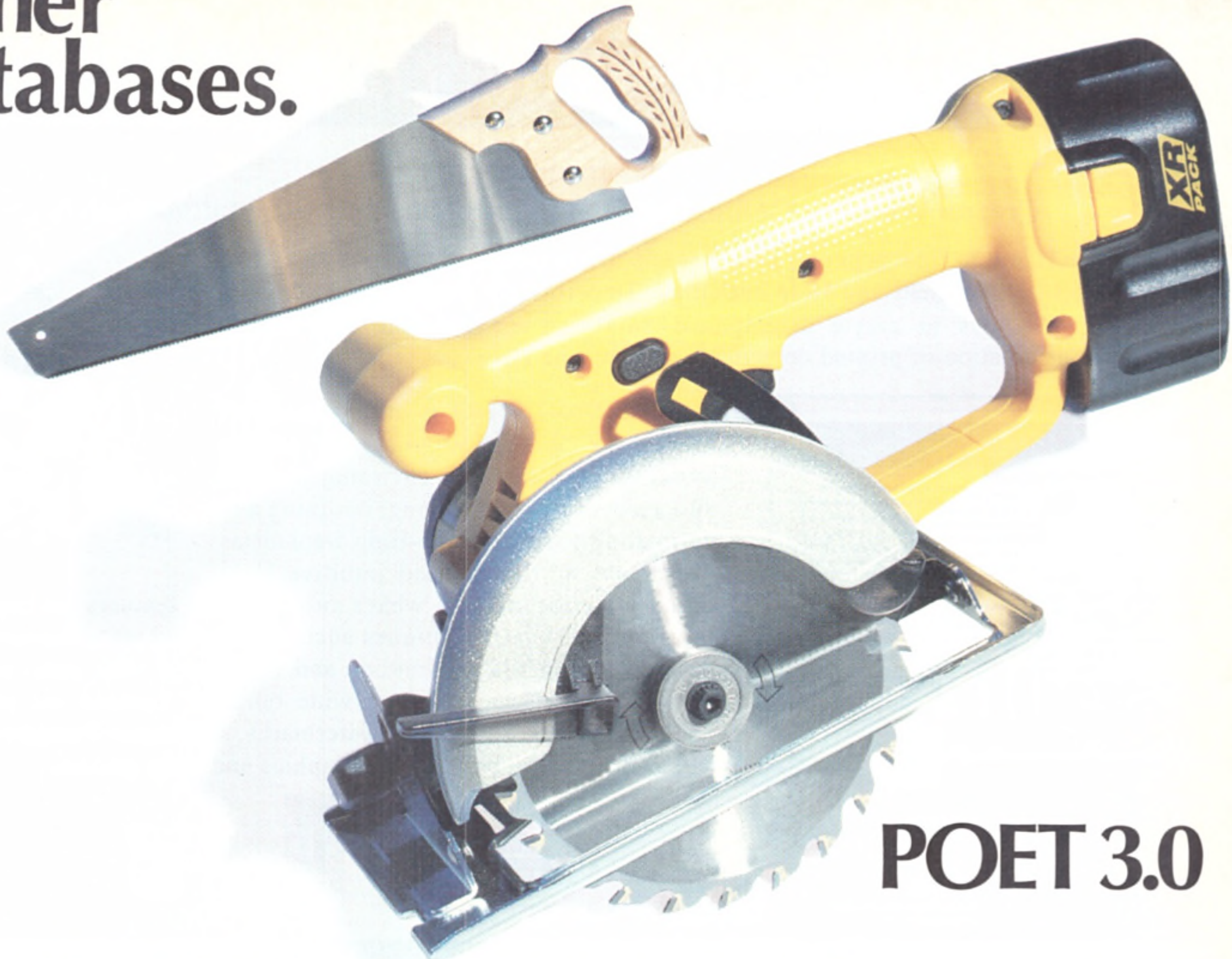

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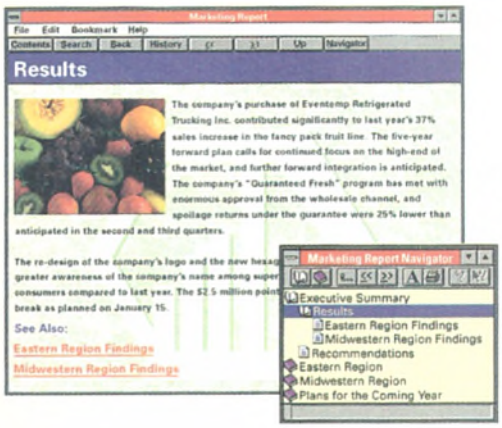

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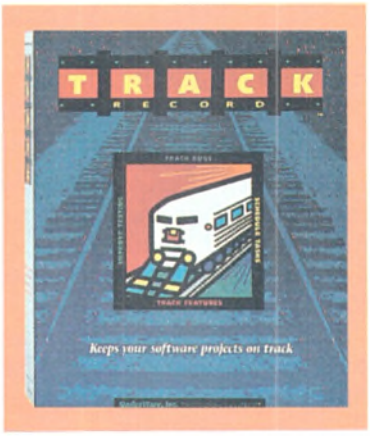

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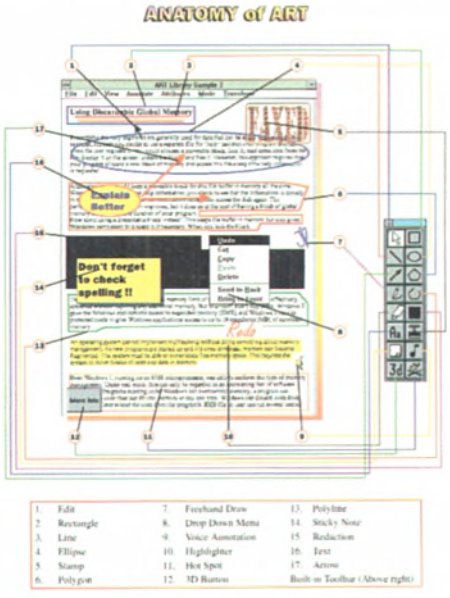

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When a student tracks down the size of objects, it prompts **Francis Glassborow** to reveal the true story behind compilers' alignment switch.

Several weeks ago I received an email message from a student member of ACCU concerned about the effect of switching on alignment when compiling code. The question was: 'Why does switching on alignment in Borland C++ result in an increase of one in the size of all objects whose original size was odd?'

My immediate reaction was 'Why only the odd sized objects, and why by only one?' Surely alignment should guarantee that all types (including data members) but `char` start on an alignment boundary. Look at the following structure:

```
struct X{
  int i;
  char c;
  int j;
  char k;
};
```

Despite being of even size in unaligned memory, it will increase in size by 2 or 6 depending on whether the architecture is two byte or four byte aligned. Actually it could be worse still on 32-bit architectures using 16-bit `int`s or on 64-bit architectures such as the Cray XMP. In some cases, C++ objects with large lattices can expand considerably when alignment is required and the programmer has not considered the problem.

My enquirer thought that alignment was only applicable to the whole object and could not see why the extra byte should be part of the object. To his mind all that was required was that each (whole) object should start on an alignment boundary. The reason why this cannot work is that any padding (even terminal padding) must be part of the object to honour the ISO C requirement that elements of an array shall be contiguous. There cannot be padding bytes between array elements, any such padding must be part of the preceding element of the array.

The next question that came to mind was 'Why was this behaviour of critical importance?' After a little investigation I discovered that it was a matter of persistence. His original executable – with unaligned objects – had written data back to storage by writing `sizeof(object)` bytes to backing store. When the new executable tried to read `sizeof(object)` from backing store it was reading too many bytes in some cases, thereby corrupting the input stream. There is a far more serious problem with this mechanism that I will come to in a moment but the first lesson is that writing raw bytes to backing store cannot work if you change the memory organisation between writing and reading. This is a problem on PCs if you change the memory model or the alignment requirement. The minimum requirement for raw bytes to work as a mechanism for persistent storage is that the program reading the data uses identical memory organisation (alignment, byte size, memory model, endian etc) to that of the program writing the data.

In a C environment that is probably sufficient, in C++ it is not. Consider the code below.

Notice that I have told you nothing about `SomeObject`. If this is a polymorphic type with virtual methods it will have a virtual function table pointer (or some other mechanism serving the same purpose). There is no requirement that the address of a virtual function table for `SomeObject` is an invariant over multiple executions of the program. The above program will (at best) overwrite the default instance of `SomeObject` with the stored data from an earlier use. This will overwrite the virtual function table pointer of the current execution with one from an earlier one. By the way, C++ gives no guarantee about the consequences of copying objects via raw memory by functions such as `memcpy()`.

```
#include <fstream.h>
#include "someobj.h"
int main () {
  unsigned char buffer[sizeof(SomeObject)+1];
  SomeObject s;
  ifstream infile("storage");
  infile.read ((char*)(&s), sizeof(SomeObject));
  // rest of program
}
```

I almost set this as a monthly problem, but came to the conclusion that the problem was rather obscure for the typical C++ user.

Zero size

C++ requires that the `sizeof()` for all objects is at least one. The intent is to make sure that all objects have distinct addresses. Unfortunately there are special types of classes (such as protocol classes) that have no object data and so naturally have a size of zero. Instances of such classes most naturally occur as sub-objects in what can be very large object lattices (ie objects composed of many sub-objects). The storage cost of multiple dataless sub-objects can become extravagant (particularly in systems with substantial alignment requirements.) This problem was considered at the recent Tokyo meeting of ANSI X3J16/ISO WG21 and it was decided that zero-sized sub-objects would be allowed even though complete objects would still need a minimum size of one. No two zero-sized sub-objects may have the same address; though, as I understand it, one such can share an address with a normal object.

I have also heard that they relaxed the rule on layout of sub-objects. For C compatibility reasons the current rules require that the layout of a C++ `class/struct` object shall be the same as that for a C `struct` with the same elements declared in the same order. For some time compilers have been able to reorder blocks of declarations that have a sin-

gle access specifier, but not reorder the declarations within a block. For example, in

```
class X
private:
  char a;
  int b;
private:
  char c;
  int d;
public
//rest of the class definition
};
```

`a` and `b` must be adjacent (contiguous barring alignment padding), so must `c` and `d` but they may be ordered `a`, `b`, `c`, `d` or `c`, `d`, `a`, `b`.

If I heard correctly, the relaxed rule allows compilers to reorder private data. It would make sense because private data can never be a compatibility issue with C. It would also deter 'programmers' from trying to use implementation details about data layout. If your program relies on a precise data layout then I think you have some serious problems to address in your coding skills.

