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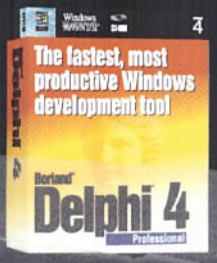

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RoboHELP Classic 7.0

Breath New Life into Your Existing Windows Help Systems

RoboHELP Classic 7.0 offers WinHelp 2000 which brings the power of HTML Help to the traditional WinHelp format, giving you the best of both worlds without any learning curve. It automatically integrates the dynamic new tri-pane, explorer-style interface of HTML Help right into WinHelp, providing advanced yet easy to use, search and navigation features. Web links, smart "See Also" buttons, Web graphics, and ActiveX controls, can also be added to WinHelp projects.

ColdFusion 4.0

Are You Building Dynamic Web Sites?

ColdFusion 4.0 is the fastest way to build and deliver scalable applications that integrate browser, server and database technologies. The IDE includes visual database, programming and debugging tools while the server provides a highly scalable foundation for high volume Web sites with load balancing and fail over. This version allows faster development, more scalable deployment, more technology integration and more robust security .

Visual WebGrid 3.0

Create Interactive Data-Bound Web Applications in Minutes!

Visual WebGrid 3.0 is the fast way to build web database applications. The new designer lets you visually build a powerful data-driven grid using real data from any local, ADO or ODBC data source. It can then be published automatically with the push of a button, including a built-in record navigation menu.

FlashFiler 1.5

Are You Looking For A Fast, Compact Royalty-Free Client/Server Database?

FlashFiler 1.5 is a professional, compact, multi-user, client/server database engine for Delphi and C++Builder developers. Just build your application, then ship it anywhere along with the royalty-free FlashFiler Server. Single-user apps can compile FlashFiler right in so there's only one EXE! And you can use FlashFiler as easily as the BDE - its components can be used anywhere you would use TTable or TDataSource. Your data-aware controls seamlessly connect with FlashFiler tables.

With Class 98

Powerful CASE Tool Can Import Your Delphi, C++, Java or Visual Basic Code

With Class 98 is an object-oriented CASE tool that models a system graphically with Class, State, Activity, Sequence, Use Case, Collaboration, Deployment, and Implementation diagrams. You can then generate source code in any object oriented language using a powerful scripting language. You can also generate class diagrams from your existing Delphi, C++, Java or Visual Basic code as well as from relational databases. With Class 98 supports all the leading methodologies including UML, Rumbaugh, Coad-Yourdon, Booch and Shlaer-Mellor.

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Exploding the PC as we know it

New Year is a time for predictions, the kind of stuff which is made fun of in the *Ctrl-Break* page a few years later. Well, I'll take on the challenge and start with a very bold prediction: the PC as we understand it will change beyond recognition. I'll even put a timeframe on that. It'll start to happen in about a year's time.

Let's start by looking at where we are today. When I say 'PC', we all have a common general understanding of what I mean. Usually, a box that contains at least one CPU, some RAM, one or more hard disks, a network card, and a video card; the whole thing connected physically to some input/output devices such as a keyboard, a screen, a mouse, a network, etc. Not forgetting some kind of operating system – for desktop systems most likely a version of Windows or Unix.

In essence, the PC is a multi-purpose device containing all that is needed for most applications, from real-time embedded control systems up to accounting packages. And, when on the move, we just shrink everything in a laptop making a few compromises on the way.

Here is a refinement of my prediction: the PC architecture will be exploded. The different elements making a PC will be physically separated. The one missing technology today is cheap wireless links with sufficient bandwidth. Bluetooth affords that and it is already in the labs nearing the standardisation stage. Bluetooth is the codename for a technology. In short, it specifies a low-cost, small form factor, short range radio-link in the unlicensed band at 2.4 GHz capable of a gross data rate of 1 Mbps. To be more precise there's one data link of 721 Kbps (with a return channel of 56 Kbps) and three synchronous voice channels of 64 Kbps. It is maintained by a Special Interest Group, which consists mainly of telecommunications and computing companies. The list of participants is long. More info can be found on the Bluetooth site itself *(www.bluetooth.com)* and elsewhere on the Web.

Initially we'll probably see a similar main box, and similar peripherals, but most if not all the cable will have disappeared. We'll use the new technology simply as a replacement for the bundle of cable dangling at the back of computers and to get rid of the line-of-sight requirements for the few current uses of infrared (IrDA). In a second stage, we'll start to discover new scenarios. We'll realise that we can use our favourite keyboard with whatever computer we want. We'll be able to roam around our offices and home and use whatever modem is in range to connect to the Net. The impact will be greater for portable computers and electronic devices. For instance, we'll be able to check our email from our PDAs without having to take the cellphone out of our pocket, or finding a phone point. Still, if we prefer to use a keyboard on the very same PDA, we'll just use one – no connection required. The third stage will be the integration of devices not considered as standard peripherals today: PCs, PDAs, digital cameras, fixed phones... In this scenario, some appliances begin to appear, ie devices with one precise function, such as cameras.

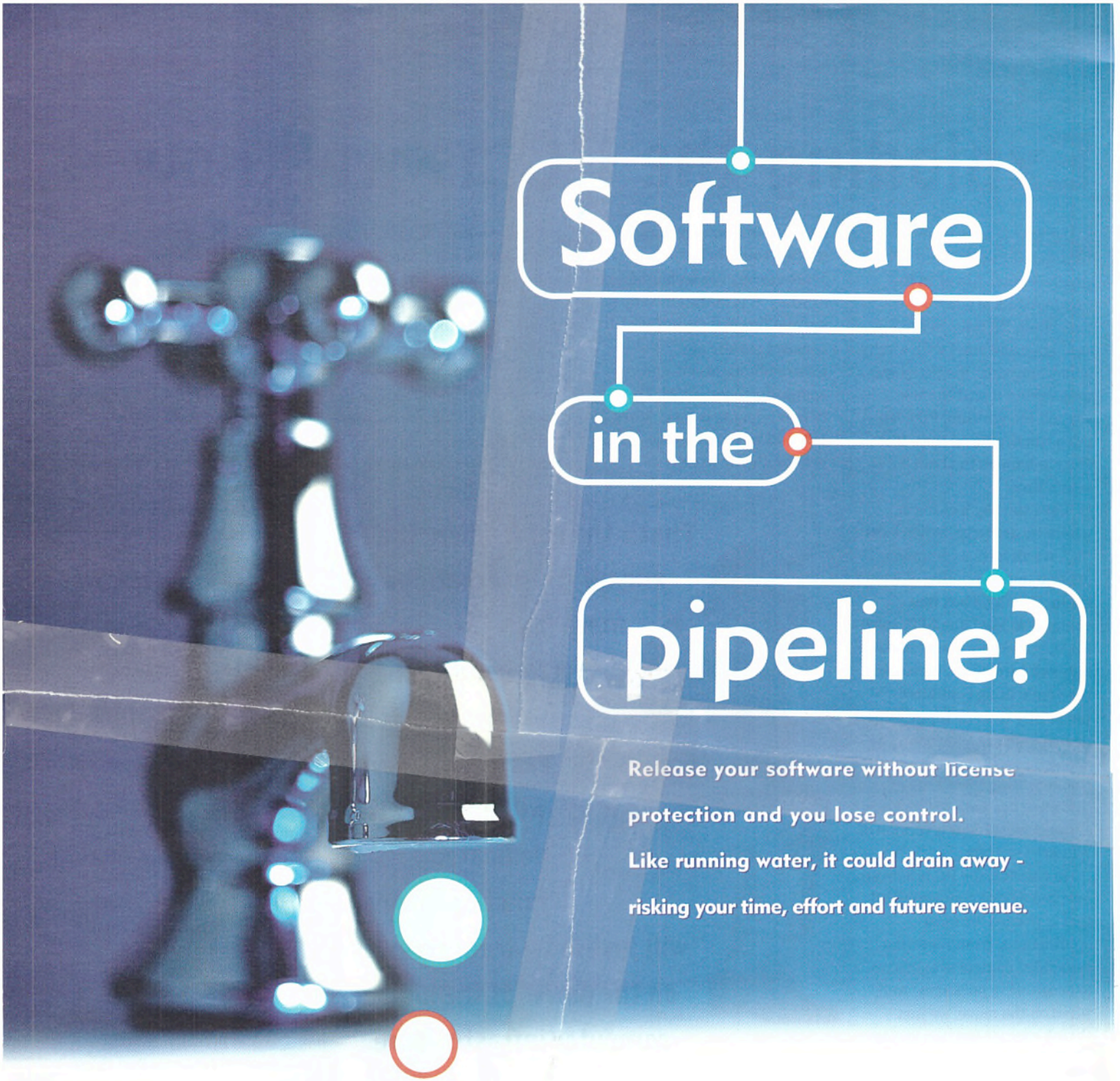
That's the point where the PC and all its incarnations will move from the foreground to the background. New easy to use devices will appear with dedicated functions, which will just draw transparently on the power of the hidden computer infrastructure.

Astute readers will have realised by now that all this is great but a bandwidth of 1 Mbps is not that much if we want to implement the most extreme scenarios. What will free this new power is a different type of software architecture. Instead of sending huge amounts of raw data, we need to send more high-level data associated with some actions. This sounds quite like the early efforts of Novel with NEST or Microsoft with Microsoft At Works. Both failed. My second prediction is that these software efforts were too early. Re-read the NEST specifications and read the much more recent JINI specs from Sun. Surprised by the amount of similarities? I predict that JINI or a similar technology will be successful on this new distributed/disparate architecture of devices/appliances.

What is really exciting about this future is that there will be opportunities to create appliances with completely different hardware and software as compared to what exists today. This will provide opportunities for small companies to become big and will force big companies to be innovative.

I believe that these two predictions are quite realistic. I haven't tried to make any forecasts as to when a wireless technology will offer bandwidth as large as what's currently available directly between CPU and RAM, for instance. That's still dreamland. ■

David Mery



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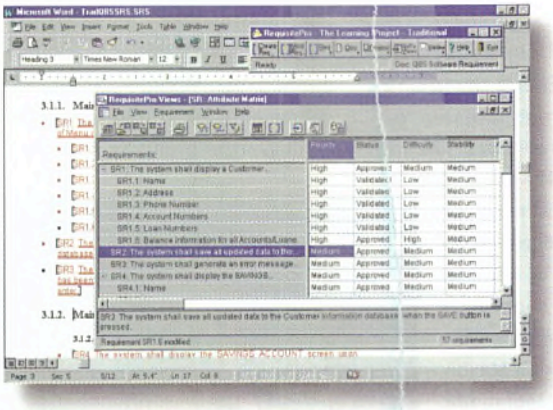
Scaling up Rational's RequisitePro



RequisitePro 4.0, for Windows 95, 98, and NT, is a major upgrade to Rational's system for requirement management. As well as some GUI enhancements and repository integration with Rational TeamTest, this release sees the addition of discussion groups and off-line authoring. In addition to version 4.0 there is the release of RequisiteEnterprise 4.0 add-on, for the scaling of RequisitePro for large-scale, distributed development, and RequisiteWeb 4.0, which provides web access for project members without the need for client-side installation. The COM-based API, for third-party and user-specific extension of Requisite Pro, is also officially released.

The idea of the discussion groups is to further aid team communication. Team members can take part in threaded dialogs regarding any requirements, problems, or change notices. Version 4.0 manages the distribution and tracking of discussion threads and allows participation by specified members through the application or by email. This is designed to clarify communication and further record the context surrounding any requirement.

Aimed at remote or mobile users, off-line authoring gives team members the flexibility to uncouple a requirement document from the project to allow modification 'off-line' in Microsoft Word. Other project members will view the original document until RequisitePro automatically updates the project when the document is brought back on line. The change in status of the document will be highlighted, for example as a 'suspect link' in the Tracability Matrix that shows the requirement relationships between different 'requirement types', eg end-users and software-engineers. Filtered views can be applied to group together, for example, all high priority requirements that have changed which have an estimated testing duration of more than 12 hours. The administrator will have previously defined such attributes.

The RequisiteEnterprise 4.0 add-on increases the scope of the product's implementation. Teams can manage requirements from Access, SQL Server (6.5), and Oracle (7.3) databases, and migrate between them within a project. Cross-project tracability is also provided.

RequisiteWeb enables users to modify requirement attributes and tracability relationships, participate in discussion groups, and create filter views, through IE or Navigator browser. Admin functions aren't provided.

UK list prices include one year of service and support. Requisite Pro 4.0 will be £1,300 (node-locked licence), RequisiteEnterprise 4.0 Add-on £400 (node-locked licence), and RequisiteWeb 4.0 £2,400.

w www.rational.com/products/reqpro

SQL Server 7.0 – packaging & prices

Microsoft has released the pricing and packaging for SQL Server 7.0 even though availability is not yet known. There are three editions – desktop, standard, and enterprise – and they will be available across all 32-bit Windows platforms. The different editions are built on the same code base and are designed to provide users with transparent application scalability, from a laptop to an SMP cluster.

Microsoft SQL Server 7.0, the standard edition, runs on Windows NT Server and is designed for workgroup and departmental applications. SQL Server 7.0 Enterprise Edition runs on Windows NT Server Enterprise Edition and is designed, obviously, for large departmental and enterprise applications. The Desktop edition runs on Windows 95, 98, and NT Workstation. It is optimised for desktop or small workgroups, and is 100% compatible with other SQL Server 7.0 versions, and includes merge replication for mobile use.

Pricing for the standard edition begins from £1099, for a five-user system. The Enterprise edition starts from £5,599, for a 25-user system. The Desktop edition is only available as part of the Standard and Enterprise editions. Microsoft SQL Internet Connector, a special unlimited-user access licence for Internet use, is £2099 per processor.

w www.microsoft.com

A message to you, TAPI

The Message-Master Developer Suite V1.1, from Derdack Software Engineering, is an ActiveX component for sending alphanumeric messages to mobile phones or pagers through modems and ISDN.

Features include scheduled delivery, transmission notification (telling the user whether the message has reached the mobile phone or has been stored), single and group transmission, and automatic splitting of large messages. Its design allows parallel use of outgoing lines for message transmission if the developer runs multiple instances.

ComponentSource charge £199 for the Standard Edition of V1.1.

w www.componentsource.com

Version 6.0 of **Visual CASE**, the OO design and **modelling** tool from the Stingray division of Rogue Wave, provides roundtrip engineering and extra modelling and editing features. It is fully integrated with Microsoft's **Visual C++** 6.0 IDE.

www.stingray.com

Microsoft's latest **Java Virtual Machine** for Windows includes support for the Java Native Interface (**JNI**) to be in compliance with the recent ruling in the San Jose Federal District Court. There is a smaller memory requirement and faster start-up time.

www.microsoft.com

SNiFF+ 3.0, the source code engineering tool from TakeFive, has been integrated with Objecteering 4, the **UML**-based OO code-generation tool. A class model of **Objecteering** can be analysed, visualised, and changed with SNiFF+.

www.takefive.com

TPBroker 3.1 is Hitachi's **Corba** compliant object-oriented **transaction** processing manager. As well as supporting C++ clients and servers, it supports Sun's Java Transaction Service (**JTS**), which allows developers to write transactional client/server apps in Java.

01628 585335

Continuus/WebSynergy, the change management tool for web teams from Continuus, will support Microsoft Internet Information Server (**IIS**) 4.0 and Windows NT Server 4.0. This follows news that the Continuus/CM suite will be integrated with **Visual Studio 6.0**.

www.continuus.com

ParaSoft, a provider of automatic error-detection and error-prevention tools for C, **C++**, and Java, has made its development tool Inuse available in a stand-alone version. It helps **optimise** performance by analysing and animating dynamic memory allocation in real-time.
www.parasoft.com/products/inuse

RM/Cobol 7.0 for Windows includes **compiler** improvements, a cross-language call system to simplify communication between Cobol and **C/C++** routines, and a standalone source-level debugger. There are enhancements to Windows printer handling. Performance over version 6.51 has been improved by up to 30%.
www.liant.com

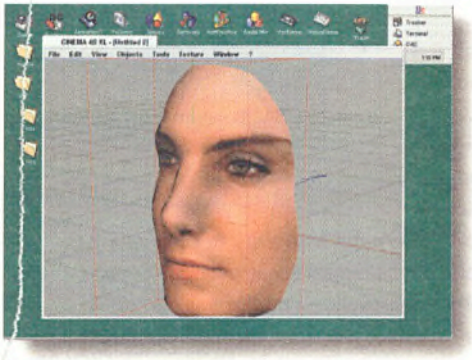
Unicenter TNG and **Jasmine**, of Computer Associates will employ the latest version of Sun's JDK, the Java 2 platform. For Unicenter this is expected to ease the **integration** of third-party management tools with Unicenter TNG's core services.
www.cai.com

QSSL has introduced **QNX** RTOS support for the Independent Computing Architecture (ICA) from **Citrix** Systems. This means businesses can use QNX and Citrix ICA to distribute their existing Windows applications to embedded systems.
www.qnx.com

The **Patent** Office has posted the UK Trade Marks Register on the **Internet**. The new service will be of use to anyone needing to demonstrate or verify the ownership or status of a **trade mark** on the Register.
www.patent.gov.uk

BeOS ready for a larger audience

Last month Be started shipping release 4 of BeOS for Intel and PowerPC platforms. This is the first release that is not targeted exclusively at developers. Be will market its OS for specific end-user needs where an alternative to Windows makes sense. The list of applications available confirm its strength as a 'media OS': Cinema 4D XL from Maxon, UltraDV from Mediapede, Studio A from Adamation, MusicWeaver from Goodeve... General apps such as wordprocessor, spreadsheet, ftp client, games, etc. are also appearing on BeOS. Most commercial software is available on the BeDepot website.