Winning the lottery

Last issue's problem program was intended to generate lottery entries. There are several commercial programs that do this. I wonder if some of the erratic results of the Lottery are a result of faults in programs akin to this one. Let us re-examine last month's code, shown at the top of the next column.

```
int main() {
  int values[49];
  int i, select, temp;
// first initialise the array
  for (i = 0; i<49; i++)
    values[i] = i + 1;
// set the random number generator
// from the system clock
  srand((unsigned)time(0));
// shuffle the array
  for (i=49; i>1; i--) {
    select = rand() % i;
    temp = values[i-1];
    values[i-1] = values[select];
    values[select] = temp;
  }
  printf("The six numbers are:");
  for (i=0; i<6; i++)
    printf("%d ", values
  printf("\n");          [i]);
  return 0;
}
```

At first (second, and third) glance there is nothing wrong with this program. It will compile and run, generating sets of six numbers in the range 1 to 49. Using a shuffle routine ensures that it is robust even if the implementation of `rand()` is poor. (Despite the substantial chapter on pseudo-random number generators in Knuth's 'Art of Computer Programming Vol 2' there are still many low grade implementations around.) The program runs in approximately constant time (proportional to the number of numbers you wish to select). If performance matters, you could limit the shuffle to only six iterations and use the last six entries as the selection.

The writer clearly intends to select random sets of six numbers. Most of us would expect this meant that all the possible (almost 14 million) sets of six would have a roughly equal chance of being chosen. This will not be the case for this program if it is compiled using 16-bit `int`s.

The sequence of numbers generated by consecutive calls to `rand()` is determined by the argument that is passed to `srand()`. (If `srand()` is never called, ISO C requires that `rand()` behaves as if `srand(0)` has been executed.) So the above program can generate no more different sets than the number of available arguments for `srand()`. In systems with 16-bit `int`s this is no more than 65536. This means that the above program can, at best, generate only 0.5% of all possible selections.

The limited set of compilers coupled with the small number of likely programs (strategies and algorithms) means that most possible lottery selections will never be chosen by programs running on popular hardware. On the other hand, if the lottery numbers are one of those sets that can potentially be selected by a program there will be a much greater chance of multiple winners.

Systems with 32-bit `int`s do not suffer this limitation in regard to lottery numbers but where selections are being made from much larger ranges of outcomes (dealing Bridge hands, shuffling for Poker etc.) the problem raises its head again.

Note that the best cases above assume that the pseudo-random number generator is good enough to generate a unique sequence for each seed passed to `srand()`. Experience shows that this is far from being universally true. It would be nice if implementers documented their choice of algorithm. Indeed I think implementers should always document choices that may affect the outcome of conforming code, but until users start demanding such added quality they will not get it. Perhaps a higher priority is for compilers to actually compile code to work correctly. We heard a lot about the 'Pentium bug' but what about the code generation bug in Visual C++ 2.1 and 2.2 where the global optimiser breaks integer arithmetic in a raft of cases. I know that almost all compilers have bugs, but this one is particularly nasty as it is relatively likely to bite and was introduced in a limited release (and one where there was no indication that anything had been done to the compiler itself).

This month's problems

I am setting you two problems this month. The first concerns selecting subsets from very large collections. Without appropriate, familiar reference books, you will find it difficult. The second is a code problem for you to try and then check on your compiler.

Problem 1

Look back at the code for last month's problem. Note that though only six numbers are wanted, storage is provided for all forty-nine. In the Lottery context this is fine, it keeps the program simple and makes the algorithm easy to follow. This will not always be the case.

How would you tackle this problem if you needed to choose a set of six from the first million integers? Your solution must make all possible selections equally likely. What is the hidden cost of your method?

I would be pleased to see your solution, because it might be better than the one I have to hand.

Problem 2

How many errors are there in the following C++ code?

```
#include <iostream.h>
int main() {
  int i=10;
  i= i->i();
  cout << i << endl;
  return 0;
}
```

When you have decided, try it on any and all C++ compilers you have available. At least one of them might surprise you. ■

Association of C/C++ Users subscriptions: individual £14, student £7, corporate £75, Overload & C++ SIG £15 (+ ACCU membership). For further information about ACCU write to Francis Glassborow, 64 Southfield Road, Oxford, OX4 1PA, ring 01865 246490 or email (without contents) info@accu.org.

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CIRCLE NO. 542

Programming Graphics Server 4 with Visual Basic

What is the best way to present data: pie chart, 3D scatter, bars... It's all a matter of taste. **Colin Hume** reviews a toolkit which gives you the power to let the user decide.

Graphics Server 4 is the latest release of the Bits Per Seconds graphing toolkit for Windows 3.x, Windows 95 and NT. It is available in two versions, as the Graph control only (called the Component Kit) or the Graph control combined with the Graph library (the Development Kit). The Graph control, in a less fully-featured form, is licensed by Microsoft and appears as the Pinnacle-BPS Graph Control in Visual Basic 4 Professional and Enterprise editions.

Graphics Server 4 supports a range of host languages and applications but the focus of this article is on programming with Visual Basic, specifically with the 32-bit version of VB4 which incorporates VBA – Visual Basic for Applications. Microsoft is standardising on VBA as the common variant of Basic across its desktop range.

Graphics Server functions are sensitive to the data type of variables passed to them as parameters but it is not mandatory in Visual Basic to declare variables explicitly or strong-type them, it is possible to declare a variable just by assigning a value to it, for example:

```
Result = 0
```

It is normal VB programming practice to include `Option Explicit` within the declarations section of a form or module, this enforces that all variables are declared with the `Dim` statement. As an alternative to `Option Explicit`, *Require Variable Declaration* can be checked under *Tools | Options*. Including `Option Explicit` is a better option if source is ported to and possibly modified using other VBA compatible development platforms.

Accessing the Graph library

Accessing the Graph library DLLs from VB4 requires a set of `Declare` statements. VB4 in its Professional or Enterprise editions is a dual 16/32-bit product and the syntax of the `Declare` statement varies according to whether calls are being made to the 16- or 32-bit version of the Graphics Server DLLs. If the dual capabilities of VB4 are being used the preferred method is to use the new `#If Win32` compiler directive, for example:

```
#If Win32 Then
  Declare Function GSCloseServer Lib
    "GSWDLL32.DLL" () As Long
  Declare Function GSOpenServer Lib
    "GSWDLL32.DLL" (ByVal szKey$,
    ByVal szHost$) As Long
#Else
  Declare Function GSCloseServer Lib
    "GSWDLL16.DLL" () As Integer
  Declare Function GSOpenServer Lib
    "GSWDLL16.DLL" (ByVal szKey$,
    ByVal szHost$) As Integer
#End If
```

The syntax of the 16- and 32-bit `Declare` statements is supplied with Graphics Server in text file format. As there are over 200 functions in the Graph library, developers have the option to declare all of them in one standard code module or to declare only the functions used by a particular project. It is not even necessary to use a standard module as `Private Declare` will enable functions to be declared within a form, if required. The problem with `Private Declare` is that function declarations can end up scattered throughout a project with the obvious implications for maintenance. Using a standard module and including the whole of the supplied set of `Declare`s in it is the preferred approach since the same module can then be used not only in any VB4 but also in any VBA project which calls Graphics Server.

Most Graphics Server functions take numeric values as their parameters, which raises the prospect of code such as

```
r = AGShow(4, 2, 1)
```

To increase readability, Graphics Server defines not just DLL calls but also a set of nearly 600 constants. It makes code both easier to write and maintain. For example, the line above can be rewritten as:

```
' Show a 3D Bar graph, with no labels
' on the axes and draw a mean line
r = AGShow(AGBAR3D,AGLINENOLABELS,AGMEAN)
```

Visual Basic has some weaknesses in relation to declaring constants, the situation has not improved with VB4. Specifically, there is no `#DEFINE` or `#INCLUDE`, and constants can only be defined with the use of the `Const` statement. Like the `Declare` statement, the `Const` statement can be used within a VB standard module, or within a form or a report. The advantage of declaring constants in a standard module is that if the value of a constant is amended then only one change is necessary, and there is no possibility of differing values for a constant existing elsewhere within the project.

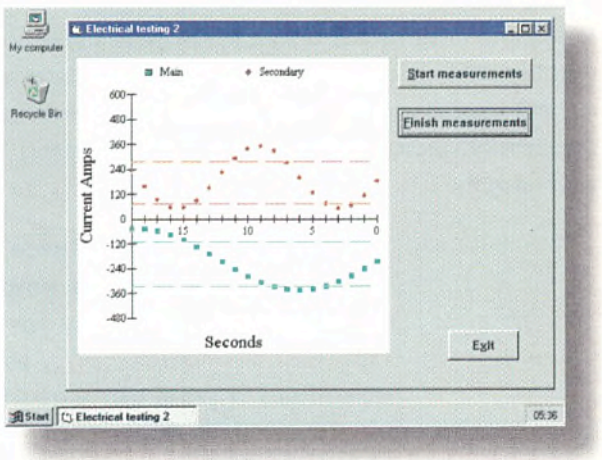
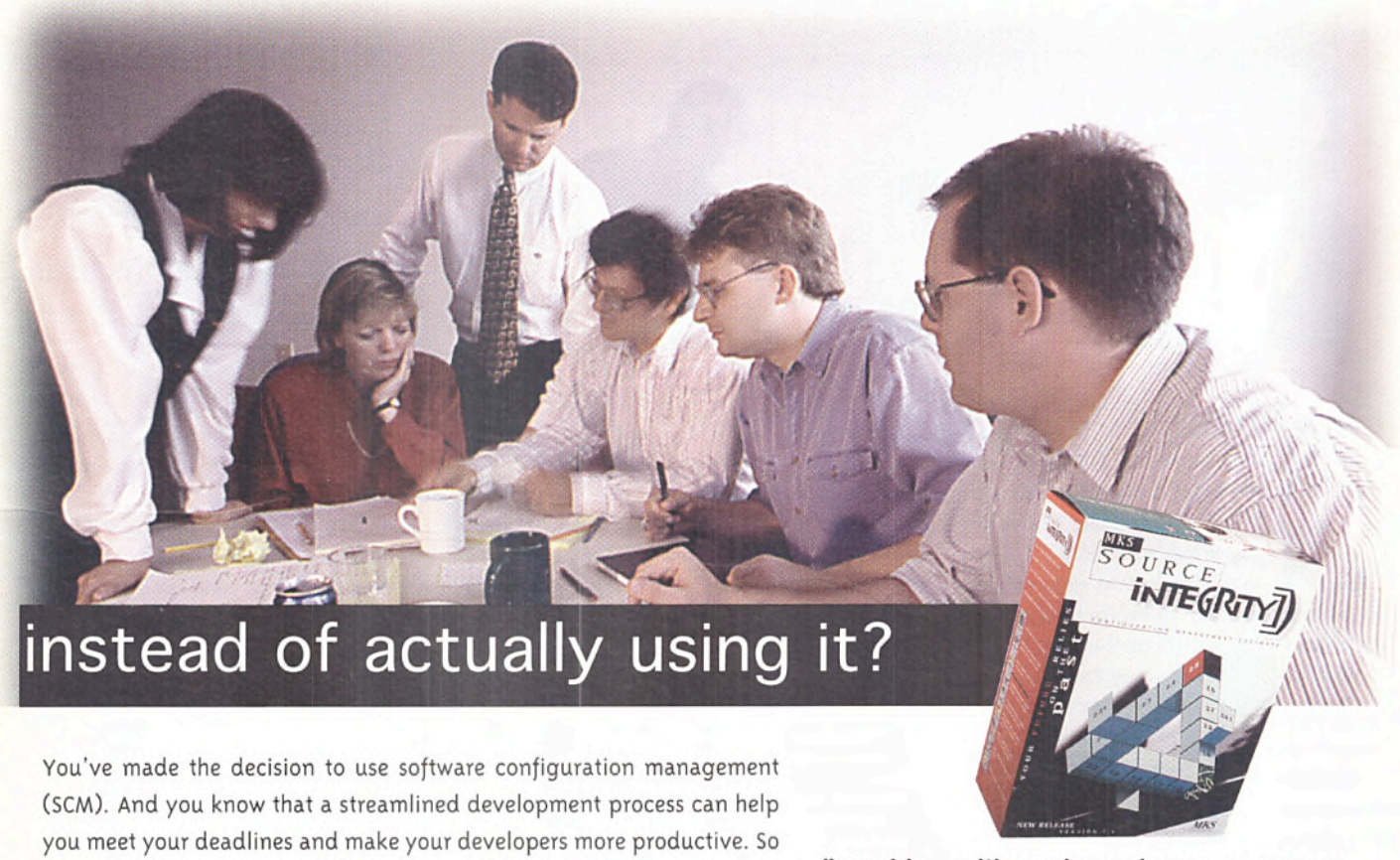