Performance has been improved (a 25 to 30 percent increase according to Be) while adding new features. The classic demo consists of running two 30 frames per second video streams while applying some real-time effects, all this done in software. One reason for the speed improvements on the Intel platform is the switch from the Metrowerks compiler to Cygnus's GCC, which has better optimisation. While PowerPC developments are still based on the CodeWarrior products, there is a new symbolic debugger and gdb support for the Intel platform. The format of executable files has changed from the PE format to ELF (BeOS Release 3 binaries are not compatible with Release 4).

Release 4 features the BeOS Media Kit, which deals with time-based media such as digital audio and video. The graphics driver architecture has been revamped: writing additional drivers and codecs should be easier.

The installation has been completely revamped (new boot manager, new boot loader, and revised boot menu) to make it very easy to install on a system which already has a version of Windows. The two can coexist quite easily. Read and write for FAT16 and FAT32 is now supported as well as a client for Microsoft Networks. Hardware support has been expanded to cover most popular devices (including SCSI cards), and additional drivers will be available on Be's website. On the Internet side, the services include FTP and Telnet servers, a DHCP client, and an HTML 3.2 compliant browser with SSL support. Java is still missing – it is announced for Release 5.

More than 7,000 previously registered developers have revalidated their entries, and Be estimates that about 1,200 are actively developing BeOS applications.

BeOS Release 4 requires 16 MB of RAM and 150 MB of hard disk. It is £49 from ComputerWarehouse.

w www.be.com w www.cwonline.co.uk
w www.BeDepot.com w www.BeFunk.com

JDK 1.2 – Java 2 platform

Formerly code-named 'JDK 1.2', the Java 2 platform has been made available for download by Sun. There are performance improvements, a flexible security model, and extended class libraries. A new pluggable look and feel, part of JFC, is designed to create consistent UIs across multiple platforms. Standard Extensions (packages of Java classes and any associated native code) allow platform vendors to extend the core platform for specific customer needs.

The Java 2 security model includes policy-based access control and certificate interfaces (X.509 V3). Performance enhancements include native thread support for Solaris, memory compression for loaded classes, faster memory allocation and improved garbage collection, and a new Just in Time compiler. JFC is now core to the Java 2 platform, and a Drag and Drop API enables the movement of text, graphics, or components between Java-based apps and native platform apps. The Java IDL API enables the invocation of remote network services and a fully compliant Java ORB is included in the runtime. For JDBC, there is improved performance, an ODBC bridge driver, scrollable cursors, and support for SQL 3 types.

Standard Extensions now available include: Java 3D, Java Naming and Directory Interface (JNDI), Java Servlet, JavaMail, and Java Media Framework (JMF). JNDI provides network-wide sharing of information about users, machines, networks, and services.

w java.sun.com/products/jdk

Linux exposed

NetProject, in association with the UK Computer Measurement Group and UKUUG, is organising a conference and exhibition on 'Linux and Open Source Software'. The event planned for January 20th at the Commonwealth Institute will feature luminary Eric S Raymond, aka esr, aka the author of the *Cathedral and the Bazaar*, and of the *Halloween papers* commentary, aka maintainer of the *New Hacker's Dictionary*... Other speakers include Peter Murray-Rust responsible for the development of XML parsers using Open Source development techniques and Mike Banahan, whom long-time readers of EXE will surely remember.

The conference will run two streams in parallel (management and technical) and costs £300.

w www.netproject.com

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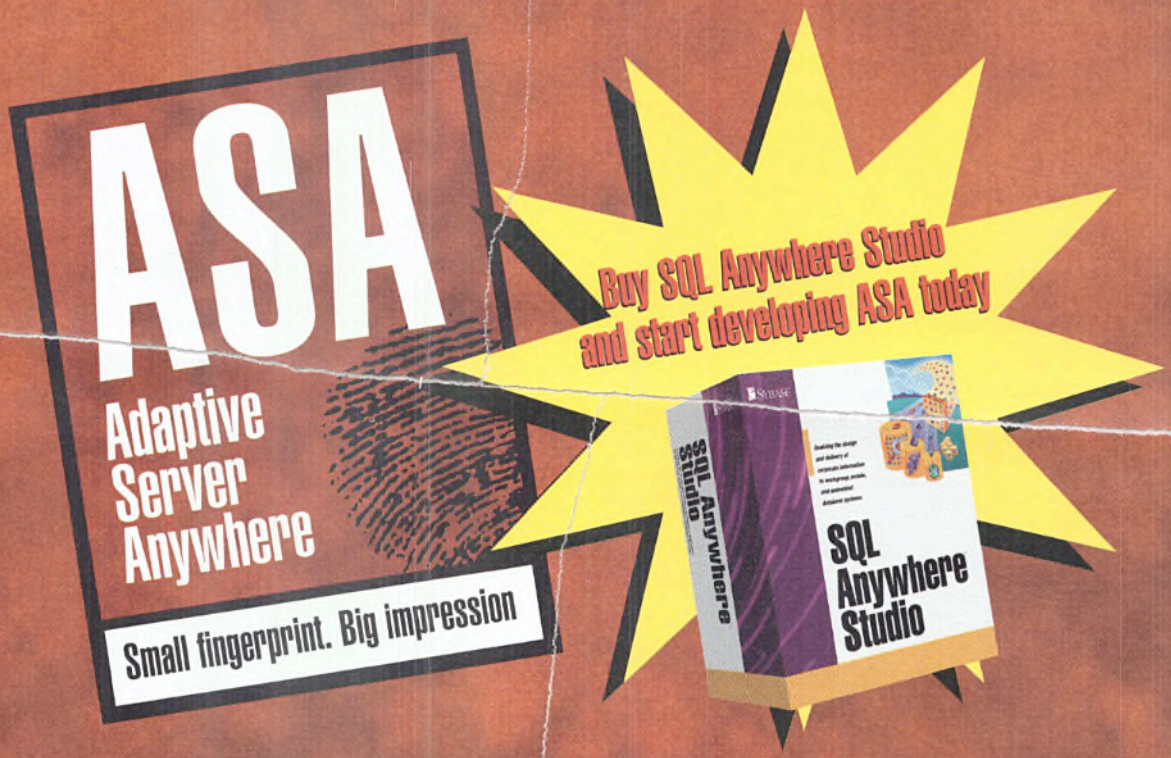

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A pair of COOL:Spex and Plex patterns

Sterling has extended and updated its COOL line of products: there is a new version of COOL:Spex 2.0, its modelling tool for component specification, and the product formerly known as Obysdian enters the COOL range as COOL:Plex 3.5.

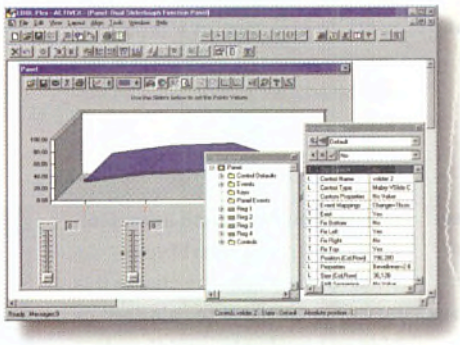
Version 2.0 of COOL:Spex features a new component specification diagrammer, improved method support, enhanced usability, additional model management functionality, and further integration with COOL:Gen and other development environments.

COOL:Spex is designed to support the specification of components by UML. The idea is that UML-compliant modelling should help users avoid the cost and time of retooling, retraining, and rewriting of software designs as environments change.

The new architecture diagrammer addresses application integration problems: it visualises the interactions between interfaces and components. This should aid a better understanding of application structure.

For enhanced usability, there is an improved tool user interface, additional search functionality, enhanced diagram drawing capabilities, and improved reporting through a component specification report, a consistency check report, and full ActiveX integration with MS Word.

The new model management features in COOL:Spex 2.0 include multi-user capabilities supporting object locking and model sub-setting. There is support for the Microsoft Repository, and additional data sources, to provide easier integration with other development environments.



Moving on to what was Obsydian, COOL:Plex 3.5 (pictured) is a model-based development tool that combines code-generation with pattern-based development. This is the first version to be incorporated into the COOL portfolio and it enables users to build applications rapidly for Windows NT and AS/400. Version 3.5 includes enhanced pattern libraries that contain designs for areas ranging from low-level graphics controls to business contact management.

With COOL:Plex patterns are dynamically linked so that changing a pattern will automatically change related parts of an application. Sterling believes that patterns allow developers to apply best practices across applications and organisations. Users are not limited to the patterns provided by Sterling – they can build their own or buy them from third party pattern providers.

Other new features in COOL:Plex include an HTML-based help system, Windows 98 client support, a national language translation tool, and a 'Guided Tour', which contains best practices for using the product.

w www.sterling.com

A Java calendar

JFCDataCalendar, a calendar component for Java, is the third (Swing) product to complete ProtoView's JFCSuite, alongside JFCDataExplorer (formerly DataExplorerJ) and JFCDataInput. It is designed for Java scheduling and Personal Information Manager (PIM) applications. As well as an API, a number of features are provided through customisers (point-and-click property pages). It is 100% Pure Java and designed to support all base JFC features.

Selection for days on the calendar can be done via single, multiple, or range selection. This can be set through the customiser or in code and implemented with mouse clicks or Shift+arrow keys.

Display of the JCDataCalendar can be set for one, three, six, or twelve months. The first day of the week can be Sunday or Monday, and days in the calendar can hold image icons. Users can choose the month and year from drop-down menus provided at the top of the component.

The JCDataCalendar includes the DatePlus input and validation component. This supports a number of date formats and the ability to hide or show the century and leading zeroes. Both components support a variety of font, colour, border, shadow, and display options.

The JFCSuite retails for £299. All products in the JFCSuite are sold separately: JCDataCalendar for £114, JFCDataExplorer for £180, and JFCDataInput for £144.

w www.protoview.co.uk/jsuite

Inherit comms

LUCA 2.4 brings the benefits of OO programming to data communications. It is a software development framework for telecommunications and networking, with over 50 C++ classes for the popular transport protocols. Using inheritance, different file transfer protocols such as ZModem and FTP can be used by calling identical methods. For Delphi programmers, all protocols and services are available as VCL components.

Version 2.4 includes online encryption that allows secure transmission of email and files over public networks. The Windows CE version of LUCA comes with an ActiveX control enabling VB programmers to use LUCA's functionality on CE targets.

Langner's LUCA is sold in different product packages, with prices starting at $299.

w www.langner.com

Pervasive claim that **Pervasive.SQL** for Windows **CE** is the first high-performance, multi-threaded embedded database engine for Palm-sized PCs and other smart devices. With less than a 50 KB memory **footprint** it provides zero-administration features.

www.pervasive.com

A partnership of Allaire and net.Genesis will see the integration of **net.Analysis**, an e-business intelligence system, into **ColdFusion**. This will enable enterprise reporting and **analysis** capabilities for the cross-platform Web application server.

www.netgen.com

Oracle has announced the availability of **JDeveloper 2.0** Beta, a visual Java development tool that enables users to build and deploy rapidly multi-tier database applications. There is new support for Enterprise **JavaBeans** and Java servlets.

technet.oracle.com

Enterprise Alternatives has added support for Microsoft's Active Scripting interfaces to its Enterprise REXX for Windows. **ActiveREXX** runs in Active Scripting Hosts such as **ASP** and WSH; DNA applications can now be scripted in the **REXX** programming language.

www.WinREXX.com

ToolBook II Instructor, a courseware **authoring** product for developers, allows delivery of interactive courses over the Internet, corporate intranet, LANs, or CD-ROM. Version 6.5 enhances **Internet** deployment using HTML and JavaScript, and improves compression of content.

www.asymetrix.com

Choose your own knowledge base

Microsoft has joined the Meta Data Coalition (MDC), a consortium of software companies, and transferred to the organisation the rights to maintain and evolve the Microsoft Open Information Model (OIM), a specification for representing meta data. Microsoft Repository 2.0 will also support XML Meta Data Interchange, for integration of data from multiple repositories.
msdn.microsoft.com/repository

Software Productivity Research, a software estimation and measurement firm, has launched SPR KnowledgePLAN 3.0. This project estimation tool provides knowledge base customisation, and vertical industry knowledge bases for the telecommunications and financial services markets. Version 3.0 simplifies the development of project estimates and features bi-directional connection to Microsoft Project 98.

Users can select whether they use the standard knowledge base to derive estimates, or a custom knowledge base created within KnowledgePLAN 3.0, or an industry-specific knowledge base. There is a new wizard to assist creation of organisation-specific data.

KnowledgePLAN 3.0 can combine two sizing metrics. It allows users to size part of a project in function points or lines of code and part by another metric such as sizing by analogy. It includes online help and customisation capabilities.

KnowledgePLAN 3.0 runs on Windows 95 and NT and is sold in two configurations. With all 3.0 features *except* the knowledge base creation wizard, it is priced from $2,900. The product with the knowledge base creation wizard is priced at $9,999. The telecommunications and financial services knowledge bases are priced at $500.

w www.spr.com

Exploding pies!

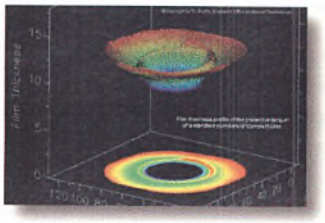
Rational's DevelopmentDeskTop (RDD) is a suite of development tools to test and maintain multi-language, component-based applications for Windows. RDD includes new versions of Purify, Visual Quantify, Visual Test, Visual PureCoverage, and ClearQuest, providing automated runtime error and memory leak detection, performance profiling, code coverage analysis, test scripting, and change request management.
www.rational.com

Olectra Chart 6.0 is the latest release of KL Group's charting tool for Windows. It's an OLE/ActiveX control providing a range of 2D and 3D charts and graphs.

There are a number of new features for version 6.0. There is Visual Studio 6.0 support; the tool can be used with VC++ 6.0 and VB 6.0. New chart types include bubble charts, exploding pie charts, stacking area and line charts, plus 3D scatter plots. And in addition to stacking bar charts, you can stack area, plot, polar, and radar chart types.

With improved pie charts it is possible to show 'exploded' or hidden pie charts, and the start angle for pie drawing can now be specified. For polar charts, negative values are now possible for the Y-axis. There is additional documentation for C/C++ developers and support for TrueType fonts on the axes and text areas.

Olectra Chart 6.0 has been priced at $399. It runs on all 16- and 32-bit Windows platforms and evaluation copies are available from the Web. Olectra Chart 6.0 source code is available for corporate development environments.



w www.klg.com/olectra/chart

Any size that you like

Rapid SQL 5 is Embarcadero's server-side development environment for client/server, web, and warehouse database applications. This release adds project management, version control, and build management capabilities. There is new support for MS SQL Server 7 and Oracle 8.
www.embarcadero.com

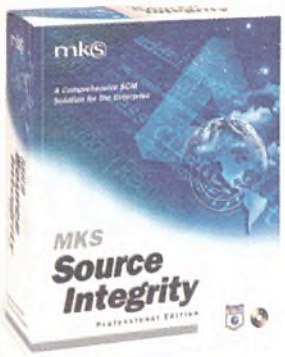
ActiveThreed Plus, from Sheridan Software, is a set of 32-bit ActiveX controls for the reshaping, resizing, and general jazzing-up of user interface controls. There are four new controls. SSResizer, placed on a form or inside a container control, will automatically resize all other controls in the same container and scale their fonts. With SSScroll, any control placed within the scroller can be scrolled vertically or horizontally. SSPlash can automatically shape a form or container control to any user supplied image. Finally, SSTransition enables the display of 37 PowerPoint-like transitions from one appearance to the next.

Contemporary Software sell ActiveThreed Plus for £125 with an upgrade priced at £55. The set is also available as part of the Sheridan ActiveSuite, which is priced at £385.

w www.contemporary.co.uk

Books received this month

Publisher	Title	Author	ISBN	RRP
John Wiley & Sons	Client/Server Data Access with Java and XML	Dan Chang/Dan Harkey	0-471-24577-1	£32.50
John Wiley & Sons	Connecting JavaBeans with Infobus	Reaz Hoque	0-471-29652-x	£32.50
John Wiley & Sons	Data Structures and Algorithms	Bruno R. Preiss	0-471-24134-2	£23.50
John Wiley & Sons	Data Warehouse Performance	W.H.Inmon/Ken Rudin/C.K.Buss/R.Sousa	0-471-29808-5	£29.50
John Wiley & Sons	Fast Track Visual C++ 6.0 Programming	Steve Holzner	0-471-21290-8	£29.50
John Wiley & Sons	Foundations of Application Management	Rick Sturm/Winston Bumpus	0-471-26916-1	£29.50
John Wiley & Sons	Intrusion Detection	Terry Escamilla	0-471-29000-9	£25.95
John Wiley & Sons	Learning to Program with Visual Basic	Patrick G. Mckeown	0-471-19814-5	£19.99
SIGS Cambridge	Process Patterns	Scott W. Ambler	0-521-64568-9	£27.95
Penguin	Release 2.1	Esther Dyson	0-14-026662-3	£6.99
John Wiley & Sons	Software Design with C++	Steven P. Reiss	0-471-24213-6	£19.99
SIGS Cambridge	The VisualAge for Smalltalk Primer	Liwu Li	0-521-64669-3	£30.00
John Wiley & Sons	Transition to Object-oriented Software Development	Mohamed Fayed/Mauri/Laitinen	0-471-24529-1	£25.95
John Wiley & Sons	Virtual Private Networks	Dave Kosiur	0-471-29526-4	£29.50
John Wiley & Sons	Year 2000 Software Testing	William Perry	0-471-31428-5	£32.50



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- ✔ Windows CE Help
- ✔ Netscape NetHelp 1.0, 2.0
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MFC—my favourite code

'Don't make me do it,' said Jules. But they did, and now he's an MFC programmer.