Figure 1 – Specialist graph types such as Time Series are a feature of Graphics Server.

How much time are you spending learning your configuration management system.....



instead of actually using it?

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At your service

A key feature of Graphics Server is that as its name implies it provides a single server application which can be accessed by any number of client applications. Only one instance of Graphics Server is ever opened, by the first application which includes either a call to the `GSOpenServer()` function or activates a Graphic Server control. The server maintains an internal usage count which is incremented with each call to open the server and decremented with each call to close the server. The server does not close until all client applications are themselves closed and the usage count reaches 0.

For this feature to work correctly, the following line of code is required before any other Graphics Server function is called:

```
r = GSOpenServer("", "C")
```

When exiting the application a matching line is needed:

```
r = GSCloseServer()
```

The first parameter of `GSOpenServer()` is always a null string, the second parameter controls whether or not the Graphics Server icon appears on the desktop. Using `"C"` as a parameter will show the icon, which is useful for developers as a way of checking that Graphics Server has opened and closed. For distributed applications setting this parameter to `"HC"` will hide the icon.

Return values from Graphics Server functions are generally either 0 for success or -1 for failure. Unless there is a major problem, it is common to expect that every function call will be successful. It is better practice to assume that any call may fail and write code to handle failure if it occurs. For example if a call to `GSOpenServer()` returns a value of -1, a dialogue box could be opened, the end-user informed that Graphics Server cannot be loaded and the facility for a retry or exit offered. This avoids a succession of errors as all subsequent function calls will fail.

Defining windows

Graphics Server draws graphs within a graphing window or child-window. Defining windows does not require any interrogation of the graphics hardware or screen resolution. Windows can be defined as full-screen, or positioned and sized as a calculated proportion of the current screen height and width. These calculations require Graphics Server functions to use device-independent 'anchor units'.

Determining the screen height and width in anchor units requires two function calls:

```
ScreenHeight = GSGetSXExt()
ScreenWidth = GSGetSYExt()
```

Setting a point of origin for a graph window one-quarter of the way across the screen and half-way up involves some anchor unit calculations:

```
fxOrg = ScreenWidth * 0.25
fyOrg = ScreenHeight * 0.50
```

as does setting the width and height of the graph window:

```
fWld = ScreenWidth * 0.25
fHt = ScreenHeight * 0.50
```

These calculated anchor unit values are used as parameters to Graphics Server functions which open windows or child-windows. It is also possible to specify the window style, for example whether maximise and minimise buttons, and a title are present.

Another issue which needs to be addressed is the number of colours supported. The Windows standard is 256 colours, but Graphics Server defaults to a palette of 16-colours, plus 16 half-tones used to shade pie-charts, for example. As an option a set of ten 128-colour palettes is available. They consist of the standard 16 colours and 16 half-tones plus 96 other colours. The Graphics Server constants only cover the 16-colour palette so developers intending to use a 128-colour palette will need to generate their own set. While a full range of 256 colours would be preferable, the limitation to 128 is not likely to be significant for most graphing purposes.

Graph types

The raison d'être of a graphing toolkit is that it should not only provide many options for the common graph types such as area, bar, line and pie charts but should offer some of the more specialised varieties. The Graph library includes some of the more esoteric options such as box-whisker, bubble, fast Fourier transformation and time series as well as a comprehensive range of 3D types including scatter and surface area (see Figure 1). It is possible to overlay a line graph over some graph types, and statistical lines such as maximum, mean and minimum can also be shown (see Figure 2).

A useful option is the ability to label data symbols, with explanatory text. It may be necessary to graph data which is not precisely defined and where a range of known error or uncertainty exists, the Graph library provides error bars for precisely this situation. While the customisation options such as text orientation, bitmap backgrounds and colour palettes can, if used correctly, add to the visual impact of a graph, a potential downside is often the amount of source required to achieve this. Bits Per Second has addressed this issue by providing a set of high-level AG or AutoGraph functions. Using the AG functions requires at least some of the low-level GS Graph library functions, but the amount of coding required is minimised.

Using the AG functions to construct for example a scatter graph with curves to suggest trends in the values and error bars only needs about 20 lines of code. See Listing 1. This example illustrates the importance of source documentation and the use of the symbolic constants.

It is possible to draw two or more graphs within the same graphing window, if necessary drawing the same set of data (see Figure

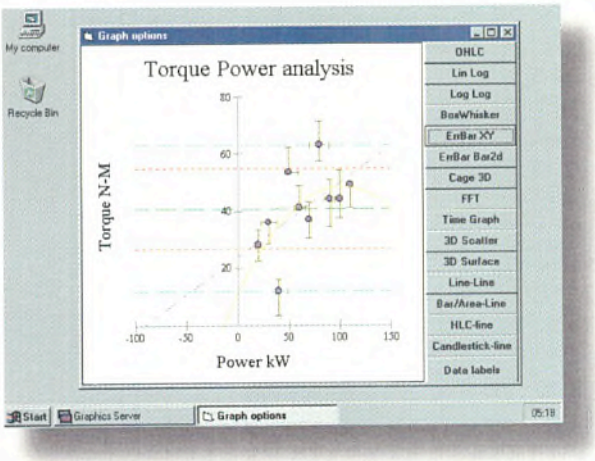

Figure 2 – Graphs can be overlaid with statistical lines such as mean, minimum and maximum.

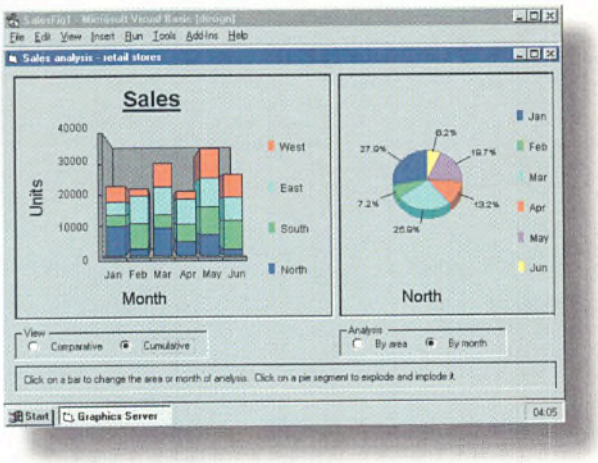

Figure 3 – Graphics Server can display two or more graphs simultaneously.

3). Each graph becomes a view and can be turned on or off with the `GSOnView()` and `GSOffView()` functions. End-users can be given a choice of views by attaching the `GSView` functions to the `On_Click` event of command buttons in a Visual Basic form.

Hot-graphing

An important Graphics Server feature is 'hot-graphing' or the ability to introduce a degree of interactivity into a graph, such as displaying additional information when a particular slice is clicked on a pie chart. Hot-graphing requires the use of two functions, `GSHotGraph()` and `GSMNotify()`. `GSHotGraph()` takes a single parameter – True or False – which turns hot-graphing on or off. `GSMNotify()` enables or disables notification of mouse events, and generates a message identifying the index number of the region where the mouse has been clicked.

Enabling hot-graphing requires the developer to write source to access the Windows API to retrieve the message from the queue and process it. Sample code is supplied as part of the Graphics Server documentation.

Obtaining data

Graphics Server requires data in the form of one or two-dimension arrays. Amplitude (Y axis), distance (X axis) and Z axis (3D scatter graph) arrays use floating-point values so the array must be declared as double, other arrays can use integer or string values. Graphics Server does not support DDE, nor are there any functions to extract data directly from sources such as spreadsheets or databases. Databases are perhaps the most likely source of information for data, and for graphing purposes only the data from a particular field or set of fields is likely to be required. A new VB4 object, the `Recordset` – in `Dynaset` (updatable) or `Snapshot` (non-updatable) form – can be created with an SQL statement. This can take into account end-user choices such as the table, and a set of records within the table, for a particular customer. A `For...Next` loop can be used to store field values in an array.

Powerful but not visual

The AutoGraph functions represent the best initial approach to programming the Graph library and the Graphics Server low-level functions offer as much customisation and facilities (such as printing) that developers are likely to require. Graphics Server has the advantage of being a product developed by a UK software house which offers free technical support, a BBS, and regular upgrades.

There are some weaknesses in Graphics server which could be addressed in future releases. One is the restriction to 128 colours and another is the absence of the toolbar which is a feature of the Graph control. Graphics Server also offers no form of visual design and this confines Graph library programmers to the traditional write, compile, test mode of application development. This makes less sense with products like VB where visual design is an important feature.

These points notwithstanding, Graphics Server is a powerful but complex general-purpose graphing toolkit which has no equals for applications where graphing is an essential feature. This is particularly true where some of Graphics Server's more specialised graph types are welcomed or even required. ■

Colin Hume is a journalist specialising in software. The Component Kit (CK) version including the VBX, OCX and a 16-bit VCL is available for £200. The Development Kit (DK) which includes the CK plus DLLs and a C class library costs £245. Bits Per Second (01273 727119) just announced that mid-March should see the CK discontinued and a 32-bit VCL added to the DK.

```
' AGOpen() must be called before any other AG functions. It allocates
' additional memory for data arrays required by this group of functions.
r = AGOpen()

' Define the graph title, the left title and the right title
r = AGTitleG("Torque/power analysis")
r = AGTitleY("Torque N-M")
r = AGTitleX("Power kW")

' Transfer amplitude (Y axis) data to Autograph.
' nPts = number of data points, nGroup = number of data sets,
' fAmp is a pointer to an array of amplitude data
r = AGAmp(nPts, nGroup, fAmp(0))

' Transfer distance (X axis) data.
' fDist is a pointer to an array of distance data
r = AGDist(nPts, fDist(0))

' Transfer symbol information.
' nSym is a pointer to an array of symbol data (defining 14 symbol designs)
r = AGSym(nPts, nSym(0))

' Transfer colour information.
' nCol is a pointer to an array of colour (by default, the default palette)
r = AGClr(nPts, nCol(0))

' Transfer amplitude (Y axis) error data for error bars.
' Errors are plus and minus error pairs stored in the error data array.
' nErrVs = number of error values; 1 = number of data sets
' fAmpErr is a pointer to the array of amplitude error data.
r = AGAmpError(nErrVs * 2, 1, fAmpErr(0))

' Transfer distance (X axis) error data for error bars.
' fDistErr is a pointer to the distance error data array.
r = AGDistError(nErrVs * 2, fDistErr(0))

' Low-level GS function to define the symbol size (standard size = 25).
r = GSSizeSymbol(30)

' Set title size and background colour.
' AGTTLYLEFT = select left title, AGTTLUP = draw title upwards,
' BLACK = text colour.
r = AGTitleBG(AGTTLYLEFT + AGTTLUP, BLACK)

' Define error bars.
' AGEBY = amplitude (Y axis) data; AGEBX = distance (X axis) data,
' 0 = standard style; BROWN = error bar colour,
' AGEBMAXMIN = error data is provided in an array,
' AGEBPERCENT = the error is expressed as a percentage of the data value.
r = AGErrorBar(AGEBY, 0, BROWN, AGEBMAXMIN, AGEBPERCENT)
r = AGErrorBar(AGEBX, 0, BROWN, AGEBMAXMIN, AGEBPERCENT)

' Set the X axis style.
' AGUMIN = axis minimum value is present,
' 0, 0, 0 = number of ticks, labels every nth point, axis maximum value.
' 100 = axis minimum value.
r = AGXAxisStyle(AGUMIN, 0, 0, 0, -100)

' Set colour of foreground objects.
' First parameter, values 6 to 13 colours the legend text, axis,
' grid lines, mean lines, min and max lines, standard deviation line,
' best-fit line and curve fit line.
' Second parameter, values 7 to 14 are the colour constants: WHITE,
' LIGHT GREY, LIGHT BLUE, LIGHT GREEN, LIGHT CYAN, LIGHT RED,
' LIGHT MAGENTA and YELLOW.
For j = 6 To 13
  r = AGFGColor(j, j + 1)
Next

' Set the curve style.
' CFPOLY = variable-order polynomial,
' 2 = number of points over which average is taken,
' 50 = number of steps (granularity) of the curve.
r = AGCurveStyle(CFPOLY, 2, 50)

' Show the graph.
' AGSCATTER = scatter graph,
' 0 = no styling options selected,
' AGMEAN = draw a mean line, AGMINMAX = draw minimum and maximum lines,
' AGSD = draw standard-deviation lines,
' AGLINEFIT = draw best-fit line (linear regression),
' AGCURVEFIT = draw curve through points.
r = AGShow(AGSCATTER, 0, AGMEAN + AGMINMAX + AGSD + AGLINEFIT + AGCURVEFIT)

' Close Autograph and free the memory allocated for data arrays.
r = AGClose()
```

Listing 1 – A scatter graph developed using AG functions.

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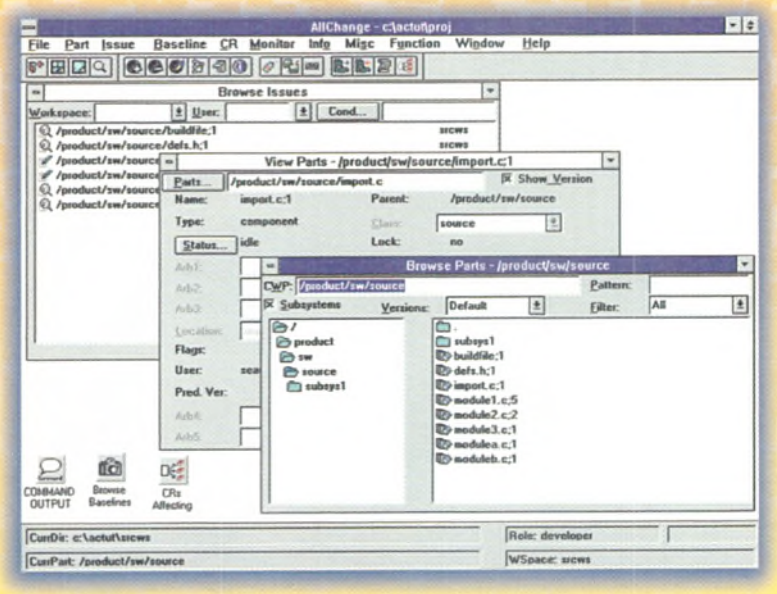

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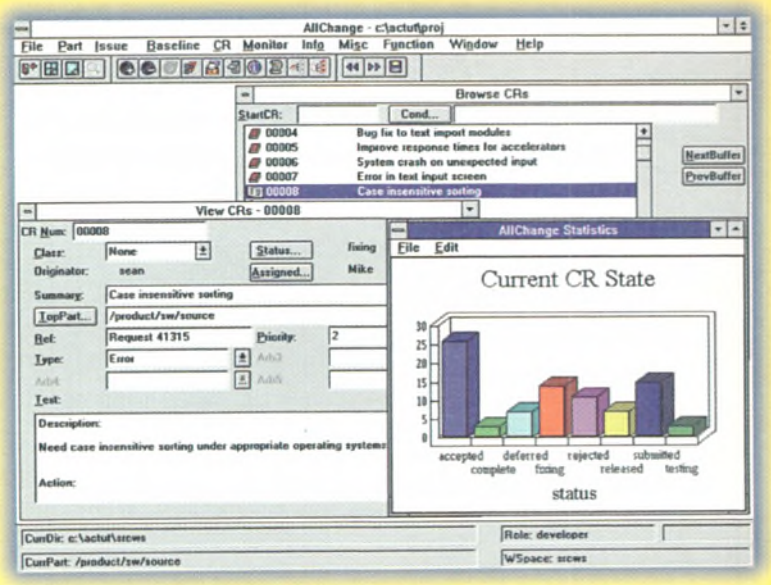

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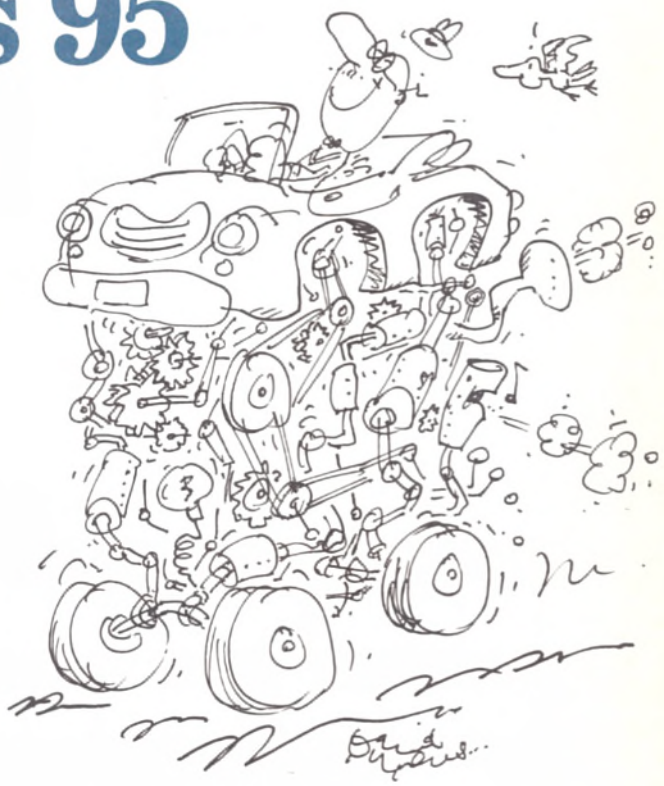
CIRCLE NO. 546

VTOOLSD for Windows 95

Developing Windows VxDs can be tricky. **Roland Perera** discovers whether Vireo's device driver toolkit for Windows 95 makes the task any easier.



Device driver development for Microsoft Windows has always been notoriously difficult. Thanks to Vireo Software's VTOOLSD toolkit, the device driver territory – traditionally the domain of assembly language programmers – is now open to C and C++ programmers. VTOOLSD was first released for Windows 3.1 in July 1994, a pre-release version for Windows 95 was available as soon as early 1995 (see 'Easy Peasy, when it's VXDeasy' in *EXE* April '95). The final version has eventually been released at the very end of '95. It supports all the system services new in Windows 95, and adds functions, examples and enhanced documentation.

VTOOLSD consists of Windows-based tools for VxD development, command-line utilities, a *User's Guide*, various help files, and some bits taken from Microsoft's DDK (Device Driver Kit) for Windows 95. Table 1 lists the individual components. To build VxDs using VTOOLSD, you'll need either Microsoft Visual C/C++ 2.0 or later, or Borland C/C++ 4.02 or later. During the installation process, VTOOLSD will ask you for the path of your command-line compiler, although for some reason long filenames are not supported in the browse dialog. Little oversights like this don't engender a lot of faith in a product specifically redesigned for Windows 95, and in fact the lack of support for long filenames crops up again in the Dynamic VxD Loader/Unloader, but don't let this put you off, it would be an error!