Regular readers of this column will know that I'm not a great fan of application programming. I think making hardware, writing drivers, and even cutting core code is far more interesting than modern applications, because, unlike in applications, all the work goes into the task at hand. Painstaking and detailed it may be, but that's better than fiddling each time with file handling, OLE-awareness, and all the silly, routine bits and bobs that a real application needs to make it work. Personally, I think this stuff should all be automated, and writing it by hand is beneath human dignity.

My client asked for his job – an application – to be done in VC++ under MFC. I begged and pleaded; I shouted, grovelled, stamped, and wept. He wouldn't let me write straight to the API, he wouldn't let me use any of my homebrew tools; he wanted the code to be maintainable into the future, dismissing my suggestion that nobody maintains anything any more. He wanted MFC.

I do know about tools such as MFC, and though I'd played with it, and understood its principles, I was never really convinced that it was a good idea, and was quite convinced that it didn't scale, so I spent very little time with it. I decided it was probably fine if you were writing word processors for an employer called Microsoft, but not much cop for anything else. I reckoned it was fine for the right job, but that I wouldn't like it.

The trouble with MFC, as I highlighted a few months ago, is that it's okay if you want to write the same things that Microsoft has already written. There's loads of interesting functionality there, and some of it even works, but it doesn't extend. Take the list control; sweet thing – lots of interesting behaviours, particularly in the report view. But, I wanted to put icons into the subitems, and there's no way I can do that. I can switch over to owner-draw, but then I lose nearly all the functionality I started with, and because the internals of the control are barely documented it is easier to start from scratch. And I hate the documentation for not telling me that you can't begin an in-place edit unless the control has the focus. How much time did I waste?

Another thing I wanted was a tab control, which the user could extend. I tried placing a tab control in the dialog editor, and then placing stuff inside it. Didn't work. I tried property sheets, but you've got to get them completely determined before you show them, or they go haywire. Again, in the end I wrote the insertion code adjusting sizes and moving controls to fit, entirely by hand. It was easier than working with the framework!

Then came the file access. Here, MFC promised to make life easy. Everything serialises. Well, nearly everything; all you have to do is write a bit of serialisation code for your own classes, and everything else is automagic. Except, the file format is not documented properly, it reflects the internal storage of the program (which is bound to change) and it also externalises in the file a stack of private stuff, which should not be externalised at all. It was impossible to filter the data through encryption procedures, either in or out. In short, in return for not much less work, I got less flexibility and an immense versioning problem – perhaps that's why there are so many incompatible versions of Word 6.

The entire MFC is shoehorned into C++, of course. It is no secret that I think C++ is a wildly complicated language that uses a model that is quite wrong for most real programming jobs. It does occur to me that, since the fearsomely complex wizard system exists, my views are not entirely unique. And who ever thought that wizards were a good idea? You make a stack of decisions about your program, and if you want to change even one of those decisions, you have to go right back to the beginning, dumping all your work. It also serves to hide loads of functionality – I accidentally deleted the application icon one time, and try as I might I could not find out how to replace it. But wizards enable you to take strategic decision about your programs, and they synchronise the details in fragments of code spread all over the program. I think these strategic decisions (and the details they rely upon) should be either in a control language or in linkage.

If half the ingenuity that had gone into these silly wizards were put into languages or linkage (in the way the makefiles have developed, they're now more complex than the code they control) we'd have all kinds of useful technology that would generalise and scale properly.

Ultimately, I think, the reason for this dreadful paucity of built-in controls is because some Microsofty wrote something that they found useful and it found its way into the internal compilers – which is why it annoys me so much that I can't write a composite control of my own and use it through the dialog editor in the same way. Then, as they developed technology like OLE and then ActiveX, dockable windows, and so on, they grafted them into their tools to help them understand what they'd made. This compiler, the MFC in general, is nothing more than their own test bed, badly documented and barely working, which has been palmed off on a world devoid of competition because we all need to know how these technologies work as well.

Gentle reader; don't you realise that paying for this stuff only encourages them to write more? Now they've run out of innovative ideas, all the development is going into protocols that are managed by the wizards. Quite frankly, you and I are as capable of developing in that direction as they are, and (with the massed ranks of the world's programmers on the case) we could achieve more reliability and more general solutions than Microsoft ever could. ■

Jules is a programmer who enjoys writing compilers and has a deep love and respect for elegant language design. He does a passable rendition of 'It wasn't like this in the old days'. Call him on 01707 662698, or email him at jules@cix.co.uk to hear it.


MFC
C++

We welcome short letters on any subject relevant to software development. Please write to: The Editor, *EXE Magazine*, St. Giles House, 50 Poland Street, London W1V 4AX, or email editorial@exe.co.uk

Khan's wrath

Dear Sir,
My underlying philosophy was encapsulated rather succinctly by Captain Kirk, in *The Wrath of Khan*: 'You have to learn *why* things work'. This is profoundly different from merely understanding *how* things work. If I were to explain how to be a really good programmer, or come to think of it how to be a really good anything, in one sentence, that would have to be it.
Philip Hibbs,
philip.hibbs@tnt.co.uk

In control

Dear Sir,
Re: PVCS from Intersolv (in *Don't you just love being in control*, EXE December 1998).

I am sorry but this article was so short of the mark that as a subscriber I felt compelled to write and state so. I am a development manager, 14 years experience in the software industry, controlling the software of 50+ developers.

1. Not to include SourceSafe was such a petulant act, I know we all hate Microsoft's position but their products are becoming the *de facto* products. To blame it on late delivery, well, it comes free with a lot of the Microsoft 'toys', a copy can be had from most places.
2. Cost of the tools, particularly the licences and licensing structure, was not covered. As well as coders we have to look at providing access to PVCS for testers, release teams, support teams, even administrators. For a package of PVCS+CB+TRACKER for 100+ people, you can be looking at a bill of £100,000 plus ongoing maintenance costs. For such a price you expect a professional product for large scale projects.
3. My main problem with your PVCS article is that it did not look at the practical issues. PVCS does not provide:

- Any simple concept of controlling multiple projects. A system is generally made up of subsystems that are in turn made up of many projects. Which is a pain when it comes to preparing releases and tracking changes.
- Any simple reporting tools. How can you report the status of a project, which elements are ready for testing or release. You can see the status of individual files, but not the overall project.
- There aren't any simple ways of standardising things such as labels. Which with multiple projects becomes a major headache. Ensuring that all file versions are labelled exactly the same for a particular release.
- Things such as the kludgy PIGUI interface I can live with even when it comes to manually scrolling through 200+ projects to open a project. You can't type the project name in directly, you have to select it off a list.

In short I found less in this article than reading the brochures myself.
Steve Hurst
steve.hurst@instem-lss.co.uk

We should point out that Ian Murphy wanted to review SourceSafe 6.0, which at the time the article was written (September 1998) had only just been released as part of Visual Studio 6.0; getting hold of any of the older 'toys', as you term them, would not have helped. Microsoft UK proved unable to get copies of Visual Studio for most journalists until late October. Gold discs were available to a selected few (which was how we managed to sneak the 12-page Visual Studio review into the September issue, when we looked at VSS briefly), but Ian Murphy required a full shipping copy. Microsoft unfortunately failed to get the product to Ian when promised, an error for which it has since apologised. Frankly, if a company of Microsoft's stature cannot get products into the hands of journalists when it has ample time to do so, it really has no-one to blame but itself if it misses out on review opportunities.

Basic pricing information was omitted when it should have been presented as a box-out. Mea culpa. However, as you rightly point out the possible permutations of pricing are endless, depending on the size and structure of your software development, testing and QA teams: it's difficult, if not impossible, to give sensible pricing information for every potential customer. – *Ed*

I've also been in development since early 1982 and have worked as a developer in small companies, in medium to large teams, and as a contractor. In the latter capacity I have worked on small and large project teams, several times as the project leader. I am a subscriber to EXE as well as a professional journalist and over five weeks of working with the tools went into this review.

When a vendor knows its products are being reviewed it is up to the vendor to supply code. The industry relationship between magazines and vendors has worked this way for a substantial amount of time. Mike Pryke-Smith, the development tools product manager at Microsoft, was quite literally fuming over what was an acknowledged mistake on Microsoft's part, and has no problems with the statement about SourceSafe.

Pricing information: this was partly down to me and partly down to lack of co-ordination with the vendors. It's not always easy to come by this information – in the January issue, we deal with team testing tools from Rational and Mercury. Both declined to provide pricing saying that this was dependent on the type of project and they were therefore not prepared to give figures.

Actually, I have been working with PVCS for quite some time now and find it extremely powerful and it has only been the arrival of StarTeam that has caused me to move away. I don't know which version of PVCS you last worked with but in my experience the management of developers, their roles, and the control of software is as good as with any other product on the market. In addition, its support for an open API to allow you to extract data, import from other products or write your own add-ons is the way that every vendor in this market is heading.

I agree about the weakness of the reporting tools and I believe that most of the vendors in this market pay too little attention to reporting. Again, the API allows you to write your own report interface if you don't like those in the product. You should never be in the position of being unable to get your information out of a tool. This is why vendors have learnt to accept that people don't buy without trying a product first.
Ian Murphy

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WDM

A better class of device driver

The Windows Driver Model supports the latest device technologies, with standard class drivers doing most of the detailed hardware interactions for you. Chris Cant demonstrates how.

The Windows Driver Model (WDM) lets you write a common device driver for Windows 98 and Windows NT 5. This article will look at the development of a small virtual WDM device driver to illustrate the main principles without getting bogged down in the details. I mainly concentrate on giving an overview of the technology, rather than the minutiae of each line of code. Welcome to acronym-land (see *Glossary* on page 21).

WDM is an enhanced form of the NT 3.51 and NT 4 kernel-mode device driver model. The main structural changes are the addition of Plug and Play (PnP), Power Management, and Windows Management Instrumentation (WMI) and Device Interface support. I will describe these features, along with details of the necessary development environment.

However, almost of more significance is the provision of a series of class drivers. A class driver does the bulk of the work for a specific area of functionality. There are class drivers for the Universal Serial Bus (USB), the IEEE 1394 (Firewire) bus, streaming devices, and Human Interface Devices (HID). More on these later.

You still need to write a separate driver that calls the appropriate class driver. For example, you can write a driver to talk to a new USB device through the USB class driver using relatively straightforward USB Request Blocks (URBs), ie without having to worry about the details of talking to a bit of hardware. For HID devices, you do not even need to write a kernel-mode driver at all, as you can use Win32 HID client functions to access the device.

There are two ways of customising class drivers. The first is to write a filter driver, which can slot in above or below a class driver. Alternatively, minidrivers in various shapes and form can be used. The class driver does all the general processing while the minidriver just communicates with a specific type of hardware, eg the Windows HID class driver is paired with the `hidusb` minidriver to talk to HID devices on the USB bus. You could, for example, write a new HID minidriver to provide an interface to the serial port version of your product.

Each class driver has an appropriate specification. The USB class driver responds to several internal IOCTLs, one of which is to process a URB. As another example, a HID minidriver must register certain callbacks to work with the HID class driver. You will need to consult the relevant class documentation in the Driver Development Kit (DDK).

Note that Microsoft has managed to sneak COM GUIDs into driver development. You can use these to define a private interface that identifies your particular device. GUIDs are sometimes also used by minidrivers to identify what facilities are supported.

Unfortunately, you will not be able to port your old NT device drivers to Windows 98 with no work. WDM relies on Plug and Play for resource assignment, which was not available in these old drivers. Some people will still need to write VxDs for Windows 98, and others will need to maintain their NT-specific kernel-mode drivers for NT 5, eg for video drivers. See my article *Taking on Goliath* (EXE, October 1997) for details of NT kernel-mode driver development. In fact, I recommend that you reread this article as it covers many concepts used here.

Driver development

You will need a Microsoft Driver Development Kit (DDK) or two to build drivers. However, I have bundled a copy of the built driver with the source code, so you can try out the example driver without having a DDK. The Windows 98 DDK is available for lengthy download online, but most driver developers will need an MSDN Level 2 sub-

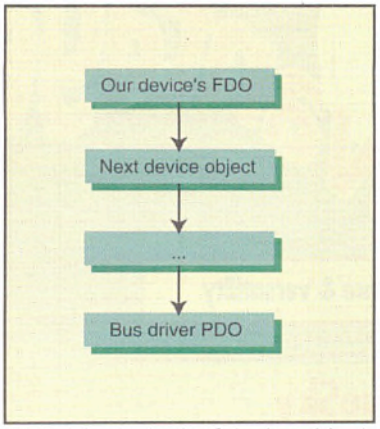

Figure 1 – A stack of device objects.

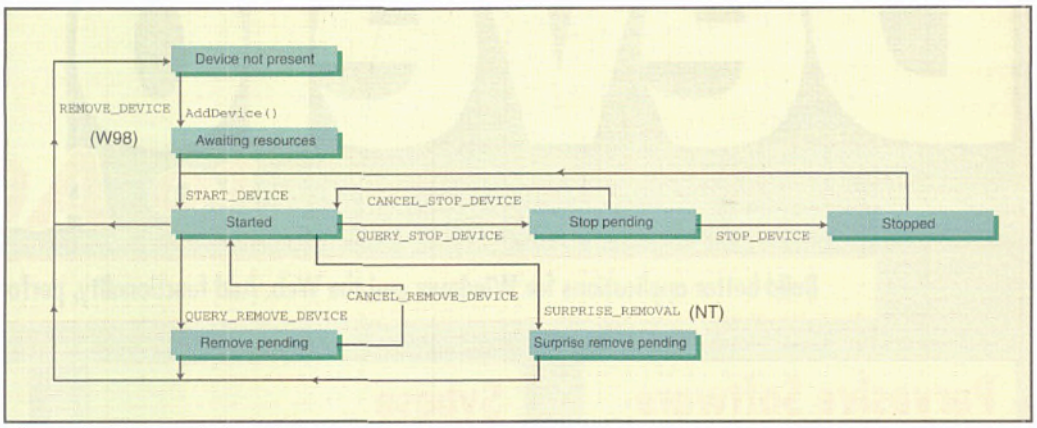

Figure 2 – Plug and play states.

scription to get the NT 5 DDK and the useful Platform SDK, as well as the latest beta test versions of Windows, etc (see *Resources*).

You can buy two different types of development tool to help you write drivers. The first lets you control a general purpose driver in user-mode to handle many standard types of I/O. The second gives you a C++ framework to base your driver on, with useful classes and examples. Vireo Software and BlueWater Systems provide products of both types.

HiImWdm example

Our device driver is called HiImWdm and the download zip `hiimwdm.zip` contains the source and built driver. Unzip the file in a directory called *c:\EXEWdm*.

The example driver comes with a suitable VC++ Visual Studio 97 workspace. The Makefile project assumes that you have the Windows 98 DDK in its default location of *c:\98DDK* and that the example source base directory is *c:\EXEWdm*. Alter the project settings if you use different directories.

The HiImWdm driver will run in Windows 98 and NT 5 without any new hardware. To test its operation, it implements a 4 byte shared memory buffer that can be read and written from a Win32 program. The 'checked' build version also makes the buffer bytes available for inspection through WMI in NT.

The *sys* directory contains the HiImWdm driver code. Table 1 lists the source code files and the files needed to build and install the driver. The 'free' release version of the driver ends up in *OBJ\i386\free\HiImWdm.sys* with the checked debug version in *OBJ\i386\checked\HiImWdm.sys*. The *exe* directory contains a small test console application. Note that the VC++ 5 Setup API header and library is seriously out of date and will cause a compile to fail. The project is set up to use the *c:\98DDK* versions of these files. The NT DDK and Platform SDK versions are even newer.

The W98 DDK does not currently include the WMI headers and libraries, so I have made the free build WMI-free. You can compile the checked build with WMI under NT 5. The W98 DDK does not have the `mofcomp` tool so I have removed this compile step.

I would nevertheless have expected the checked WMI build to run under W98, as it is supposed to support WMI. The Microsoft WBEM implementation seems to have been updated to include a WMI namespace that was not there before. Perhaps this update only runs properly in NT 5. (To install WBEM you have to select Add/Remove Programs in the Control Panel. Select the Windows Setup tab. Click on the Internet Tools component. Click on Details. 'Web-Based Enterprise Mgmt' appears at the bottom of the list. Check its box.)

Install and test

To install the driver, go to the Control Panel and select 'Add New Hardware' or 'Hardware wizard'. Opt to select the hardware from a list and select 'Other devices' and 'Have Disk'. Next, browse to *c:\EXEWdm\sys* and install the 'HiImWdm Example, free build, without WMI' driver. The driver is now copied to the Windows *system32\drivers* directory and the installation `INF` file is copied to one of the Windows *INF* directories.

The HiImWdm device should now appear in the Device Manager 'Other devices' category. If you rummage around the registry, you will find references to the driver, the device, and the device interface that have been installed. The Windows Unknown GUID {4D36E97E...} appears in the first two cases, while the device interface uses the HiImWdm GUID {87472BA0...}. Be warned that W98 and NT 5 use slightly different registry structures.

To test the driver, run `TestWDM.exe` in the *c:\EXEWdm\exe\Release* directory. TestWDM opens a handle to the first HiImWdm device and reads the buffer. The first time you run it, the buffer will probably have a value of zero. However, the next time it should be storing 0xABCDEF01, left over from the last write. TestWdm goes on to write 0xABCDEF01 to the buffer and checks that this value can be read. It then checks that an incorrect write fails and finally closes the device handle.