QuickVxD

The quickest and easiest way to write your own VxD is to start with the QuickVxD tool. As a user of Visual C++ or Borland C++, you'll no doubt be familiar with the concept of *wizards* (in Microsoft parlance) or *experts* (in Borland nomenclature), and that is just what QuickVxD is. Rather than using the 'back'/'next' sequential style of Microsoft wizards, QuickVxD employs a tabbed dialog to capture your requirements (see Figure 1). You check various check boxes, enter a few details here and there, and QuickVxD does the rest, generating an include file, a code module and a make file for your VxD (Borland or Microsoft format). A VxD specification can be saved for later use as a .QVX file. QuickVxD allows you to define characteristics of the target VxD, such as:

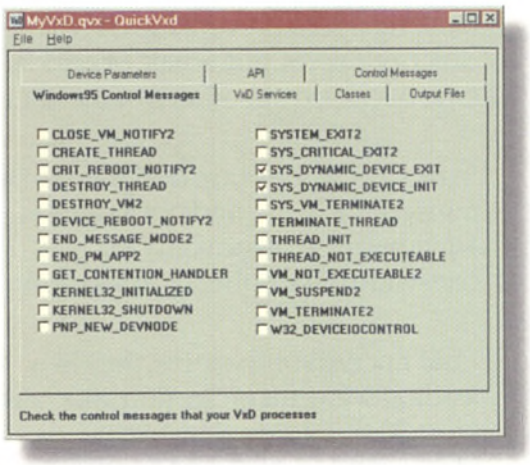


Figure 1 – QuickVxD can generate skeletons for control message handlers

- its name (which should not use Microsoft's VxxxxxxD convention);
- a device ID, required if you wish to supply services to other VxDs (`VIREO_TEST_ID` can be used for test purposes – otherwise a unique ID must be obtained from Microsoft);
- whether or not the VxD is to be dynamically loadable, a feature introduced with Windows 3.11;
- control messages the VxD should respond to (see Figure 1);
- V86, protected mode, and vendor-specific API entry points;
- prototypes for any services your VxD provides, including a `Get_Version()` function that should be specified as service 0.

The generated source files will include skeletons for any control message handlers, API entry points, and VxD services that you have requested. (Figure 2 shows a .CPP file generated by QuickVxD.) Once you've fleshed out these skeletons, you can run a make utility – NMAKE or MAKER – on the QuickVxD-generated make file to build the VxD. (One way to do this is to 'wrap' the make file in a Visual C++ or Borland C++ project.) The make file will invoke the SEGALIAS utility to modify object files to conform to VxD segment conventions, and then PELE to convert the linked binary from PE (Portable Executable) to LE (Linear Executable) format, yielding a .VXD file. No

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Virtual Device Drivers – an overview

It's worth digressing briefly for those unsure of exactly how device drivers fit into the Windows architecture. Originally the purpose of a device driver was to provide an abstract interface to a piece of hardware, such as a monitor or mouse. Windows extended this notion, in the form of virtual device drivers, or VxDs, to encompass other operating system services such as file system extensions and protocol stacks. (The name 'VxD' means 'Virtual Device Driver'. VxDs distributed by Microsoft have names such as VKD, for Virtual Keyboard Device.) A VxD is best thought of as a general-purpose DLL that runs in ring 0, the most privileged protection level of the 80x86 architecture. VxDs can export API services both to user applications and to other VxDs.

Typically VxDs are used by two kinds of developers: hardware engineers, and software engineers. Hardware-oriented VxDs are employed for tasks like managing device contention, buffering data, and handling hardware interrupts. Software problems solved with VxDs range from hardware emulation to the monitoring of system behaviour.

The Windows enhanced-mode kernel depends heavily on VxDs, and Microsoft supplies dozens of such drivers as part of the core operating system. Unfortunately, programmers writing low-level drivers must use the register-based, assembly language interfaces offered by the Windows Virtual Machine Manager (VMM). VtoolsD for Windows 95 simplifies the development of VxDs by providing tools to build them in C or C++.

Virtual machines and the VMM

A virtual machine (VM) is the abstraction that allows an application to execute as though it were the only application running on the system. In the Windows operating system, it is a task that has its own address space, I/O port space, interrupt vector table, and CPU register state. Virtual machines have three components: a virtual 8086 (V86) component; an optional protected mode component; and a set of ring-0 data structures. The V86 component contains a 1 MB address space, which, when a virtual DOS machine is created, is initialised with a 'snapshot' of all the real-mode drivers loaded by AUTOEXEC.BAT and CONFIG.SYS during the boot stage.

The system VM is a special virtual machine in which all Windows programs run, including 16-bit Windows 3.1 applications as well as 32-bit programs. It is created during system initialisation by the Virtual Machine Manager, or VMM. The VMM is the lowest layer of the Windows operating system, managing multiple VMs and providing virtual memory and scheduling. It consists of a set of services and of the VxDs. VxDs extend the range of services the VMM provides to applications.

Events, handlers and notification

VxDs are primarily event-driven – there is no synchronous flow of control. VxDs subscribe to notification of an event type (including interrupts, exceptions and faults) by calling the VMM, supplying the entry point of a handler. VxDs often need to execute in the context of a particular VM or thread. To achieve this, a VxD can post a special event that invokes a callback once the desired VM or thread becomes current.

Each VxD must provide a control message handler. Control messages are generated by the VMM when various system events occur, for example when Windows starts up or shuts down, a protected-mode application starts or terminates, or a thread is created or destroyed. Figure 1 shows the control messages specific to Windows 95.

manual intervention is required to build a basic VxD, though if you require special features – say if your VxD needs a real-mode initialisation segment – you'll need to modify the make file yourself.

For debugging, Vireo recommends Nu-Mega's Soft-ICE/Windows source-level debugger, although PELE can generate symbol table files compatible with the WDEB386 debugger that comes with the Microsoft DDK. Use of Windows 95s debug kernel is recommended.

Frameworks

Vireo provides two 'frameworks' for developing VxDs, one for C and one for C++. QuickVxD is capable of using either of these frameworks when generating a VxD skeleton. The frameworks generate a `Declare_Virtual_Device()` macro to define the VxD's Device Descriptor Block (DDB), a data structure that the Virtual Machine Manager uses to determine the virtual device's initialisation order, find its control message handler, and establish its linkage to applications and other VxDs. (Figure 2 shows code generated by QuickVxD that uses this macro.) Similarly, a set of `VxD_Service()` macros is provided for creating the tables required to register services with the VMM.

A VxD written using either framework also has access to a set of C wrapper functions for all the VMM and system VxD services of Windows 95. System interfaces use a register-based calling convention which is tricky to use and prone to error. The C wrappers allow you to call system services using a stack-based calling convention which is safer as well as more convenient.

Beyond this, the two frameworks differ considerably. For example, the C framework processes a control message issued by the VMM by

VToolsD component	Description
QuickVxD	Wizard-style application for rapidly generating a VxD template.
Dynamic VxD loader	Loads/unloads dynamically loadable VxDs.
VxD Viewer	Displays information on all currently loaded VxDs.
SEGALIAS	Utility that modifies the segment names of OMF object files so that they conform to VxD conventions.
PELE	Converts 32-bit DLLs from PE (Portable Executable) format to LE (Linear Executable) format.
SETHDR	Stores extra driver information in the header of a VxD file. Replaces Microsoft utility ADDHDR.
VXDVER	Creates a compiled version resource that SETHDR can append to a VxD.
TESTVXD	Examines a VxD to see if it contains proper records for fixups that span a page boundary.
LINK	Patch for Microsoft linker shipped with Visual C++ 2.0.
Wrap libraries	C interfaces to Virtual Machine Manager and standard VxD services.
C Framework	A framework for writing VxDs in C.
C++ Framework	A class library framework for writing VxDs in C++.
C Run-Time Library	A subset of the ANSI Standard C Library tailored specifically for VxDs (no DOS or BIOS calls).
NDIS libraries	An implementation of the Network Device Interface Specification (NDIS) functions.
Help file	On-line help for VToolsD.
DDK component	Device Driver Kit
INF file editor	Allows the editing and creation of Windows 95 INF files.
Help files	Help on I/O, Network Device Interface Specification (NDIS), VCOMM and Plug-and-Play subsystems.

means of a `ControlDispatcher()` handler which must be defined by the VxD. The C++ framework, which warrants further explanation, employs a quite different strategy.

C++ framework

The VTOOLSD C++ framework comprises 50-odd classes covering a wide range of functionality. Often, in writing a VxD, a large fraction of the development time is spent dealing with the complexity of the VMM and other system VxDs. The C++ framework attempts to combat this in a couple of ways. First, by providing a consistent interface to system services and a standard way of exporting services and dispatching control messages. Secondly, by combining operations that are commonly used together: the library offers a higher-level, more abstract interface than the fine-grained interface of assembly language or C. However, key sections have been written in assembly language so there should be minimal performance degradation.

Three classes in the library play a special role in structuring a VxD:

- `VDevice`, used to derive a class which represents the device driver itself;
- `VVirtualMachine`, an instance of which may be constructed to process VM-oriented messages;
- `VThread`, an instance of which can be constructed to process thread-oriented messages.

```
MYVXD.cpp
// MYVXD.cpp - main module for VxD MYVXD

#define DEVICE_MAIN
#include "myvxd.h"
Declare_Virtual_Device(MYVXD)
#undef DEVICE_MAIN

MyvxdVM::MyvxdVM(VMHANDLE hVM) : VVirtualMachine(hVM) {}

MyvxdThread::MyvxdThread(THREADHANDLE hThread) : VThread(hThread) {}

BOOL MyvxdDevice::OnSysDynamicDeviceInit()
{
    return TRUE;
}

BOOL MyvxdDevice::OnSysDynamicDeviceExit()
{
    return TRUE;
}

VOID MyvxdDevice::V86_API_Entry(VMHANDLE hVM, CLIENT_STRUCT* pRegs)
```

Figure 2 – File generated by QuickVxD using the C++ framework

Member functions of classes you derive from `VDevice`, `VVirtualMachine` and `VThread` determine which services to export to other VxDs, whether or not your VxD supplies an entry point for applications, and which control messages you process. For example, protected-mode or V86 API entry points can be provided by overriding `PM_API_Entry()` or `V86_API_Entry()` members of your `VDevice`-derived class. Similarly, `OnDeviceInit()` must be overridden to handle `DEVICE_INIT` control messages. The class library itself handles message dispatch, so there is no need for the `ControlDispatcher()` callback of the C framework. Processing a message specific to a particular virtual machine or thread is as simple as deriving a class from `VVirtualMachine` or `VThread`, overriding the appropriate member function, and ensuring that an instance of the class is created during initialisation of the VxD.

Other classes of the C++ framework provide a wealth of system-level functionality, covering pipes, event handling, debugging via an auxiliary terminal, memory management, interrupt handling, DMA channel virtualisation and buffering, callbacks, fault handling, time-

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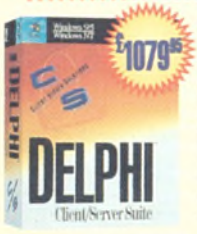

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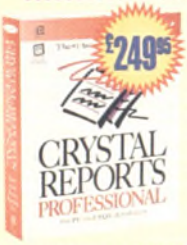

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out notification, port virtualisation, hot keys, semaphores, mutexes, and accessing the registry.

Documentation

Surprisingly, I found one of the best aspect of the product to be the documentation. Since system vendors tend to put far more resources into supporting application development than they do for system extensions, information on system-level programming can be scant to say the least. The Windows 95 DDK, for example, provides minimal documentation on the assembly language interfaces that VxD programmers rely on. The VTOOLSD *User's Guide*, by contrast, is a very good introduction to the internals of Windows 95, and is refreshingly short, logically ordered and perspicuous.

About a third of the guide pertains to the C++ class library, which gives an idea of how central the library is to the VTOOLSD product as a whole. Chapter 8 of the book covers various Windows 3.x topics, such as the controlling of VxD segmentation (which segments are used for particular code and data). The last chapter is devoted to special Windows 95 issues, like application time events (called 'appy time' events), which are signalled when it is safe for a VxD to invoke any Windows API. Figure 3 shows a VxD using an appy time event to display a message box. Also included are some excerpts from the Microsoft DDK documentation.

My only complaints about the *User's Guide* are the abundant typos, a poor index, and an unimaginative use of hierarchical headings. This last point is most notable when you try to read the book linearly, rather than just dipping into it as you might a reference tome: it's easy to lose track of the context of the topic you're currently reading.

Figure 3 – Example VxD responding to notification of CREATE_VM event

The VERDICT

VTOOLSD is a comprehensive ensemble of tools and utilities for VxD creation. If you're currently developing VxDs for Windows 95, or plan to in the near future, VTOOLSD is a must. It provides all the functionality of the Microsoft DDK that ships with Level II of the Developer Network, while allowing developers to take advantage of the high-level, object-oriented features of C++. Of course, there are aspects of VTOOLSD that could be improved, and that no doubt will be in future versions, but in the absence of any competition the choice of tool is already made for you. May you drive many a virtual device in the days to come! ■

VTOOLSD for Windows 95 is available from System Science, priced at £345, with free next-day delivery.

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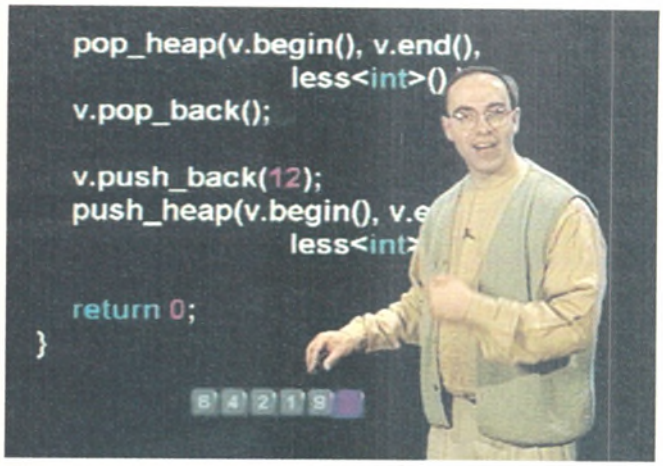

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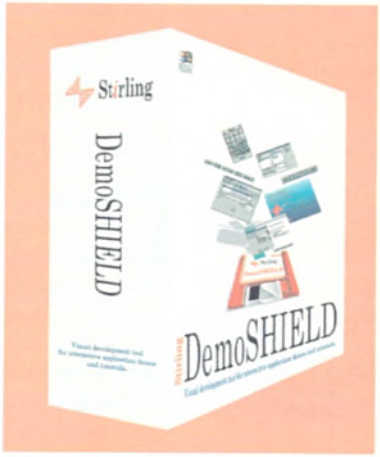

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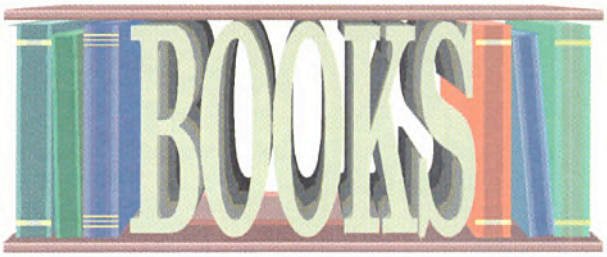

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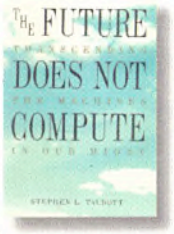


This book is the antidote to hype about the Internet. The theme is not the usefulness of the net or how to use it, rather the effect it has on your spirit and soul. It could be described as a 'meta-net' book, that is, it is about the effects of the Internet on the way we live our lives. Steven Talbott's argument is that a meaningful life involves vision, ideals, risk and a spiritual element. Computing involves making decisions on the basis of past behaviour, and a future based on this is impoverished and ossified. It is about the limitations of rationality.

Perhaps acknowledging the limited attention span induced by Internet exposure, the book is organised into short chapters, usually less than 10 pages long. These have grabby titles like 'Settlers in Cyberspace', 'Dancing with my Computer' or 'Awakening from the Primordial Dream'. The overall message of 'computing can harm the soul' is structured into sections dealing with the effects on community, education, words and consciousness. The approach tends to be a debunking one of taking a claim for the Internet, eg global peace through global communication, and then demolishing it. In the section on education, Talbott argues that the effect of computers is to move the child's experience away from the concrete and towards the abstract. As well as the loss of wonder that can follow from using simulations rather than the real thing, there are more metaphysical concerns. One of these is the lost opportunity for growth due to the lack of connectedness between the child and the experience. Children need the real world first and abstraction later.

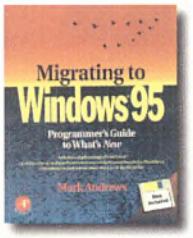
This is largely a study of what the Internet says about the human condition. '[We have] text processing or program execution without thinking; information instead of meaning; connectivity instead of community; algorithmic procedure instead of willed human behaviour; derived images instead of immediate experience.' The style is easy to read, but tends to take longer than necessary to make the point. However it achieved its aim as the effect of the whole was to make me switch off the computer and seek out human company.

I feel confident in being able to predict the type of reader who will enjoy this book. Ignoring the limitations of stereotypes I suggest that you will enjoy this book if you a) have a sixties set of values b) have/had Roszak's 'Cult of Information', Hofstadter's 'Gödel, Escher, Bach' or Pirsig's 'Zen and the art of Motorcycle Maintenance' on your bookshelves or c) read the Guardian. It was right up my street. Here is a man with a message writing from the heart. Having said that, if you wished to be cynical, you might also describe the author as a computer expert having a mid-life crisis. It slips out in the text that Stephen Talbott is moving to a small community that bakes its own bread and grows its own vegetables. While the Internet may appear to link us all together, he believes an authentic community requires eyeball to eyeball communication.

✓ **Verdict: Recommended (if you fit the stereotype)**

Title:	*The Future Does Not Compute*
Author:	*Stephen L Talbott*
Publisher:	*O'Reilly & Associates*
ISBN:	*1-56592-0856*
Price:	*£16.95*
Pages:	*455 pages*

Migrating to Windows 95. Programmer's Guide to What's New reviewed by **Chris Cant**



I was looking for a general book to fill any gaps in my Windows 95 programming knowledge. On-screen help can give the new usage of routines that you already know of, but a good book will introduce you to new areas of functionality.

Migrating to Windows 95 seemed to fit the bill from a C/C++ and MFC programmer's point of view. It starts with aspects of the user interface for programmers and the Windows 95 architecture. The book then goes through the Win32 API, MFC 4.0, its support for common controls, Visual C++ 4.0 and OLE controls. It finishes with processes and threads, console applications, DLLs, MFC extension DLLs, and TCP/IP sockets support.

The single floppy 'bonus disk' uses InstallShield to produce 12 MB of source code, including a simple OLE Control, to compile with Visual C++ 4.0. Topics covered range from processor registers to the 'new Windows API' – MFC. (I am not sure how Basic and Pascal programmers are supposed to use the 'new API'.) I felt that other APIs ought to have been described, but only Win32 and MFC were in there.

As befits the book's general scope, there were succinct code snippets and not too many listings of function parameters. However there were quite a few screen shots and walk throughs from VC++4.0. And the Microsoft line and product line did seem to be much in evidence; a reference to Delphi described it as an 'application generator'.

Migrating to Windows 95 needs a good proof-read, not least in checking that the figures match up with the text. The font for function names and code examples changed in various places. Perhaps some sections had just been culled straight from the author's NT programming book. Also a back cover claim that the book tells you how to use named pipes is not born out.

Some of the explanations not very clear to me at the start, eg the overall context and use of OLE controls within MFC, ought to be clear to a reader. Though, I am sure that some were plain wrong. A simple example is that Andrews says that his host IP address is the same as his email address – no!

Some topics which ought to be pointed out, especially in a general book, were missing. For example, in Windows 95 some Win32 functions calls are not implemented, Unicode is not used internally, and asynchronous I/O does not work.

Migrating to Windows 95 did get across some new information, but it was after fighting through a tangled web. I will double check anything before I use it. I was disappointed and am still looking for a good general overview of the Windows 95 API scene.

✗ **Verdict: Not recommended**

Title:	*Migrating to Windows 95. Programmer's Guide to What's New*
Author:	*Mark Andrews*
Publisher:	*AP Professional*
ISBN:	*ISBN 0-12-058525-1*
Price:	*£24.95*
Pages:	*623 pages (with floppy disk)*

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                                 method of your class
                                 'when the timer expires
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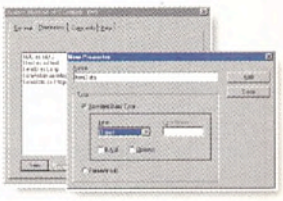

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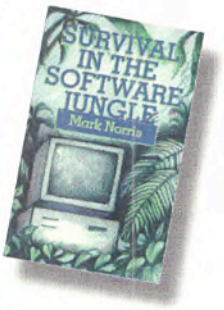

Written especially for managers and engineers who are responsible for systems development and information technology, the book uses a no-nonsense approach and practical examples to show you what you can and should do to make your software projects successful. The book provides signs to watch out for and assessment mechanisms, guiding you around the pitfalls and helping you to avoid costly mistakes. A collection of invaluable checklists backs up the advice provided in the main text, and the accompanying software allows you to evaluate the likelihood of your project succeeding.

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by Angelo Bobak

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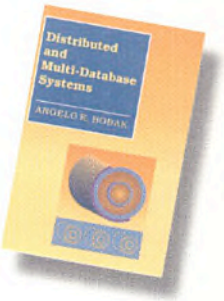

Regardless of your database experience, this book provides the foundation and understanding necessary for proper design of databases for today's distributed and multi-database architechtures. Introductory chapters help novices understand essential topics such as SQL, relational databases, transaction processing, and deadlock detection. Subsequent sections dealing with homogeneous, distributed databases, heterogeneous multi-databases, and federated databases apply information discussed in earlier chapters enabling readers to understand the complexities of distributed database design.