Initialisation

The driver's main entry point is the `DriverEntry` routine in `init.cpp`. The main job here is to set up the series of callback routine pointers shown in Table 2 so that the driver can be called again when appropriate. Some calls originate in the kernel. A Win32 pro-

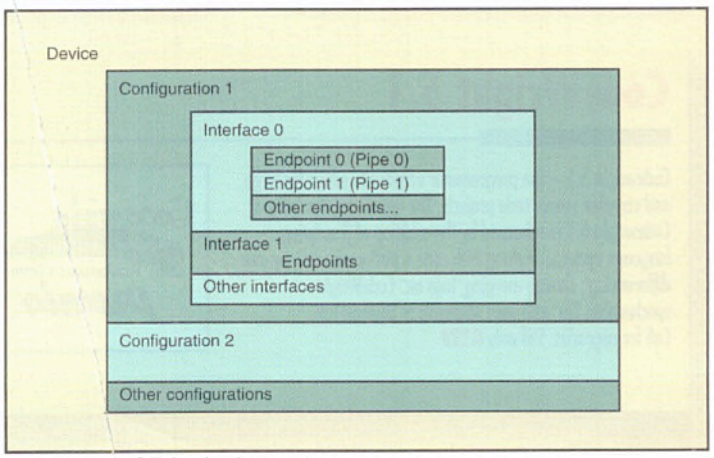

Figure 3 – USB logical structure.

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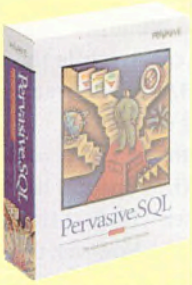

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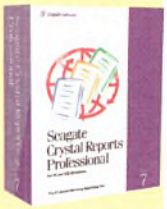

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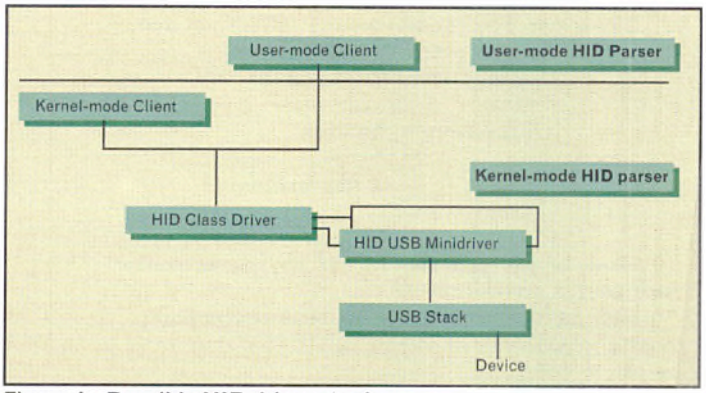

Figure 4 – Possible HID driver stack.

gram accesses the device as if it were a file, and these requests end up as driver calls as well.

A driver works primarily by processing I/O Request Packets (IRPs), so callbacks are defined for each of the IRP major functions that HiImWdm supports. Some of the IRPs come in different forms, eg the Plug and Play `IRP_MJ_PNP` has an `IRP_MN_START_DEVICE` minor code, which indicates that this IRP requests you to start the device. This example does not cope with IRP cancelling.

Plug and Play

Plug and Play (PnP) makes it easier for users to insert new devices into a computer as there should be no complicated hardware addresses to set up. Instead, a Plug and Play device should be configurable in software. For a low-level bus driver, its PnP resources are the different sets of IRQs, I/O space registers, and memory-mapped addresses that it supports. Most bus types define their own scheme for making devices configurable. Some ISA devices are PnP configurable as well.

Glossary

API ..... Application Programming Interface
COM ..... Common Object Model
DDK ..... Driver Development Kit
FDO ..... Functional Device Object
PDO ..... Physical Device Object
GUID ..... Globally Unique Identifier
HID ..... Human Interface Device
IEEE 1394 ..... 100 Mbps+ serial bus, né Firewire
INF ..... Installation information file
IOCTL ..... I/O Control Code
IRP ..... I/O Request Packet
ISA ..... Industry Standard Architecture PC bus
mof ..... WMI class file
MSDN ..... Microsoft Developer Network
PnP ..... Plug and Play
SDK ..... Software Development Kit
URB ..... USB Request Block
USB ..... 12 Mbps Universal Serial Bus
VC++ ..... Visual C++
WBEM ..... Web-Based Enterprise Management
WDM ..... Win32 Driver Model
WMI ..... Windows Management Instrumentation

Device stack for Plug and Play

PnP builds a device stack from the bottom up, and I shall describe how the right drivers are found for USB devices.

PnP uses enumerator drivers and arbiters to find devices and allocate resources to them. The root enumerator might find a PCI bus. The PCI bus enumerator might find a USB host controller. The USB host controller class/miniclass drivers are loaded, and, above them, the USB hub driver for the embedded USB root hub. The USB hub then enumerates the USB bus.

When a USB device is first plugged in, it appears at the USB default address of zero. The act of inserting the device notifies the USB hub of a new device. It retrieves the USB device's descriptors and in due course allocates it a proper USB address.

Each device has a Hardware ID, which is used to identify the appropriate driver. In the USB context, the Hardware ID is formed using the vendor's ID and the product ID. A fallback Compatible ID is also made available in case an appropriate driver is not found. For USB, this is the class and subclass of the device. For example, Windows recognises the 'HID keyboard USB device' class so that it can be used straight away without a vendor-supplied driver.

A driver's `INF` installation file lists a driver for each Hardware ID and Compatible ID supported, and it lists the files that need to be copied and the registry entries that should be made. NT specific sections are used to set up the driver service registry entry and any error logging features.

When a device is added, it is put at the top of a stack of devices, for example, above the HID class driver/minidriver pair, the USB class driver, and the PCI bus driver. Any I/O requests are sent to the top of the device stack. Each layer of the stack can do some processing on the request, or pass it down the stack. A driver can attach a completion routine to an IRP so that it can handle the IRP after it has been processed by the rest of the stack below it.

Note that a driver can have an 'upper edge' interface that is totally different to the facilities it uses in the next lower driver. A device might have a streaming upper edge, but make calls to the USB system to do its job.

Device objects for Plug and Play

A WDM driver has to cope with three different types of device object, as shown in Figure 1. The bus driver object at the bottom of the device stack is called the Physical Device Object (PDO). Each WDM driver must make its own Functional Device Object (FDO) for each device. Finally, you must remember the next device down the stack. This is so you know where to pass a request when you need to send it for processing down the stack of drivers.

Listing 1 shows how HiImWdm's FDO is made in the `AddDevice` routine using the `IoCreateDevice` call. The `AddDevice` routine then attaches to the top of the stack above the PDO using `IoAttachDeviceToDeviceStack`. The returned FDO device object has a pointer to some memory for us to use: the device extension. The HiImWdm device extension structure is defined in `HiImWdm.h`. Our `AddDevice` stores the PDO, FDO, and the `NextDevice` in the device extension. When our device is removed, our FDO is detached from the stack and deleted.

Plug and Play states

A PnP driver goes through several different states as devices are added, removed, or stopped to allow for resource reallocation. When

a new device is loaded, the PnP Manager eventually finds the relevant driver for a device. The driver is loaded and its `DriverEntry` routine called. Figure 2 shows the different states that a PnP device can then go through. To begin, a driver's `AddDevice` routine is called so that the driver can create its FDO and attach it to the stack. However, do not talk to your device yet!

When your driver receives an `IRP_MJ_PNP` request with the `IRP_MN_START_DEVICE` minor function code, all the relevant hardware resources have been assigned. Normally you must pass this request down the driver stack first so that the bus driver can process it, ie make the device available to you. Your IRP completion routine can talk to your device as the IRP travels back up the driver stack. Indeed, you may well want to send some more requests down the stack to configure your device, before finally completing the original start-device IRP.

Similar considerations apply to stopping or removing devices, ie make sure to do any of your work to stop the device *before* you send the IRP down the stack.

The other PnP states are used to cope with device removal requests and stop requests. Both these have query IRPs to let you reject the request for the moment. You might say 'no' if you have a read or write request in progress. You should store any further ordinary I/O requests in a queue while a device is stopped, and reject them if a device is removed. If a user brutally unplugs a device then you must cope with an `IRP_MN_REMOVE_DEVICE` in Windows 98 or an `IRP_MN_SURPRISE_REMOVAL` in NT 5.

Plug and Play flags

Proper PnP handling requires the use of various flags, etc, in the FDO device extension. You will usually need a flag to indicate that the device has been started. Always make sure to check this flag before performing any I/O requests.

I/O operations can be in progress when a device is removed. You must ensure that the remove request waits until the current I/O is cancelled or finished. Drivers usually do this by having a usage count and `RemoveEvent` event in each device extension. The usage count is incremented atomically when an I/O operation is started and decremented when it completes. A remove request checks that the usage count is zero. Otherwise, it waits for the `RemoveEvent` to be signalled when an I/O operation completes. While your device is stopped for resource reallocation, you should hold any incoming I/O requests in a queue for processing when the device is restarted.

HiImWdm currently only provides minimal PnP support. It responds to `AddDevice` and `REMOVE_DEVICE` calls, ie to make and delete its FDO. It does not use any PnP flags to queue IRPs during stops nor check remove requests.

Device interfaces

Moving on from the realm of Plug and Play, a device must be accessible to the kernel or Win32 code for it to be of any use. The old NT device driver model uses explicit symbolic links to provide a name that a Win32 application can open.

While this technique is still available, WDM lets you use device interfaces instead. A device interface uses a GUID to identify the interface that a driver implements. In HiImWdm, we just use the `WDM_GUID` to identify the fact that we are a HiImWdm device. In other cases, a driver might use a standard GUID to indicate that it implements a particular COM interface.

```
// Create our Functional Device Object in fdo
status = IoCreateDevice(DriverObject,
            sizeof(WDM_DEVICE_EXTENSION),
            NULL,       // No Name
            FILE_DEVICE_UNKNOWN,
            0,
            FALSE,      // Not exclusive
            &fdo);

// Remember pdo and fdo in our device extension
PWDM_DEVICE_EXTENSION dx =
   (PWDM_DEVICE_EXTENSION)fdo-DeviceExtension;
dx-pdo = pdo;
dx-fdo = fdo;

// Attach to the driver stack below us
dx-NextDevice = IoAttachDeviceToDeviceStack(fdo,pdo);

// Set fdo flags appropriately
fdo-Flags &= ~DO_DEVICE_INITIALIZING;
fdo-Flags |= DO_BUFFERED_IO;
```

Listing 1 – AddDevice routine for Device object handling.

Our `AddDevice` routine calls `IoRegisterDeviceInterface` to register the link between `WDM_GUID` and our FDO. It then has to enable it using `IoSetDeviceInterfaceState`. When our device is removed, the `WdmPnp` routine disables the device interface.

The `IoRegisterDeviceInterface` makes a symbolic link to our device. The actual link name is a long string that includes our GUID. Win32 programs like our TestWdm use various `SetupDi`*XXX* functions (for example, `SetupDiGetClassDevs`) to find all devices that support a particular GUID. Eventually it can get the symbolic link name, which it can pass to `CreateFile` to open a handle to our HiImWdm device.

Power Management

Device drivers are an important part of Power Management. The idea is to have shorter startup and shutdown times by not turning off the computer completely. Power Management policies can also help to conserve battery life and might result in quieter running of the computer.

There are six system power states defined, S0 to S5, with S0 being fully on and S5 shutdown. Each device can be in one of four power states called D0 to D3, with D0 fully on. A device might decide to reduce its own power level, eg if a disk has not been accessed for 5 minutes. Alternatively, the Power Manager can request that the whole system power down. A device that is sleeping (S1-S3) or hibernating (S4) can wake the computer up, eg if a modem receives an incoming call.

Power Management is done with the `IRP_MJ_POWER` IRP. The Power Manager uses the `IRP_MN_QUERY_POWER` minor code to see if a driver can go into a specified state, and then `IRP_MN_SET_POWER` to actually request that state. If you are going to fail a power request,

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then complete the IRP immediately. Otherwise, it is up to the bus driver to complete the power IRP.

Drivers like HiImWdm that do not implement a power policy should just pass the power IRPs down the stack. This means calling `PoStartNextPowerIrp`, `IoSkipCurrentIrpStackLocation`, and then `PoCallDriver`. Note the call to `PoCallDriver` rather than `IoCallDriver` to call the next driver.

If a driver does handle power IRPs then proceed as follows. The Power Manager initiates an `IRP_MN_QUERY_POWER` IRP to set a new *system power state*. If your device needs to change to a different *device power state* that is appropriate for the given system power state, then you need to send yourself a power IRP to do this. Yes, that's right, you call `PoRequestPowerIrp` to tell yourself to change power state. Once this IRP has completed its rites of passage, you can pass on (or complete) the original system power IRP.

If you get an I/O request while powered down, you must send a set power IRP and wait for its completion, before handling the request.

WMI

Windows Management Instrumentation (WMI) lets administrators tend your device. This means your driver must provide information and events to user-mode applications. Methods in the driver can be invoked.

WMI is a part of the Web-Based Enterprise Management (WBEM) initiative. The Win32 implementation of WBEM has various providers of information, giving access to the registry, the NT event log, Win32 information and, WMI.

For WMI, you can define your own custom data and event blocks in a C++ class-like file, compiled into a resource using the `mofcomp` tool. Each WMI block is identified by a GUID. A WBEM Object Browser tool lets you view all the WMI blocks on a computer, or across the network. Alternatively, custom user-mode programs can be written to access WMI, either using Java APIs or COM ActiveX interfaces.

NT drivers can and should still send NT events to the system log. However, WMI is supposed to be available in Windows 98, giving WMI broader appeal. As stated before, at the moment I have only got the WMI to run in NT 5.

The HiImWdm code in `wmi.cpp` shows how to provide a custom WMI data event called `HiImWdmInformation`. This contains the first `ULONG` from the read/write common buffer and the symbolic name for the device interface.

HiImWdm calls `IoWMIRegistrationControl` when a device is added or removed. It sets up a `WMILIB_CONTEXT` structure in its device extension with various callbacks. When the `IRP_MJ_SYSTEM_CONTROL` IRP is received, HiImWdm calls `WmiSystemControl` to do preliminary processing. The `QueryWmiRegInfo` callback is called to register our WMI data block and `QueryWmiDataBlock` is called to return the actual WMI data.

USB

Finally, let's have a brief overview of USB and HID device drivers. USB is for lowish speed devices. It is a half-duplex 12 Mbps serial bus, with 5 V lines to provide a small amount of power to basic devices. The USB data bits are grouped into 1 ms frames, which are the basis of bandwidth allocation. Hub devices allow further function devices to be plugged in, even when switched on. A new PC usually has one root hub with 2 USB downstream ports.

Figure 3 shows the logical structure of a USB device, with endpoints grouped into interfaces and configurations. Almost all USB devices have just one configuration and most have just one interface. Windows needs a separate USB client driver for each interface.

Source files	Description
`HiImWdm.h`	Header
`Init.cpp`	Driver initialisation
`Pnp.cpp`	Plug and Play Power Management
`Dispatch.cpp`	Read, write, etc.
`WMI.cpp`	WMI handling
`..\guid.h`	GUID definitions
`HiImWdm.rc`	Version resource
`HiImWdm.mof`	WMI class definition
Build and installation files	
`HiImWdmfree.inf`	Free build INF
`HiImWdmchecked.inf`	Checked build INF
`SOURCES`	List of files to build
`..\BuildDrvr.bat`	Build batch file
`makefile.inc`	mof compile and post build steps

Table 1 – HilmWdm source files.

Callback	Description
`AddDevice`	PnP Add new device
`Unload`	Driver unload
`IRP_MJ_CREATE`	Win32 CreateFile
`IRP_MJ_CLOSE`	Win32 close file
`IRP_MJ_POWER`	Power Management
`IRP_MJ_PNP`	Plug and Play
`IRP_MJ_READ`	Win32 reads
`IRP_MJ_WRITE`	Win32 writes
`IRP_MJ_DEVICE_CONTROL`	Win32 IOCTLs
`IRP_MJ_SYSTEM_CONTROL`	WMI

Table 2 – HilmWdm callbacks.

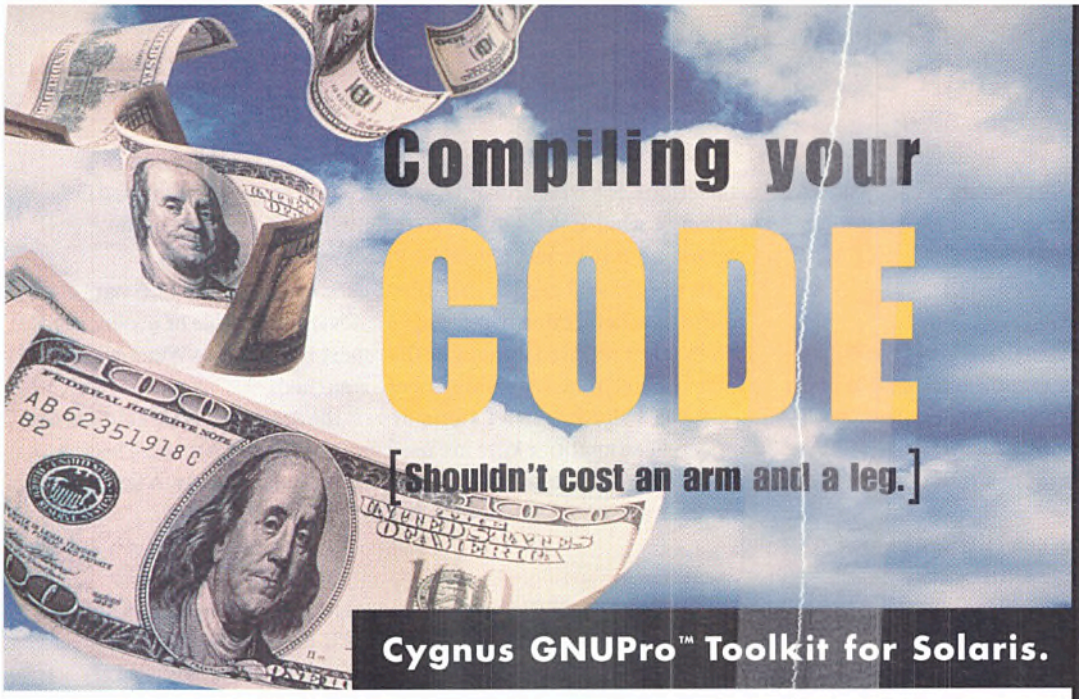
Keyboard collection
Input: 8 single-bit modifier keys
Output: 5 single-bit LEDs
Output: 3 single bits for padding
Input: 6 data bytes for scan codes

Table 3 – HID keyboard report definition.