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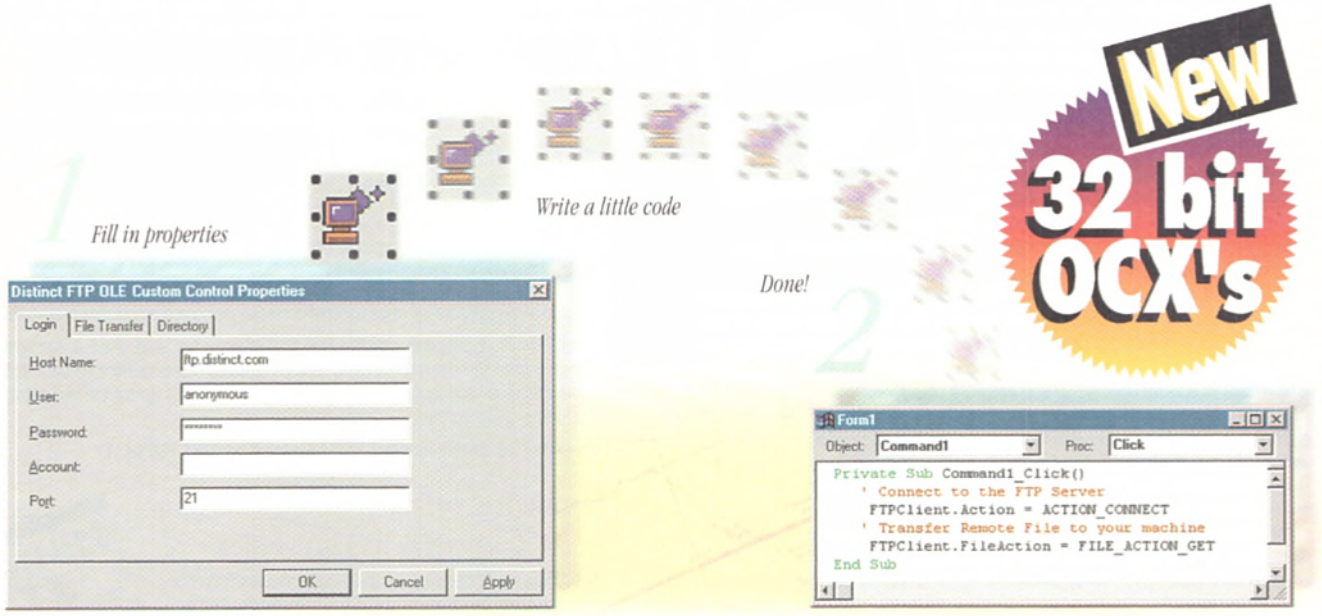

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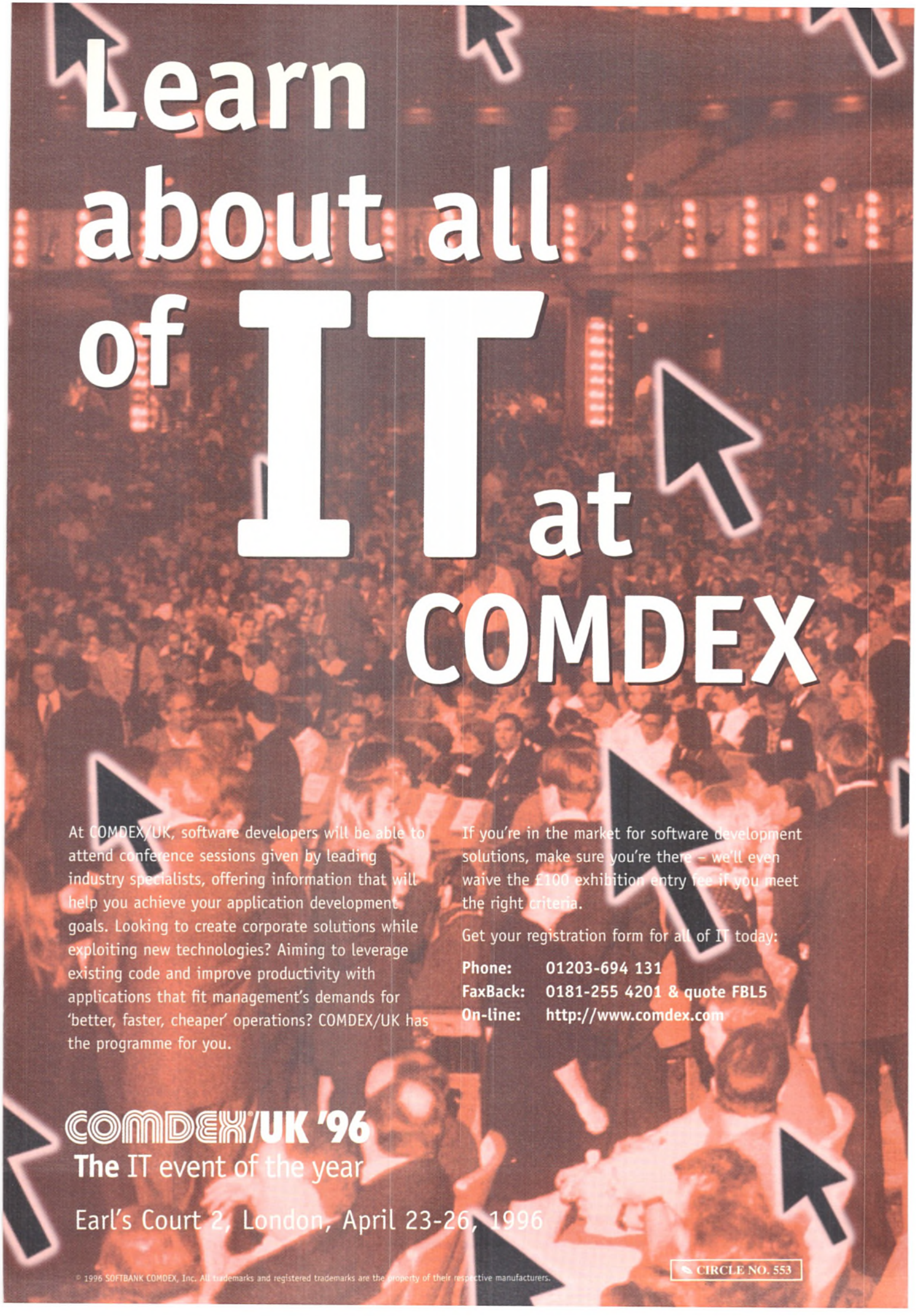
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C/C++/VISUAL BASIC/UNIX/WINDOWS 95/NT SERVER — **DEVELOPERS**
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UNIX/VMS/WINDOWS 3.1/95/NT MFC/C/C++ — **ALL LEVELS**
A degree in computer of natural science, two years solid C/C++ programming experience and a sound understanding of UNIX, VMS or MS-DOS are required to work on large scale programs with user interaction. You will need an intelligent problem solving approach to work and be a quick learner to programmer software in an X-Windows, Windows SDK or NT environment, port software to different systems and liaise with customers to drive through product improvements. Excellent career opportunities for the right candidates.
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SOFTWARE ENGINEERS-SENIOR SOFTWARE ENGINEERS
Various Client/End Users, Software Vendors and Software Houses dedicated to strategic implementations of leading edge technology and integration of applications across different hardware and operating systems platforms require candidates to degree level with a scientific/technical development bias and 1-3 years experience. There are two main options
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£12-£25K + benefits — **REF: SC/09/EXE**
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C, C++/MFC - Countrywide — **REF: SC/13/EXE**

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You would be responsible for developing and delivering courses from our Windows programming curriculum for Windows 95/NT. Your background will be one of programming and design, and you will have been writing software for Windows NT/95 for at least two years. You will be able to demonstrate the following essential skills: in-depth Win32 API knowledge; experience in using MFC; proven application design skills; an excellent C and C++ background.

Object Technology Specialist Lecturer

You should have practical experience with object-oriented design methodologies, such as OMT and BOOCH. This should ideally be backed up by knowledge of object-oriented programming techniques, databases and case tools. As well as lecturing, you will be responsible for managing courses in terms of their quality and content and may become involved with the delivery of strategic OO seminars to key clients.

C++/C Programming Lecturer

You should have extensive experience of software development using C++ (a minimum of 2-3 years) and should be able to demonstrate excellent presentation and communication skills. You will be managing OO programming courses, responsible for the course content, quality standards and future enhancements. Experience with other OO programming languages, especially Smalltalk, would also be very useful.

Ctrl Break

Please send your rants, raves and interesting tales to:

Ctrl/Break
EXE Magazine
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Cut your road tax bill in half

SEGA has launched a campaign which aims to deter British motorists from paying road tax. Play Don't Pay is part of the launch campaign for their new driving game Rally. 'At £49.99, it's less than half the cost of a car tax disc' comments one SEGA employee.

Having recently banished the four-wheeled one, and benefited in reduced stress – but higher drinking costs – Ctrl Brk can vouch for the wisdom of the virtual driving motor experience. 'The campaign will ultimately benefit society through reduced traffic congestion, improved quality of the environment and an immediate halt to the alarming increase in road rage' concurs SEGA.

Of course Ctrl Brk would be the first to admit that actually getting anywhere has become a distinct problem of late – but you can't have everything can you.

Ram-Raiders beware

Ctrl Brk has recently been alerted to the fact that nowadays even computers can be prone to attacks of memory loss. Or to be more accurate, attacks of *stolen* memory.

'It takes just one and half minutes for a skilled person to open a computer and remove just enough Ram so as not to totally disable the PC, restart the PC and be clean away with upwards of £300 per PC' announced Mark Roberts of Visionsoft Ltd.

But it's OK, the aforementioned company has developed a program to combat memory theft. *Ram-Alert* comes complete with sound alarms and visual displays to let you know of any technical amnesia, although it doesn't mention what they are. Ctrl Brk thinks that a knotted hankie might be rather nice.

All mouth and no anorak

At last Ctrl Brk is able to give a clue as to the hugely differing estimates of just how many people are using the Internet.

Recent research by advertising agency Chilcott Le Fevre has shown that 'men like to think they know a lot about technology, but in reality their knowledge is often very limited'. 57% of males questioned claimed to be on intimate terms with the Internet, yet over half were unable to provide an accurate description of the *thing*.

Women, on the other hand were less economical with the truth: of the 50% who claimed to know of the Internet, only 8% gave an inaccurate description.

Ctrl Brk can only assume that in today's safe sex climate, claiming knowledge of new technologies has taken over from British mans previous drinking pastime – claiming knowledge of the other sex.