Each endpoint can transfer one of four types of data: control, interrupt, bulk, and isochronous. A connection to an endpoint is called a pipe. Transfers on endpoint 0 (the default pipe) have a standard format.

Each USB device has a series of descriptors that describe its logical structure. The presence of additional class descriptors indicates that the device is of a certain standard type, eg printer, HID, hub, display, etc. If Windows detects a USB device with a HID descriptor, then it automatically fires up the HID system drivers to interrogate the device. I guess that Windows will support other device classes in due course.

In the meantime, to control your USB device, you will need to write a WDM USB client kernel-mode driver. The Windows USB class driver is controlled using a series of internal IOCTLs. The most useful allow you to send off USB Request Blocks (URBs) for processing.



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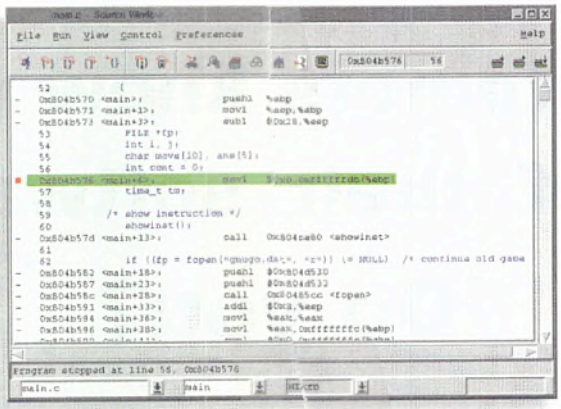

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There are 39 different URB operations that you can request, allowing you to get descriptors, perform the different transfer types, etc.

HID

A Human Interface Device (HID) is not some gruesome force-feeding contraption. Instead it is an abstract model for most types of input device that people could use to control their computers. HID lets you output information as well, eg to set the LEDs on a keyboard. Apparently, there is a standard HID set of controls for a magic carpet!

Windows has built-in support for various HID devices, eg keyboards and mice. Microsoft seems to be using HID more and more to get user input, as it provides an abstraction layer above the actual hardware interface. If both a HID keyboard and an old PC keyboard are attached, then you can use both of them.

Although HID was born as a USB extension class, it can now stand alone as long as the right HID descriptors are presented to the HID class driver. A USB minidriver is supplied as standard, but you can write other minidrivers if you wish.

Figure 4 shows one possible HID driver stack configuration. A USB HID device is plugged in. The USB HID minidriver provides the interface between the USB and HID class drivers. HID clients can either run in the kernel (like the Windows keyboard drivers, *Vkd.vxd/kbdhid.vxd* or *Kbdclass.sys/Kbdhid.sys*) or in Win32 user-mode.

A HID device describes its capabilities primarily in a Report Descriptor. Input, Output, and Feature reports are described. Each report consists of a series of bit or data controls, possibly grouped into collections. Each control or collection has a 'usage' – a standard definition of what it does. A keyboard must produce exactly the right reports for it to be recognised by Windows and your BIOS.

In the general case, a HID client uses the Windows HID parsing routines to determine what usages a device is capable of producing. When it has received an actual HID report it uses more Windows routines to determine what values were returned.

Table 3 shows a brief summary of the standard HID keyboard reports. The modifier keys are used for left Ctrl, left Alt, etc. The scan codes represent the keys that are pressed simultaneously. A keyboard report is generated whenever a key is pressed or released.

The latest technologies

You must write a WDM driver if you want to support some of the latest technologies like USB, HID, and IEEE 1394. (However, remember you will still need to write separate *video* drivers for W98 and NT 5.)

Supporting Plug and Play and Power Management does make a driver more complicated, but this extra work is usually more than offset by having standard class drivers to do most of the detailed hardware interactions for you. And it is certainly nice to be able to write one driver that works in Windows 98 and NT 5. ■

Chris Cant is a director of PHD Computer Consultants, and his book on WDM device drivers is due to appear in mid 1999. He can be contacted by email at chris@phdcc.com. *The source code for the HiImWdm example driver discussed in this article is available on EXE OnLine and in the PHD website download area. Download and unzip in directory c:\EXEWdm.*

Developer Tools? - Look No Further.

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Tools for testing

Scotching the nasty rumour that developers don't test their code, Ian Murphy looks at the tools available from Mercury Interactive and Rational: TestDirector and PerformanceStudio.

A great miscarriage of justice is abroad in the land and it is being perpetrated via rumour, innuendo, and supposed anecdotal evidence. Apparently, programmers don't test their code. Unfortunately, many of those making such claims have never written code, or if they have, they have never worked on complex projects where development is done in a team environment. All of the programmers I know carry out some testing of their own code, but it is predominately limited to ensuring that their code performs the specific task it is required to do. The problem with this approach is that they know what it should do and often this affects the way that they do testing.

If we were to believe the claims made by many vendors that we live in a world where programming is all about objects and componentisation, then it would be relatively easy for a programmer to test each small object, validate that object, and distribute it to system designers. Those designers would then be able to put that code together in any way they wanted to and know that it would work. This is the Holy Grail of object programming: robust objects, reliable frameworks, and system designers with a deep understanding of how Legoland was built.

Life, however, hasn't reached this stage yet so code quality assurance is still a complex and very difficult field. Ask anyone who is involved in Y2K testing about the problems that they face. Financial services have been struggling with Euro compliance this year in addition to Y2K and this has forced many of them to abandon the traditional methods of software testing.

The traditional way

There are three common images of those involved in software testing. The first is a room full of students who are just repetitively testing code by inputting random data and seeing what happens. They have sheets of test data that show what they should input and what they should get as a response.

The second image is probably the most common, and this is where software has been released to a limited number of users who have

been designated by departmental heads to test the new software. In some cases, it is those who have been involved in the commissioning and design process, but often the individuals are too precious to spare. Increasingly it falls to the departmental junior or a student on work experience. I have even seen people bring in their children to earn extra pocket money by testing systems. This is a real shame. If the correct users are chosen, then they are ideal testers because they know what they want from the system and they are unlikely to accept much in the way of compromise.

The third group is often what happens in small programming teams. Everyone takes turns at testing bug fixes, and this often means that whoever finishes their code first will begin to test other people's code. It is often very limited testing: working from bug reports and entering the data used to create the original failure to see if it now works. Depending on the diligence of the individual carrying out the testing, they might just try random data to see if the code really does break.

In all of these cases, the individuals chosen will be working from testing criteria given to them, and their results will simply be paper, to be sent back to a central department. They will all have been instructed to follow the criteria on the sheets, and should they have a brainwave and try entering something at random they will often be criticised for not following the 'methodology'. Often there is no real methodology involved, but this is not taken into account.

Perhaps the most efficient testing I ever came across was by a group of operators at a large pharmaceutical company. During long nights when they were bored, they would run up applications on their terminals and PCs. They would then try hitting keys at random, including combinations of keys. I remember an instance when one of the operators discovered that a combination something like CTRL-ALT-F-%-3-A-0 would cause the application to create a Unix system dump. Granted, they were taking things to the extreme, but maybe they just highlighted the inadequacy of the testing methodology.

I have even seen people bring in their children to earn extra pocket money by testing systems.

Large and complex

Large and complex systems cannot simply be tested via input and assessment of data. The complexity of the software is often used to justify any of several mathematical models of software quality assurance. Such models rarely demonstrate their failings until something catastrophic occurs. Systems in this category are: aircraft, railway signalling, nuclear power stations...I guess you get the idea.

Closer to home is the need to test existing systems such as Y2K compliance at a pension company, a mortgage provider, or a bank. These are extremely complex systems where testing requires many thousands of hours of input and evaluation of the paperwork. To do this properly requires structure, management, and effective tools.

The structure is necessary to make sure that the testing is thorough. Management is required to ensure that the information gathered is properly assessed. When you look at the types of systems mentioned above, this could mean evaluating several thousands, even tens or hundreds of thousands, of individual tests. Y2K compliance requires that systems be checked against more than a dozen different dates, so imagine the paperwork generated here. The tools used need to enforce the methodology; capture both input and output (particularly any error messages or screen information), allow the tests to be developed and modified to cope with a wide variety of potential inputs, and finally, produce a qualitative assessment of the software.

In order to do this the testing tools must be integrated into the entire development cycle. Integration with other products starts with the design tools. These create system specifications and some are complex enough to provide detailed functional specifications. Both types of information can be used to validate that a system carries out the tasks that it was designed to perform.

After the design tools comes integration with the SCM (Software Configuration Management) products (see *Don't you just love being in control?* EXE, December 1998). This allows for the results of any failures to be fed into the defect-tracking systems. It could be automated, but given the vast amount of information that may be generated, a simple macro to copy results across on the occurrence of a failure would work well. This integration should also contain some form of two-way messaging so that a product that is signed off as ready for testing via the SCM interface should be flagged as ready for test/retest inside the testing tool.

As soon as this integration is done and is accepted by the corporate mentality, testing is no longer something done by students or users – it is a discipline. Quality assurance becomes part of the software lifecycle and not an oversight. To some extent we should already be a long way down the road on such integration with ISO standards but while those standards do exist, they are often backed up via paper-based systems. Comprehensive testing easily overwhelms such systems and therefore their validity is questionable.

Programmers, on the whole, do care about what they write and many believe passionately in the products they produce. I don't care if you talk about highly motivated individuals with reputations to protect or maintenance programmers who often have the most boring of jobs fixing other people mistakes. However, testing individual pieces of code is not sufficient to identify many of the problems that exist today. Only when complex applications are tested in a systems sense do we really find some of the problems, and these cannot be simply laid at the door of programmers who are just members of a large team.

Mercury Interactive

Mercury Interactive is the acknowledged leader in test tools today and has been for several years. This has been achieved by ensuring that the company has remained focused on its core market. You might think that such a single-minded approach would mean a limited set of products and appreciation of the market. That is certainly not the case, although it would be the first to admit that it is not aiming its tools at the small developer market. Much of this is because the company has an in-built belief in the needs of dedicated test teams that are centred on carrying out comprehensive software testing.

This approach is borne out by its sales and training approach. Most vendors, when pushed, will happily give you a list price for all of their products and then negotiate discounts based on quantity. While Mercury has a basic list price, it is not interested in just making that sale. Getting the testing right also means selling the customer the correct tools for the job. Even more important is ensuring that they understand what they are able to do with the tools. As a result, Mercury spends a lot of its time working closely with cus-

tomers in the early days, and that approach has tremendous benefits for both parties.

TestDirector, WinRunner, and LoadRunner

Mercury has a number of tools in its two main test suite families. Its primary testing products are TestDirector, WinRunner, and LoadRunner and there are family members that are geared towards specific testing issues such as Y2K and language-specific testing such as Java. The Astra tools – Astra QuickTest, Astra SiteTest, and Astra SiteManager – are aimed at Intranet and Internet testing. There is another product called TestBytes, which is quite neat. There is nothing I dislike more than suddenly having to generate a large amount of data to populate a SQL database, whether it be for code testing or just to get a feel for the capabilities of the database. TestBytes generates that data.

Structured testing, however, is what Mercury Interactive is all about, and to understand its approach you need to begin with the core module: TestDirector. TestDirector 5 is the current version and users of previous ones need to save their data and scripts before installation. Everything you do is linked back to TestDirector and this is central to the Mercury philosophy. Most of the time you spend within TestDirector will be centred on two specific types of tasks: creating test plans and analysing test results. Tests are actually created and executed via either WinRunner or the Visual API.

User administration within TestDirector is in keeping with most network-based products today. Users are added to groups, groups get permissions to access project databases, and users gain access to commands based on the groups of which they are members. TestDirector does require that users have a valid email address if they are to receive defect reports, and you may want to consider having multiple email addresses for senior project personnel to prevent their standard mailbox from being overrun. If a project has several administrators, then you may wish to have a common email ID that they can share.

User groups are very powerful and this is one of the first real understandings you get of how comprehensive TestDirector really is. The product ships with five default groups ranging from TDAdmin, which allows administration of a project, through to Viewer, which has simple read-only privileges for a project. The other three built-in user groups in descending order of access are QATester, Project Manager, and Developer.

Groups have a remarkable number of privileges that can be granted to them, and these privileges are not just general actions. Where appropriate, each set of privileges can be applied to particular fields to control the input of a particular group. For example, you might want a group called Testers only to be able to promote a product from *UnderTest* to *Pass* or *Fail*. Another group called TestManagers might then be required to sign off a piece of code assuming that they have checked the work of the Testers. This level of control is important and is effectively implemented within TestDirector. From a security perspective, Mercury scores extremely highly in this area because groups are assigned to projects. This means that an administrator in one project would need to be added to an administrator group in another project if they are to be able to manage both of the projects.

To ensure that you can tune TestDirector to take full advantage of this level of control you can add fields to grids and dialog boxes. If you want to implement a full auditing capability, you can select those fields that need to create a history entry every time they are altered. At any stage, auditing can be turned off, so access to this level of management must be strictly controlled.

Groups have a remarkable number of privileges that can be granted to them, and these privileges are not just general actions.

TestDirector uses databases to maintain its projects and this allows Mercury to add the necessary access control to the database to prevent unauthorised access or tampering. While you can use Microsoft Access, it is almost certain that you will create your projects in a more powerful database. For this reason, Mercury provides support for Oracle, Sybase, or SQL Server.

The Mercury way

As mentioned earlier, Mercury is very precise about the way its products should be used and this is reflected in its documentation. One example is chapter 4 of the TestDirector User's Guide, which sets out a very clear set of steps to be followed when using Mercury's tools to test software. There are six steps: define testing goals, define test subjects, define tests, design test steps, automate tests, and analyse test plan. Notice immediately that actual physical testing is only a very small part of this approach and this is because Mercury believes that only if sufficient time is spent refining and building test documents will you get effective results. In this, it is absolutely correct. Too many people when asked to test software just grab paper and pencil and sit down in front of a computer. On one project I was even asked not to brief the testers about the product because if it was to be easy to use, it shouldn't require any explanation!

While defining the test goals is likely to be the responsibility of the project leader, Mercury has chosen to provide some basic questions that should be considered under three key headings. What, how, and who are the basic conceptual headings, but among the minute detail they include topics such as what resources are required (personnel, hardware, etc) to carry out the tests and when will the tests be completed. Sounds obvious doesn't it, but just take a close look at any test-

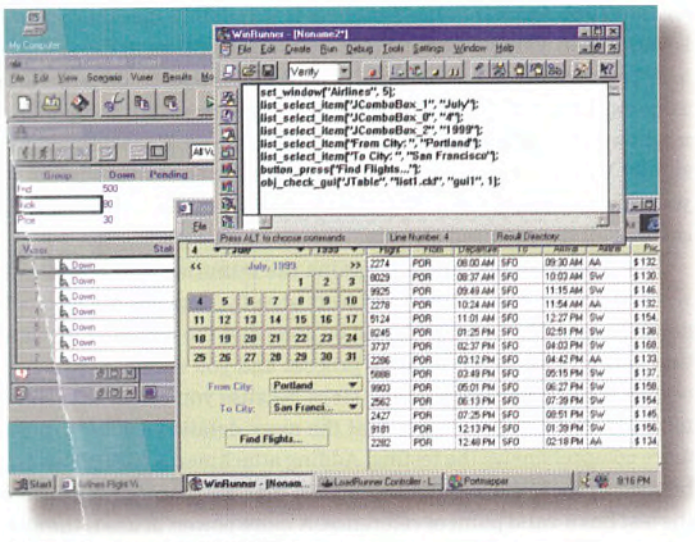


Figure 1 – Mercury's WinRunner.

On one project I was even asked not to brief the testers about the product because if it was to be easy to use, it shouldn't require any explanation!

ing being carried out around you and it is often done on machines that bear little resemblance to those on which the software will be run. Specifying the signoff criteria is as important to any testing as detailing how the tests must be carried out.

Goals and strategies

In order to define the testing goals and strategies you will need access to any documents or design programs that have been used during the early stages of the project. Ideally, the test team should be involved as early as possible so that they can understand the user requirements, the system specifications, and where used, the functional specifications. For each of these areas, it is possible to detail goals, techniques, and requirements. If done in conjunction with the design phase it becomes much easier to ensure that all parties are agreed on the criteria in use. Failure to do it this way will only lead to internal wrangling and politics that cannot benefit any project.

To facilitate this integration Mercury uses its Open Test Architecture (OTA), which provides an API framework for writing companion applications. As well as inputting data from design tools, you might want to take the results of tests and put them into your preferred SCM tool. OTA even allows you to interrogate the project databases, including the history file, so you could extract data into your own reporting tools. I have no personal knowledge of any other vendor in the field that makes this level of interoperability available. If required, Mercury will also work with you to build any interfaces that are necessary.

Defining test subjects and defining tests should be carried out together to prevent initial subjects that are too broad. A test subject of *Create Policy* within an insurance system might reasonably have individual tests covering 'input application form', 'create medical appointment', and 'check against other policies'. However, with a subject of *Check Against Policy Database* it is unlikely that there would be more than a single test and that would be identical to the test subject. Tests that have a wide range of potential inputs could be defined as being automated while others that affect the visual components might need to be checked via the Visual API tool. Each defined test should have a test plan document and this is the starting point for your test documentation as well as a check to ensure that you have covered all the required criteria.