A tricky cask

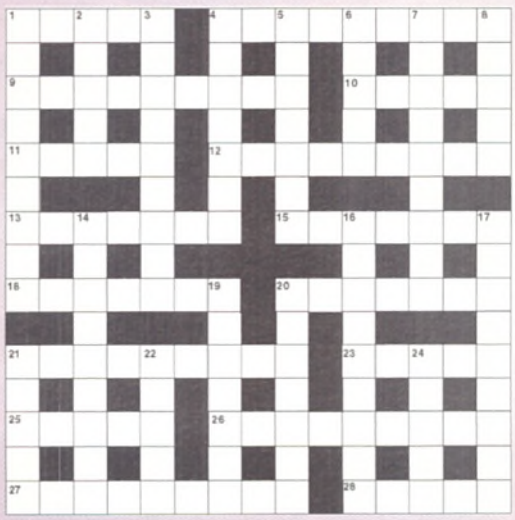
International whisky distillery United Distillers needed some help managing the movement of 3 million casks of whisky. So who did they call in? A genetic algorithm software program. Obviously.

'Each week 20,000 casks are moved in and out of our 49 warehouses... to provide the whisky needed for our blending programme' explained Inventory Manager Christine Wright.

So now XpertRule, developed by Attar Software is helping United Distillers to work out the best combinations for blending and recipes – in an effort to minimise movement of whisky.

Ctrl Brk is keen to offer its assistance should any further whisky movement problems occur – and is happy to offer its office as a final resting place for any casks they can't find room for. Doubtless the selfless nature of our readers will result in many similar offers over the next few weeks.

PRIZE CROSSWORD



ACROSS

1. Data structures used to get through the bars (5)
4. A change to data or the law (9)
9. Make 1 ac ready for 4 or reading (4,5)
10. What language programs do to commands as per change (5)
11. Throw away the class (5)
12. Such data must be in a haven (9)
13. They run down a set of files belonging to the Royal Society (7)
15. Place to find all the data in the world (7)
18. Data prep staff of the old school? (7)
20. Made corrupt like a dbms (7)
21. What shell or bubble does (5,4)
23. Vegetarian view of software hierarchy (5)
25. Sound warning of an error (5)
26. Toujours this nice way to be (9)
27. Try a major project (9)
28. Folk who prefer action to words (5)

DOWN

1. Diagram of file-handling system (9)
2. Losses of secure data, I hear, planted in Wales (5)
3. Folk who have a hard time, perhaps with their work (9)
4. Map data bases (7)
5. Festival - one-way origin of much hardware and software (7)
6. Local store, but not of data (5)
7. Faultfree, as all dp should be (9)
8. Stuck up a branching data structure by a bear... (5)
14. .. & ... (9)
16. ... duck-like part of the Internet with twelve-inch editor (9)
17. Puts at risk (a species, maybe) (9)
19. Soft soap used at the top (7)
20. Utility that calls phone numbers found in a file (7)
21. Processor sub-ordinate to another (5)
22. US uncle, graduate, leads the dance (5)
24. Output of interaction, this month's is here (5)

ACROSS:
1. ELEMENT **5.** BOOLEAN **9.** EXCLUSIVE
10. EPROM **11.** UNLATCH **12.** KEYWORD
13. ENTER **15.** OBSTETRIC **17.** OVERSTEER
19. STYLE **21.** EXTREME **23.** CLEANUP **25.** ADEPT
26. HEURISTIC **27.** ETHICAL **28.** ENGULFS

DOWN:
1. EXECUTE **2.** EXCEL **3.** EQUATOR **4.** THIGHBONE
5. BREAK **6.** ONEBYTE **7.** ERRHOURLY **8.** NOMADIC
14. TWENTIETH **16.** STRUCTURE **17.** OPERATE
18. SCEPTIC **19.** SEEKING **20.** EXPECTS **22.** ETHYL
24. NATAL

STOB

The All-New Adventures of Verity

Unsung heroes

'The people I really admire are those clever programmers who write all the software' said one of the talking heads on the BBC's *Brains Trust* series. **Ms Stob** wonders if she has ever met any.

'...and it crashes every time after the last GlobalAlloc' said the man with a nasty beard like Macca's on *Let it be*. 'Six GlobalAllocs in a row, and each time it passes back the same value.'

'There's yer bug' said a raincoated man, skilfully placing a quartet of full pints on the table. 'There's yer bug – GlobalAlloc does a kind of realloc automatically every time you call it. You gotta lock it if you want to get back separate bits.'

'Hold on a sec, Ron', said the youth in the corner, who was systematically skinning a beer mat. 'That can't be right. It's gotta give you back a different handle every time, otherwise how does it know which bit of memory you want?'

'Ah, now that's where you are out of date, old son', said Raincoat. 'That's where yer lack of 32 bit experience is showing through. In you proper 32 bit op sys, and I am not talking any old cack with last year's sell-by date on it here, know what I mean? ...in yer true 32 bit environment you can ask for a terabyte at each shot, and it still gives you back the right bit every time you want it. If that isn't what true multi-tasking is all about, what is?'

'But surely...' began Beermat, but was interrupted by Beard seizing back the initiative.

'So I reckoned it had gone west before I did the memory stuff, so I wheeled out the heavy-duty Penguin debugger, and what do you think I found in the GetSystemTime call?'

'That it thunks down to the BIOS?' suggested Raincoat in an irritating, doesn't-everybody-know-that voice, rolling his eyes.

'Wouldn't happen under OS/2' muttered the fat man sitting in the armchair who hadn't spoken before. It was his favourite, and indeed only, remark, and it was ignored by common consent.

'But how it does it, *that's* what I'm on about', said Beard heatedly. 'It only goes and generates an illegal instruction trap right in the middle of the VxD. There you are, skimming through proper 386 code and bang' – he crushed a Hula Hoop between his fingers to dramatise his point – 'bang, you're in the middle of the 1993 BIOS copyright notice.'

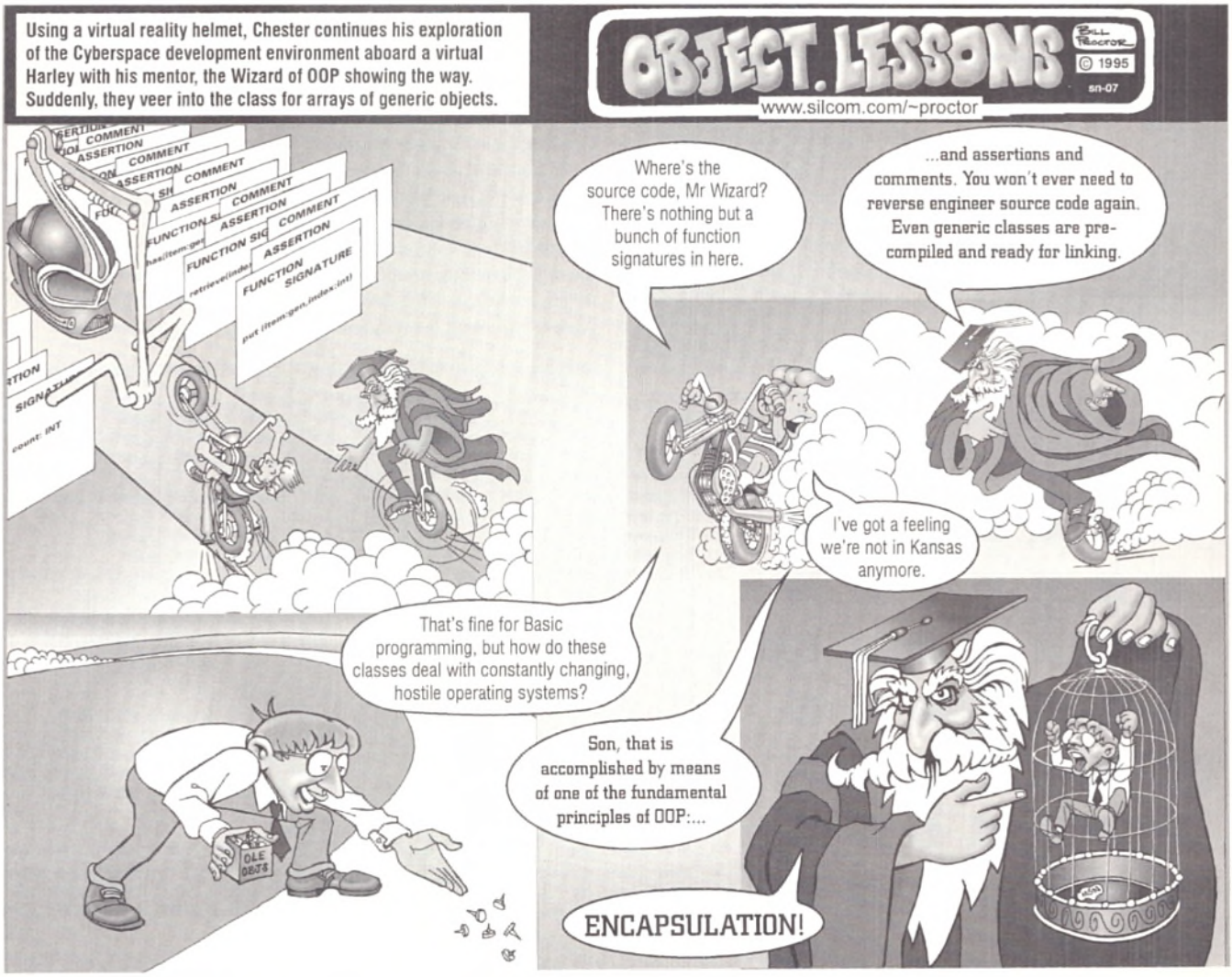
'How can you get from protected to virtual 86 mode using a trap?' asked Beermat.

'Ah, well, good question; you won't find that in the Intel manual. It's a special, secret Pentium instruction that they put in for MightySoft. Instruction code 2301, because Bill's birthday is on the 23rd of January.'

'I heard it was 1407', said Raincoat, 'because that was the day that Gary Kildall crashed the plane flying to Xerox Parc to buy CP/M for IBM.'

The bearded man frowned for a moment, as though he was going to take issue with this, then changed his mind and made peace.

'Ah well, maybe you're right', he said. 'Anybody fancy another pint?'



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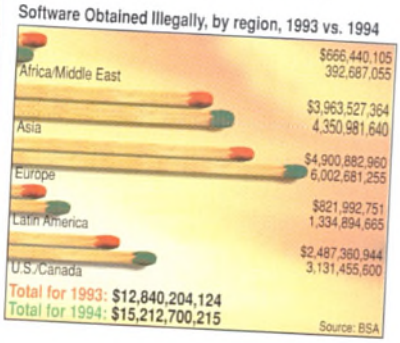
Each year, the illegal use of software consumes nearly 50% of your potential revenues. With the flames of piracy eating away at your profits, can you afford not to protect your software?

Software Obtained Illegally, by region, 1993 vs. 1994



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Ease of Learning	9.1	7.1	8.8	7.7
Ease of Use	8.3	7.2	6.8	6.3
Versatility/Features	10	8.7	8.8	8.6
Compatibility/ Power Consumption	6.7	6.5	6.6	7.4
Speed of API Calls	0.9	1.2	10	4.1
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†For a full copy of the NSTL report, contact your local HASP distributor.

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