The Test Plan document contains the minutiae of the tests you want to create. You define your tests step by step, adding as much detail as possible on what should be done and the expected result of that action. This is an iterative process and you should not be concerned about creating too many steps because you can always rationalise them later. Remember that the more detailed a Test Plan the more comprehensive the testing. Adding attachments to the steps can be used to show the expected results so that the person carrying out the test has a valid point of reference. A more powerful use is the ability to capture an error, attach it to the test, and then send the test and associated screenshots to the developer with the defect report.

TestDirector will automatically call WinRunner when you are ready to carry out the first pass of your test. This will capture the relevant steps that you can later extend via the WinRunner scripting language. The GUI Map facilities within WinRunner allow you to teach it about any objects that you have created as well as extract any information on object properties. In any dynamic environment, the individual acting as the project leader may want to delegate someone to ensure that all object and classes are taught to the GUI Map on a regular basis. While Mercury spends a lot of time positioning its products at the high end where corporate testing departments are likely to employ test professionals, WinRunner is a full code-test environment with breakpoints, watchpoints for variables, variable management, and error handling.

When you automate the execution of scripts, you are not necessarily running the script multiple times; you are simply allowing the script to execute in its entirety. The methodology that Mercury uses recommends that you try and keep to single executions with detailed analysis of results either to refine your script or report errors in the code.

There are, obviously, some types of testing where running the same test a large number of times is important. Client/server testing is one of these areas where you might be trying to locate a memory leak. Another would be to combine your tests with LoadRunner and execute a large number of tests across the network to simulate the effect of many users. Both of these, however, can only be done if you have spent enough time during the design, creation, and manual testing phase.

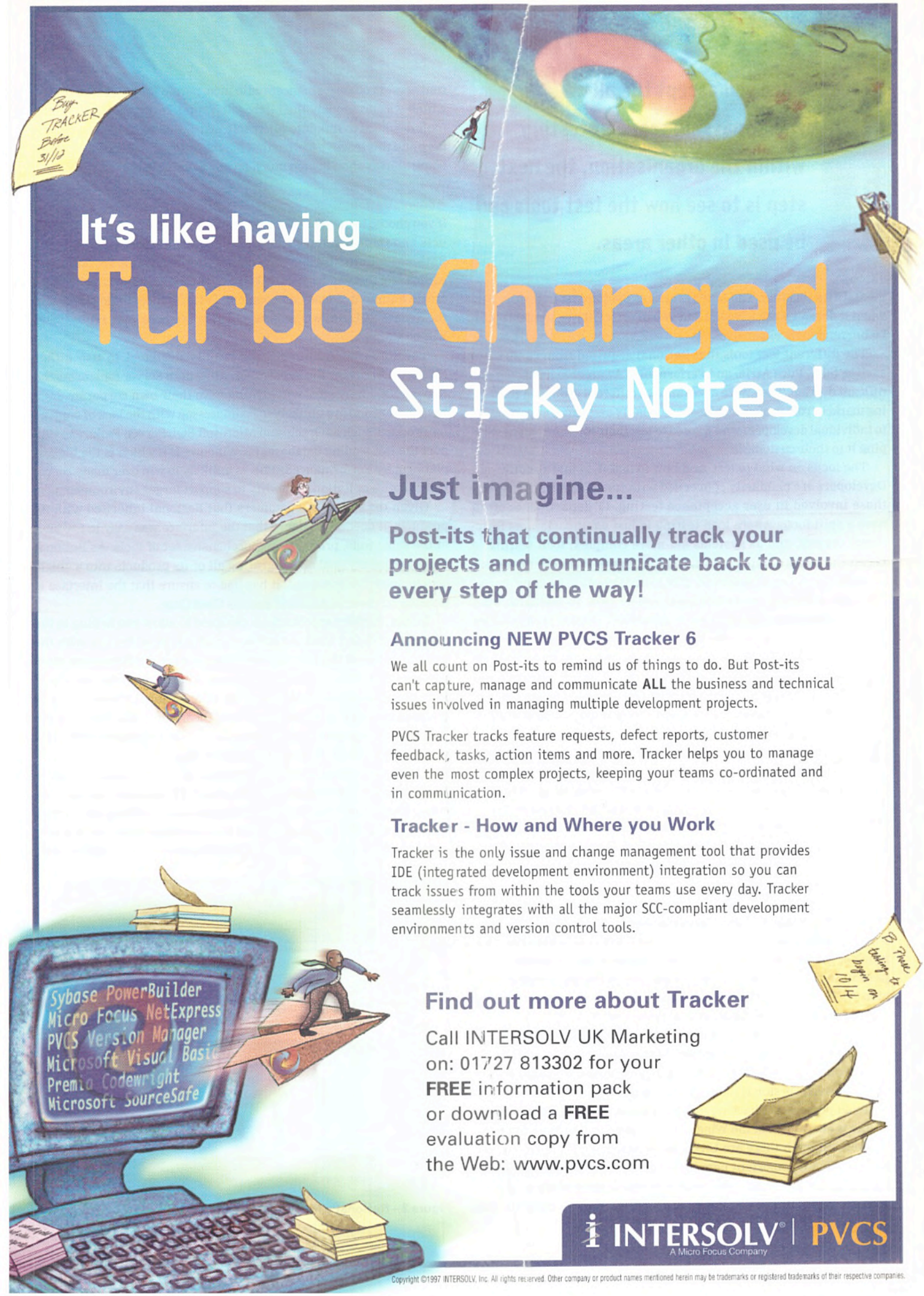
Effective analysis of your results is important, and all of the Mercury products have support for this built into them. Analysis can range from simple reporting to custom-built reports. Graphical analysis of information is also extremely important and Mercury has the ability to produce charts on all the information gathered. The analysis of each test run from WinRunner is extremely well designed. All of the events that you have declared in your script can be viewed at the end of each run and stored for later comparison. This can be a useful check when you are comparing different versions of a piece of code. The reporting from LoadRunner is the most adaptable I've seen with the ability to identify problems in each network segment to show if the infrastructure rather than the code is at fault.

Overall, the Mercury tools are the most tightly bound set of test tools I've ever come across. The company is geared up to working with test professionals and this means more than just training; it means mentoring and working to understand your business. However, there is a general developer unfriendliness when you talk to Mercury. This certainly works against small development shops that are keen on ensuring high quality testing for their applications.

Rational Software's PerformanceStudio

Over the last few years Rational Software has been working hard to position itself as the developer's friend. This has involved a number of acquisitions that have taken some time to resolve into a coherent strategy. That strategy finally became clear as 1998 drew to a close. Rational has begun the process of moulding all its products into a complete toolkit for development support. This toolkit covers design, software configuration management, and testing.

PerformanceStudio is destined to become Rational's software testing product yet it still, at this point, lacks complete integration. When Rational set out on the acquisition trail there were always doubts as to how effectively it would be able to merge different markets, different user bases, and more importantly, different corporate



Once you accept the all-encompassing scope of testing within the organisation, the next step is to see how the test tools can be used in other areas.

mentalities together. The latter is always the hardest to resolve and when it doesn't work – Novell and WordPerfect, for example – it can be horrendously expensive.

The different test tools that Rational acquired from companies such as SQA, Pure Atria, and Performance Awareness had some significant overlap. They were also aimed at different groups in the testing market, from professional test and quality assurance departments to individual developers who wanted to test their software before shipping it to their customers.

The focus on what to test, and how to test it, is just as confused. Developers are primarily concerned with functional testing as are those involved in user acceptance testing. IT departments often have a split focus where load testing is just as important as functional testing, and as systems get more complex, load testing is becoming a more important market segment. With client/server systems becoming widespread, this testing needs to be done across multiple platforms and tools must reflect this. In addition, load testing needs to be done on a continuing basis. Newer technologies are also demanding that the toolset cater for them, and with SQA SiteCheck Rational inherited a product that was ideally focused on this emerging area and the particular problems of Intranet and Internet load balancing. Over the last few years problems such as Y2K and the Euro have appeared and this has led to a newer, more focused group of test tools.

As well as resolving the different approaches and demands from the user communities, Rational has moved towards better education of customers. Once you accept the all-encompassing scope of testing within the organisation, the next step is to see how the test tools can be used in other areas. Part of the education problem that Rational has faced has been changing the perception of developers that functional testing is the most important area and that Rational is only involved in code-type testing.

To validate its place as a serious testing company, Rational has worked on the SQA Process test methodology and is promoting it as a means of ensuring that testing is carried out to maximum effect. Yet much of the serious functionality that Rational has acquired is not present in the current shipping version of PerformanceStudio (version 7). This does undermine, a little, its claim to be able to truly address corporate testing needs via a single product.

The entire family of products that make up Rational Software's test suite is enormous, yet the current version of PerformanceStudio is built around two products, Rational LoadTest and Rational Robot. While the next version is likely to contain many more of the tools that Rational possesses, I have no date for this at present. PerformanceStudio is also aimed at the Windows NT market rather than the Unix market, although there are Unix agents shipped with PerformanceStudio. What is important here is that while the number of products currently inside PerformanceStudio is small, none of them are the code-specific tools such as Purify or Quantify. Neither does the current version of PerformanceStudio incorporate Rational Visual Test, which was previously the Microsoft Visual Test product. Even the tools designed to link into Microsoft Visual Studio have been left out here and this leaves a feeling that maybe Rational is concerned about being seen as showing too much favour to developers.

Administration

If you choose to install PerformanceStudio, you get both of these products and their ancillary routines. Robot contains a version of the Rational Administrator, LogViewer, SiteCheck, and TestManager while LoadTest can be installed on a client computer to enable you to create a simulated load environment. PerformanceStudio ships with the Sybase SQL Anywhere Server, which is where your repositories will be stored.

The Rational Administrator is only designed to use either Microsoft Access or the Sybase SQL Anywhere Server for storing the Repository. Many sites will already have their own corporate database servers and are unlikely to be impressed with the lack of support for products such as Oracle and Microsoft SQL Server. Failure to support the two leading databases on Windows NT, which is the biggest platform for PerformanceStudio, is unlikely to win over many corporate sceptics of Rational's ability to support larger environments.

Given the spread of customers that Rational inherited with its products, it needed to ensure that the interface was easy to use and, at the same time, provide a comprehensive set of tools. As Rational has a secondary goal of integrating all of its products into a single development environment, it has had to ensure that the interface is familiar to users of products such as ClearCase.

In fact, PerformanceStudio is designed to allow you to plug in the ClearQuest defect tracking software and this provides you with the linkage between the test tool and the software configuration management tools. This integration between products becomes extremely interesting when you look deeper into the Rational Repository. It is the meeting place for the Rational Test, ClearQuest, and RequisitePro databases. If you have used Rational Rose to design your models, then you can link any of those models into the Repository.

There are several other tools controlled by the Rational Administrator such as the Rational Synchronizer. This product controls the consistency of information between databases. The Rational License Manager can also be plugged into the Administrator and this provides a simple interface for licence management of all the Rational

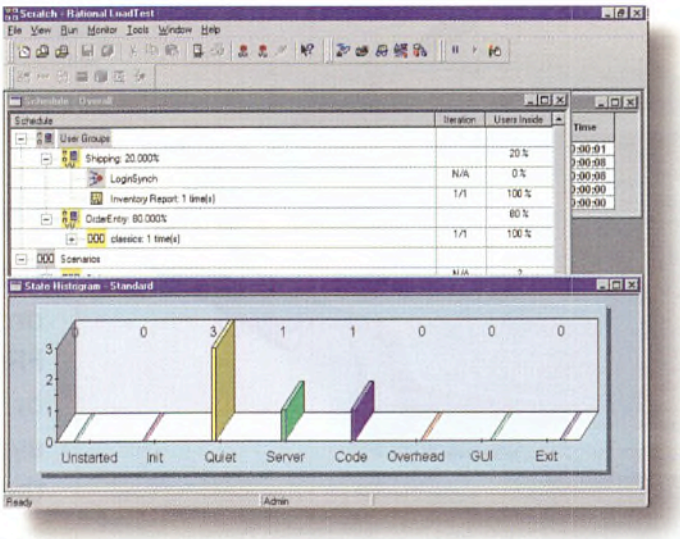


Figure 2 – Rational's PerformanceStudio.

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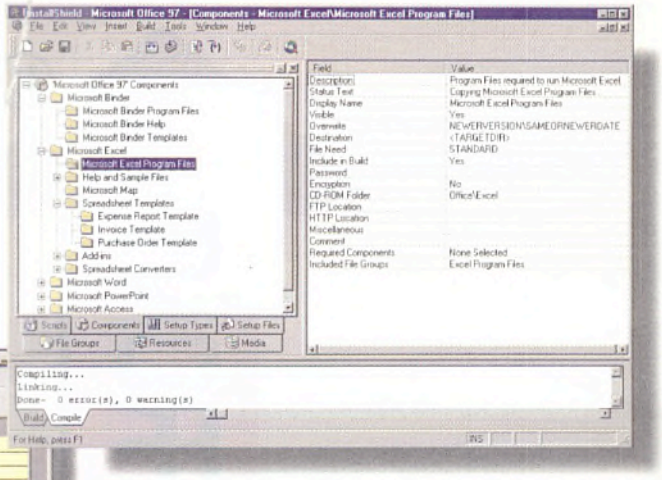

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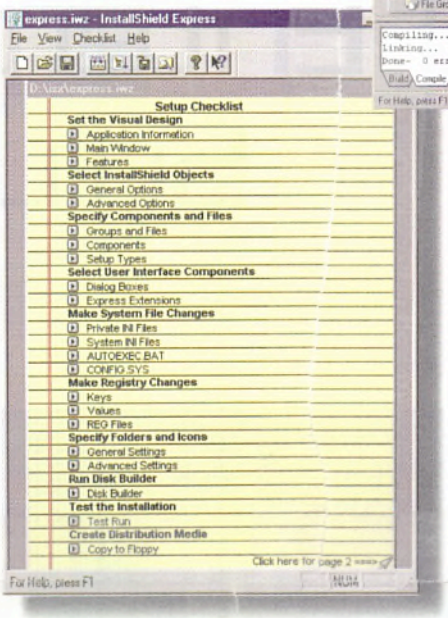

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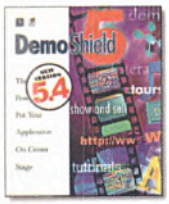

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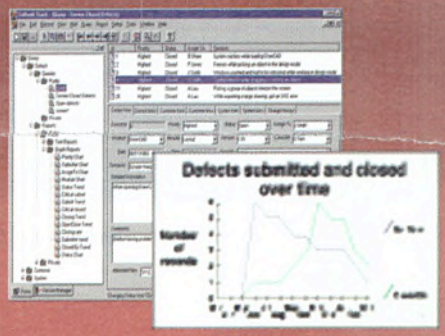

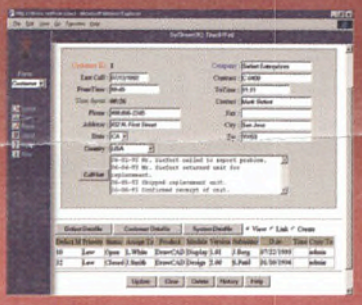

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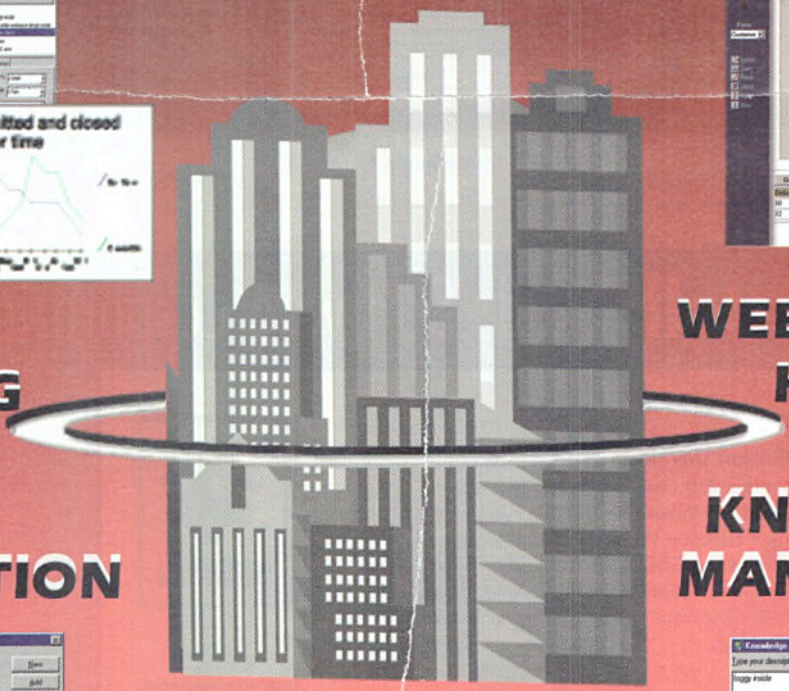
WEB-ENABLED HELP DESK



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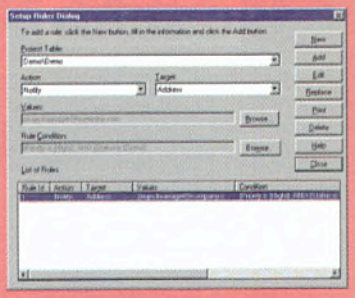

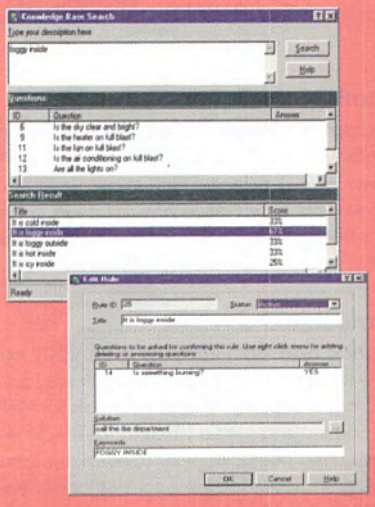

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products you own. While these tools show just how Rational is creating a single environment, only the Rational Test database can be controlled from the version of the Administrator currently shipped with PerformanceStudio.

At present, Rational does not publish an open API to allow you to write interfaces between PerformanceStudio and other products. To then withhold the glue products from the Administrator would appear more than a little shortsighted and it is to be hoped that the next version of the product will contain both the Synchronizer and the Licence Manager.

The Administrator is responsible for creating the Repository, managing users and groups, creating and managing projects, and even creating and managing computers. This latter point allows you to register computers for use in load testing scenarios. One of the things that struck me was the simplicity of the user/group mechanism, and I felt that it was oversimplified. To make any real use of the group mechanism I had to create my own groups immediately. Another drawback, as a control freak, was the inability to separate access to different projects. Once you had administrative access to one project, you appeared to have access to all projects. In a large and complex environment, this is likely to cause some concern.

Test scripts

One of the things that becomes very evident when you work with PerformanceStudio is that you are quickly moved towards creating test scripts and carrying out physical testing of your application. (There is little difference between the two when you look through the official training materials from Rational.) Here, at least, there has been a reasonable attempt to provide an outline methodology, but it appears to be subsumed by the need to actually carry out the testing. PerformanceStudio is, after all, a test tool.

The primary testing tool within PerformanceStudio is Rational Robot and this tool has been tuned to appeal to anyone who has ever created a test script. There are two basic ways of creating and working with scripts: GUI recording and Virtual User recording.

Any development environment where the developers are creating libraries of screen objects must be prepared to spend time mapping object types and classes within the GUI recorder. Simply recording input is of little use, however, when you consider that many of the applications in use today take advantage of list boxes and multiple inputs. To ensure that the test scripts can be used effectively, Rational ships SQABasic with PerformanceStudio. However, SQABasic is not just a method for automating your scripts; it is extremely powerful and even allows you to get details such as the properties of any object on the screen.

One area where this would be extremely useful is in testing to ensure that objects do not fall off the screen when the application is ported to a lower resolution. Having a script that gathers the properties of each object will allow you to check position and sizing. If the object is an array, you can retrieve all the details of the array.

If you intend to test across the network and want to gather client/server statistics, then you can use the Virtual User (VU) recording mechanism which, like the GUI recorder, comes with its own language reference. The VU language set allows you to manage the

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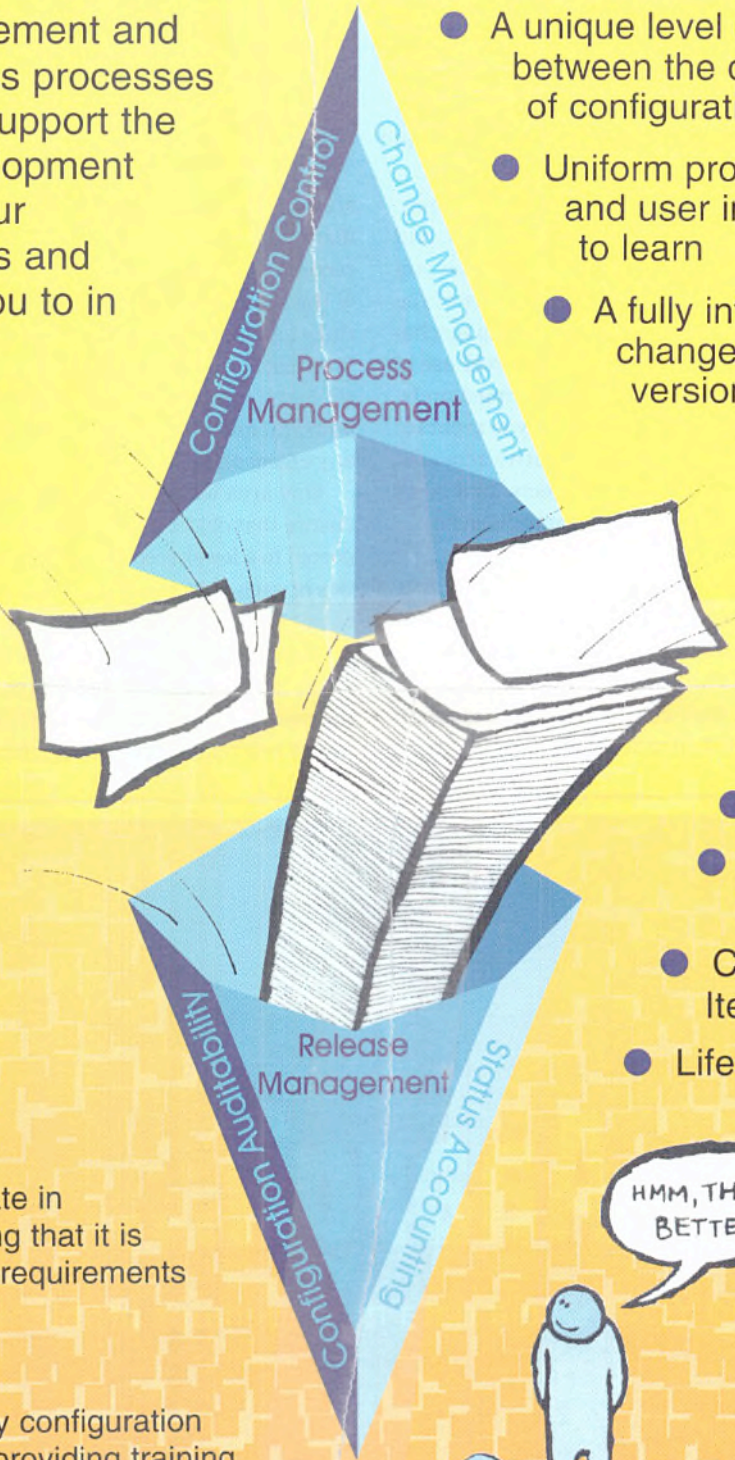

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creation of SQL scripts and the connections to your backend database. Even more important for developers within an object environment where builds may change on a regular basis, you can carry out the recording at the API level. System administrators will welcome the ability to use the Virtual User mechanism to capture just the traffic and even to monitor the traffic passing through a proxy server.

Playback of scripts is controlled through the Rational LoadTest product and a scheduler. This scheduler can be set to execute a script once or many times and the information gathered from the tests can be fed directly into a database. I was impressed with the ability to manage the speed of playback and the facility to introduce delays to simulate both user and system delays. Both of these allow you to ensure that the playback matches the use of the application in your own environment.

Analysis of the results of your tests is again carried out through the tools within Rational LoadTest. One of the problems with gathering large amounts of test data is making sense of the information afterwards and Rational appeared to have spent a considerable amount of time making sure that the analysis tools are in place. The general reports were quite good and the performance reporting was extremely easy to use and effective. In a world where network administrators are often under pressure to assess vast amounts of information of network traffic, I felt that the performance reporting would enable regular testing to easily highlight bottlenecks.

A better response

Overall, PerformanceStudio 7 is a reasonable first attempt to bring together a number of extremely powerful tools. However, Rational must make its mind up as to who the product is aimed at, include the components that enable integration with the rest of its product families, and provide an API so that other products can be linked into PerformanceStudio. The sooner it includes the entire SQA Suite, including the SQA Process methodology, and adds some of the language-specific test tools the better the response is likely to be across the entire test environment. ■

Ian Murphy is a freelance journalist and trainer because it means getting lots of toys, access to some neat technology, and gives his ego an outlet. When pressed, Ian will go out and do consultancy. If desperate, you can contact him at ianmurphy@fleet-street.com.

More information

Mercury Interactive	
TestDirector	*www.merc-int.com/products/testdirguide.html*
WinRunner	*www.merc-int.com/products/winrunguide.html*
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PerformanceStudio	*www.rational.com/products/pstudio/index.jtmpl*
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Good forms, bad forms

When it comes to creating web-based forms to capture data from a user, what represents good design? Peter Collinson considers the handling of HTML form elements and possible error reporting systems.

I seem to have turned into a hacker of web forms these days. One of the companies that I run is now doing serious website design for largish organisations. More often than not, we are generating pages by pulling data from a relational database using MSQL, which I reviewed in *MSQL – a database for webmasters* (EXE, September 1998). The information is not simply the things that the clients sell, but is the entire content of their pages, both images and text. We display the information using scripts that access templates containing the look and feel for the pages.

The attraction of using a database is that clients can modify their pages instantly, with little or no knowledge of HTML or any other arcane art associated with website design. They can cut and paste text from their favourite word processor or text editor and place it onto the Web. We can provide intelligent options for what happens when some parts of the page are not present. We can provide the notion of a page 'being online', by simply placing a flag in the database telling the generation system whether to create the page or not. And we can provide the ability to generate 'flash' messages that can be placed on the final page with news or special offers.

I generally try to take HTML-free text from the client and apply heuristic formatting changes. I don't do anything complex. For example, I want to provide the ability for clients to split their text into paragraphs, and do this by interpreting a blank line as a point to enter a paragraph break. In many cases, this is all the formatting that clients need to display their news story or press release. On a recent system that I've done for the Usenix website, a jobs bulletin board, I've also interpreted a star at the beginning of the line as the start of a bulleted paragraph. If this type of simple formatting doesn't work for the application, then you probably need to be thinking again about making HTML available to the client. There's no mileage in re-inventing it for an application.

You might think that using a database to generate pages actually makes less work for the web designer. On balance, I don't think that this is the case. For one thing, the technique is only suited to pages with semi-fixed layout. And the design of the template is crucial. We tend to find that we need to generate a bunch of static pages with real information to get a feel for how the information should be displayed, and what boundary conditions exist. The ever-present problem of differences between browsers means that page templates need to be constructed with care. The template will hold varying amounts of information and the design needs to generate a sensible image in all the browsers that you can lay your hands on.

The display of images is a problem. At a minimum, you'll need to store the name of the file containing the bits to be displayed, and you need to provide metadata with each image. It's a good idea to supply the height and width of the image so that the final page does not engage the viewer in the ugly resizing dance while the page loads. I also like to provide a text string with the image, so that a viewer who has turned off image rendering in his browser sees something sensible. The viewer may, of course, be using a browser that does not display images.

My first stab at solving the problems of displaying images in automatically-generated pages was to create an image database that stores the metadata and the names of the files. Actually, some of the necessary information can be generated automatically. For example, the width and height of the image can be ascertained by program and loaded into the image database. I then get a human to enter the remaining information, and at that point they can select which of the images they wish to use with a specific page.

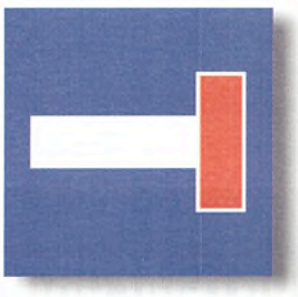
Once you have all your images accessible from the database, there is then the problem of image placement. My solution has been to limit where images appear on the page, using the template to determine where they should go. An image can be omitted and, to a certain extent, it's possible to dynamically alter the page to cope with the resulting hole. Actually, making an adaptable template is not too easy. It can be one of those classical pattern-recognition problems that have always been hard for computers and easy for humans.

I don't feel that I have reached a fully complete solution as yet. Images have other properties, supported by HTML, such as alignment, spacing, and text flow around the image. Ideally, I'd like to come up with a simple solution that would permit the random placement of images so we can generate random pages automatically, and punctuate the page with images from the database.

Forms

The upshot of these developments is that I am forever creating forms to capture data from the user and act upon it. Some of these forms drive Perl scripts and some use Lite, MSQL's scripting language. Many of the forms take information from a user and send the captured data to our clients as ordering information for their products, some take information from the clients and then update their databases.

There are several HTML elements used to generate different effects in forms. It's a testimony to the original designers of HTML that the browser manufacturers have not tended to mess with form elements (for 'mess' read 'gratuitously extend'). The set is reasonably complete and fully usable for most applications.



I'm discounting Microsoft's ActiveX controls here – these are part of the strategy for ruling the world by giving people access to a technology that locks them into a specific way of

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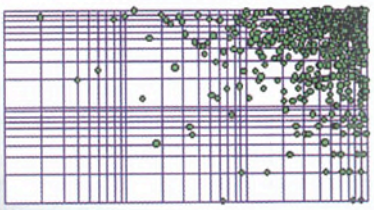

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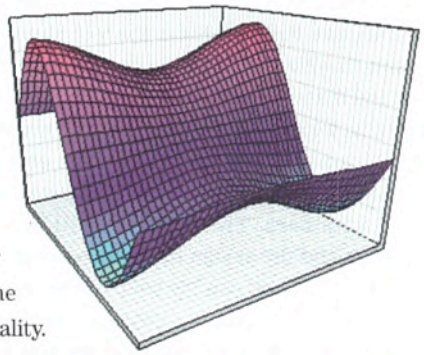

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HTML form elements range from simple text input boxes that take a single line of input, to radio buttons and drop down menus. The elements often allow their look to be modified. For example, text area boxes permit the designer to specify the number of columns and rows that should be displayed. I should note in passing that sizing information is broken on Internet Explorer 3. You ask for a box that contains 20 characters and are presented with a 10 character box. Yippee. This is a nightmare to the web designer, who sees a nicely laid out page with Netscape but whose client running IE3 is wondering why all the boxes are so short and the screen so empty. I've coded a workaround to this particular bug in several scripts.

You'll often find that Form elements don't behave like normal text elements and can disappear behind images rather than flowing around them. Using tables to constrain page layout can present other problems with forms. Browsers have adopted different strategies for what action can be taken when the contents of a table column must be wider than the space that can be allocated. Some browsers attempt to expand the table column to fit the request for horizontal space, and will squeeze other columns to give that space. Some browsers will clip the image inside the column to get it onto the page. Either way, it's bad news for forms, so the designer often has to pre-allocate narrower entry boxes than are desirable.

All the form elements have ways to set their initial state to a value or a specific setting. You can preload a text box, choose a specific radio button to be selected, or select a particular line in a drop down menu.

A particularly useful element is the hidden input box, an element that is not displayed and whose data cannot be modified by the user in any way. Hidden boxes allow you to carry state and other information from form to form. I like to create systems where all the information from the user is passed via the browser in hidden boxes, meaning that I can avoid the use of any files to store state in the server.

Each form element is given a name, and the CGI script that processes the form is presented with several `NAME=VALUE` strings that contain the data that the user has entered. The `NAME` doesn't need to be unique. The page can contain several instances of form elements with the same name, and a value for each of these elements is passed to the server. Some decoding scripts will place all the instances of the same name into an array, making it possible to obtain the value of a specific instance.

Finally, the user will have filled in the form and pressed a submit button that says 'parcel up all the information and send it to the server'. Forms can have several action buttons and these can be named, so that the script can determine exactly which button was pressed and take appropriate action.

Techniques

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Not having to provide much data checking from a form is rare. One of the benefits of having computer-supported forms is precisely that the data can be checked and dumb errors eliminated. If data from the form is being sent to a human, then it's a good idea to attempt to present the recipient with clean coherent information.

Checking for errors means that you have to supply some method of reporting that error back to the users, allowing them to change their input. My early forms tended to use an error page saying 'you've just entered something really dumb, use the BACK button on your browser, edit the data, and try again'. But there's a problem with this approach: if the form is large, the browser can decide to reload it when the BACK button is used. Under what conditions the reloading happens seems to be shrouded in mystery. However, reloading destroys the information that the user has painstakingly entered and they can become cross and go away.

You can implement error checking in the browser using JavaScript, and I've done this for a couple of applications. However, you do need to be aware that many sites are worried about allowing random scripts to be executed on their machines, and will simply strip out text from pages between `<SCRIPT>` and `</SCRIPT>` tags. This means JavaScript content testing can only be used as a nicety, something that is not relied upon to make the form work. I find this fact somewhat of a disincentive to use JavaScript. Since I have to implement an error handling system for the sites that do not like scripting languages, I don't bother to implement something for the sites that don't mind.

The error handling systems on my most recent forms will read all the information from the form, and send back a new copy containing all the information that the user has typed preloaded into the form elements. The new copy will contain error messages and indications to the user about the errors that they have just made.

Sending a new form adds significant complexity to the whole forms business. Suddenly, you are computing a page from a program and wishing to set different values into parts of it. While there is a standard Perl library that allows you to access forms (the CGI library), I personally prefer to use a Perl-based macro processor to send values to the net via a template. The template can also be used to generate the original empty form. The macro processing approach simplifies the CGI script considerably, removing all the look and feel of the page into a separate file and improving the maintenance aspects of the system. I talked about this approach in *Interaction by template* (EXE, March 1998).

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I'll often highlight the actual entry on the form about which the script is complaining. My usual trick is to turn the text above the box into red, and consistently use red lettering to signal errors. The user can easily scroll down and locate the box that needs altering.

Sending a preloaded form means that you have to be careful that you don't use the RESET button and label it 'Clear Form'. It doesn't clear the form. It resets it back to the preloaded state. I've got several forms out there in Webland containing this error.

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Standard campaign

Francis Glassborow highlights both the programming book and the C++ development package of 1998. But not before taking issue with BSI and its distribution of standards.

Having a standard is one thing, getting hold of a copy is something else. BSI is the official UK National Body and is responsible for distribution within the UK. Its pricing policy ensured that it sold very few copies of the C Standard. Its marketing policy makes it unlikely that you even know how to get your hands on the amendments to that standard. If it uses the same formula to calculate the cost for the C++ Standard (and, when it is final, the new C Standard) the price will considerably exceed the cost of buying a respectable set of development tools.

Clearly a new distribution mechanism is necessary. A third party offered to take over distribution (via CD) with a guarantee that BSI's royalty income would exceed that which it had previously achieved. The intended cost of the CD was in the price range £25 to £50. Part of the profit would have gone into the fund managed by ACCU to help active participants meet their participation costs. This deal was blown away when BSI decided that it required about £50 per copy sold.

The consequence is that it will be far cheaper to get copies from overseas and BSI will get nothing, nor will anything be available to help defray the expenses of our delegates to international meetings.

What can you do? If you feel as angry as I do, you can write to your MP and let him or her know about your ire. UK experts have done much of the work on both the C and C++ standards (without pay). Because a dinosaur organisation cannot accommodate modern media, money that is sorely needed to support continuing work will go overseas.

However, you have two other ways of obtaining legitimate access to C, C++, Java, etc. standardisation documents. You can actively participate in the process by joining one of the BSI panels and so become entitled to access the documents (in electronic form) for the purpose of standardisation. Alternatively, you can become part of the Association of C & C++ Users standards 'team' by joining the ACCU and subscribing £21 (or more) to its fund to support those in the UK actively working on C, C++, or Java standards.

Two 'must read' books

Among the piles of junk published every year about software development you will find a few very good books. Once in a while an excellent book arrives on the scene and even more rarely we get a book that provides unique insights. Quite extraordinarily, two such books have landed on my desk during the last month.

The first of these is *Multi-Paradigm Design for C++* by James Coplien (ISBN 0201824671). I met Jim soon after reviewing his *Advanced C++ Programming Styles and Idioms* (ISBN 0201548550), and his first reaction to being introduced to me was to threaten to knock my block off. He had confused me with some other reviewer who had accused him of a lack of humour.

Coplien is one of those talented presenters and exceptional writers that make average performers seem incompetent. Since writing that first book the focus of his interest has been on patterns and it is a pleasure to listen to him on that subject. However, his publishers have been nagging him for some years to update *Advanced C++ Styles and Idioms*, a task in which he has had no interest. Having said that, this new book certainly owes some of its ancestry to that earlier work. Take his earlier perception of C++ as a tool for writing in a wide range of paradigms, add the wisdom of years and the insights garnered from studying patterns, and you come up with this superb exposition of broad based design using C++ for implementation. If you are willing to accept that there is much more to good design than slavishly viewing everything as an object, then this book will help you develop your view. If you have a fixation on object-oriented methods, you just might come to realise that much good design that claims to be OO is good design that is not OO.

I was about to declare *Multi-Paradigm Design for C++* my programming book of the year when *Generic Programming and the STL* by Matthew Austern (ISBN 0201309564) landed on my desk. I have known Matt for several years because he has been an active participant in the standardisation of C++ and one who has shown exceptional insight into the requirements of the language and library. He always puts his point across clearly and gives genuine consideration to alternative views expressed by others. This meant that when I came to read his first book I expected it to be technically correct. What I did not expect from a first time technical author was a superbly readable book (it passed my famous 'bath test' – it can be read in the bath without immediate access to a computer). But it is something more than that, it is a book about an entirely new (well, the origins go back a couple of decades) programming mechanism.

Austern demonstrates how the STL is the kernel for developing generic (not to be confused with genetic) programming. By the time you have finished reading his book you will know that you need to keep it close to hand for future reference, but you will also understand exactly why the STL is not and never should be object-oriented. Generic programming is one of Jim Coplien's multi-paradigms and Matt shows us how to use it.

I have no hesitation in making this book my 'programming book of 1998' and I think that Coplien will understand that his book was a superb runner-up to an outstanding book from a new author.

In any normal year *The C++ Primer* by Lippman & Lajoie (ISBN 0201824701) would be a strong contender for 'C++ programming book of the year' but not in 1998.

Disappointment of the year

If you check the publisher for the above books, you will find that Addison-Wesley is responsible for all three. However, it is also responsible for the biggest disappointment of 1998. The long promised *Art of Computer Programming Vol 4* has yet to see the light of day. Even splitting it into three parts has done nothing to help. The software industry is often, rightly, chastised for its habit of pre-announcing software, but this book must be a record holder.

It crosses my mind that a possible cause of bugs in Microsoft's applications might be that it trusts its optimisers to work.

Development package of 1998

As IBM's next release of VisualAge for C++ for Windows NT/95 is not due till the first quarter of 1999, the three contenders for Microsoft platforms are Visual Studio 6.0, Inprise's C++ Builder 3.0, and CodeWarrior from Metrowerks. All three are worthy products. VC++ tends to get a lot of adverse publicity for all the bugs that users report. However, bug reports will always be proportional to the number of users, so not too much should be made of this. On the other hand, I find some of the reported VC++ bugs worrying. It seems that the best advice we could give to developers is to switch off all optimisation when producing a release version. It crosses my mind that a possible cause of bugs in Microsoft's applications might be that it trusts its optimisers to work. In other words the debug versions are working correctly and the code is actually correctly written, but the release versions of its applications are being screwed up by its compilers incompetence when optimising. Of course both groups (development tools and applications) are going to deny that there are any problems with their work.

C++ Builder 3.0 suffers from not being Delphi. Inprise has always taken a pride in producing standard-conforming products in so far as C and C++ are concerned. Yet they are built on the success of Turbo Pascal whose very success was because it ignored ISO Pascal and provided the kind of extensions and variations that made the language a powerful development tool rather than the beloved toy of academia. With C++, Inprise should make up its mind whether it wants to provide a quality implementation of the standard language or provide a heavily extended version including analogues of the many powerful elements of Delphi.

CodeWarrior (the current release is Pro 4) is completely different from either of the above. The core product is platform independent. The standard version is for both Win32 and Apple Mac development with support for cross-development. Versions of the product are available for other target hardware. Like Visual Studio, CodeWarrior supports several languages. Unlike Visual Studio, CodeWarrior supports multi-language development with straightforward linkage of object files derived from different languages. The C++ compiler is getting close to being conforming and its C compiler provides some surprisingly correct 'implementation-defined' behaviour.

It should be clear by now that I consider CodeWarrior Pro 4 to be my development package for 1998. If you are interested in more than pure Windows programming you should give this product a look.

Last month's problem

C9X is going to allow C++ style late declarations of variables in `for` statements. The problem is that, as in C++, you must either declare and initialise a single new variable or initialise a list of variables. Some ingenious programmer suggested the following:

```
int i;
// code
for (char * ptr = (i=4, 0); i <10; i++) {
   // code
}
```

as a way of declaring `ptr` and initialising it as a null pointer as well as initialising `i` to 4. What is wrong with the idea?

For those who struggled, let me explain that the idea was to write a sub-expression using the comma operator. All but the last of the sub-expressions would assign values to existing variables while the last one – the value of the comma sub-expression – would set `ptr` to be a null pointer.

This will nearly always work in practice, but it is based on a misconception. The meaning of the '`0`' constant depends on its context. At compile-time it is either the zero value for an `int` or is the null pointer constant. In the above context it is an `int` and you may not assign an `int` to a `char *`. Try the following on a conforming C89 compiler:

```
int main (void){
   int i;
   char * ptr =(i=4, 0);
   return 0;
}
```

If you 'correct' the error with:

```
char * ptr = (char *)(i=4, 0);
```

you hit implementation-defined behaviour. Casting zero to being a pointer is not required to generate a null pointer constant. It almost always will, but it is not required to, so an implementor could do something else. This is not entirely unreasonable. Think about programming for CP/M where address zero was an important address for the user (if memory serves me correctly, it contained the address of the table of service addresses). How could you distinguish that address from the null pointer constant?

This month's problem

Take a look at the following C (though it might just as well be C++) and comment on any problems you think it may exhibit. Note that in at least one case the problem will be one faced by implementors on some hardware platforms.

```
#include <stdio.h>
union MyData {
   int a[4];
   double d;
};
int main( void ) {
   union MyData data = {1,2,3,4};
   int iarray[4], j;
   (data.a == iarray)? puts("true"): puts("false");
   (iarray+4 == &j)? puts("true"): puts("false");
   for(j=0; j<4; ++j) printf("%d\n", data.a[j]);
   printf("%f\n", data.d);
   data.d=5.123;
   for(j=0; j<4; ++j) printf("%d\n", data.a[j]);
   printf("%f\n", data.d);
   return 0;
}
```

■

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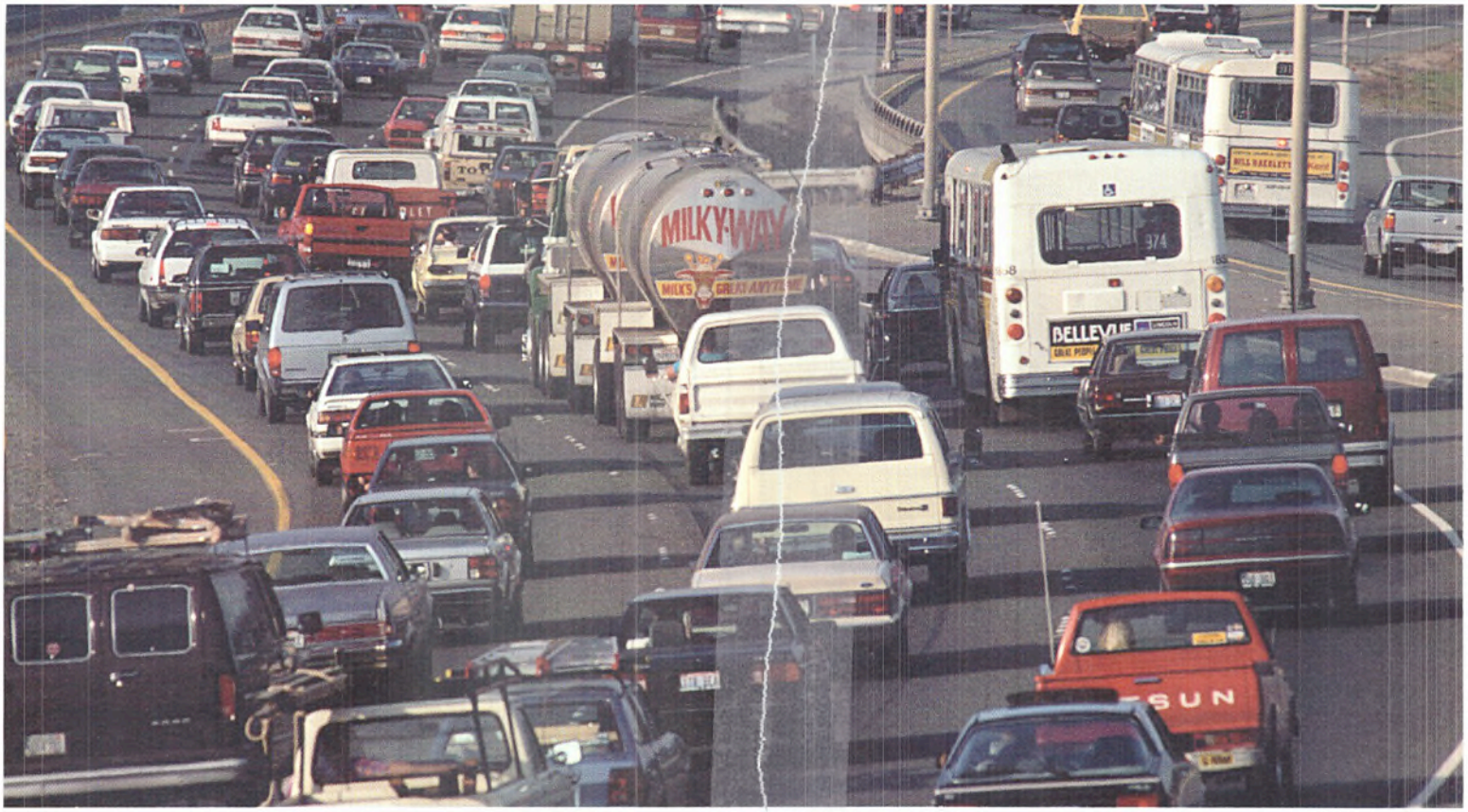

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Mementos are made of this

How to implement undo and redo facilities in Delphi – Mark Smith looks at generalised approaches using patterns.

A few years ago I read *About Face: The Essentials of User Interface Design* by Alan Cooper (ISBN 1568843224). This is a fascinating book, by turns funny, thought provoking, and infuriating. I particularly enjoyed a section called 'The guardian' where Cooper addresses an important question: how should a perfect program react to the inappropriate, inadvertent, and incorrect actions of the human user? One chapter deals with undo, looking at the user as an explorer, probing the unknown, experimenting with possibilities, and comparing variations before committing themselves to a set of changes.

I started thinking seriously about implementing undo facilities in Delphi applications when I was researching the `TClientDataset` article that appeared in the October 1998 edition of EXE. One of the neat-o features of this component is that it tracks all of the changes made to the data, and allows you to undo and re-apply changes fairly gracefully. This is fine if you use data-aware controls, have the client/server version of Delphi, and are willing to modify your programs to hold data in a client dataset, but is less useful for general programming. In this month's instalment I want to look at adding undo/redo facilities to Delphi programs in the most general way I can.

What is undo? What are we trying to achieve? Well, the general idea is to store the state of some thing or collection of things (be it a business object, a UML class diagram, or a record in a database) and allow the user to get back to this state after making a number of arbitrary changes. It would be even better if we could achieve this while preserving an acceptable level of encapsulation and information hiding. Once again there are a number of design patterns that can help with this, and I am going to focus on a variation of the Memento design pattern from *Design Patterns: Elements of Reusable Object-oriented Software* by Gamma, Helm, Johnson, and Vlissides (ISBN 0201633612).

Memento

The Memento pattern is an interaction between three objects, as shown in Figure 1, which is based on the description in the *Design Patterns* book. Originator is the thing we want to apply undo and redo operations to. Every class that implements Originator encapsulates its state in a different descendent of `TMemento`, which holds a copy of the internal state of the Originator. The `TMemento` descendents are defined within the implementation section of the module where the Originator is defined, so their implementation details are not visible to anything other than the Originator. The Caretaker stores Memento objects on a stack, where every item is a snapshot of the originator's internal state.

Here's how it works. When an object is first made available for modification, you extract its initial state, passing it to the Caretaker.

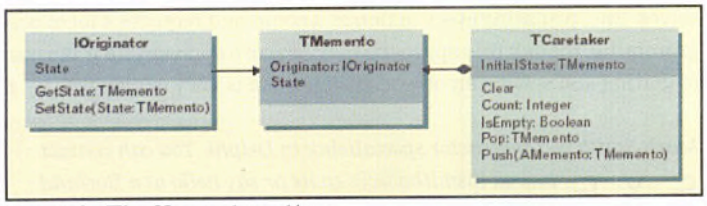

Figure 1 – The Memento pattern.

We need this state so that we can restore back to it if the user chooses to undo all operations. As the user makes changes, the application calls `GetState` on the Originator, and passes the resulting Memento to the Caretaker, which holds it in a stack. If the user chooses to undo an operation, the last Memento is obtained from the Caretaker and passed back to the Originator via the `SetState` method.

Form-based undo

The most obvious place to implement undo/redo is on a form, so let's deal with this first as we'll need it to provide the user interface for other kinds of undo later on. The first demo application allows the user to specify their choice of seasonal luncheon (inspired by the excellent Sandwich Preferences application in *Delphi Component Design* by Danny Thorpe, ISBN 0201461366). Okay, so Christmas may be well and truly past for you, but I'm writing this in November. There are two issues that we need to deal with – what to store, and when. The demonstration program deals with the 'when?' question by getting the form's state every time the user changes the value of a control. This is achieved by providing an event handler for every control's `OnChange` and `OnEnter` events. In the `OnChange` event, we set a private variable, `FChanged`, to `True`. In the `OnEnter` event, we check the state of `FChanged`. If it is `True`, we need to record the state of the form and send it to the Caretaker. Since we only record state when the active control changes, editing changes that occur within a single control do not get stored.

The 'what to store?' question is dealt with in a clunky manner as well – the `GetState` and `SetState` methods just retrieve the value of every control on the form and store them in the Memento. There is a lot of scope for using runtime type information (RTTI) to deal with this, as documented in Danny Thorpe's book and Brian Long's article *I am not a number, I am a TMenuItem* (EXE, March 1997, pp 33-42).

Redo too

Now we have undo working, we can turn our attention to redo. This uses another Caretaker stack, holding operations that have already been undone. When the user initiates an undo operation, the top item on the undo stack is popped, sent to the Originator via `SetState`, and then pushed onto the redo stack. The redo operation does the exact opposite, so Memento objects are shuffled between the two stacks as the user presses the undo and redo buttons. See Listing 1 for implementations of the key methods of `SaveState` (used to handle changes to the form), `UndoExecute`, and `RedoExecute`.

Object-based undo

Having looked at the kludge that is form-based undo, we can turn our attention to object-based undo. Object undo is a lot cleaner since we have far better control over when to save the changes – when a property of the object changes. We can do this as a side effect of our property write methods by calling a `Changed` procedure, which calls `GetState` on the current object and passes the resulting Memento object to the Caretaker. Since Delphi 4 class completion automatically

generates a write method for properties, the amount of coding we need to do is minimal. In the `SetState` method that is invoked to undo changes, you need to take care not to call the property write method otherwise you end up writing back the last set of undone operations to the undo Caretaker. Not the result you want. One sneaky trick you can use with objects derived from `TPersistent` is to make a copy of them using `Assign`, and store the copy in the newly created Memento object. Since your Memento object holds a clone of the business object, you save yourself having to write lots of repetitive code to set and retrieve your object's state. Even better, you can never forget to update the definition of your Memento class.

So far, we have only looked at undoing operations on one object. In many applications, you may have many different objects each capable of supporting undo/redo behaviour. You could maintain a new Caretaker for every single object, but that conflicts with the model of undo/redo presented by most applications. Instead, we maintain one Caretaker that handles undo for all objects, and another for redo. Clearly when the Caretaker needs to undo an operation, it needs to be able to send it to the correct Originator. To achieve this, the Memento class includes a reference to its Originator, and the Caretaker class's methods are modified to send Mementos back to the correct Originator, so that they can send the Memento to the right place when the user undoes an operation. See the second demo program for the implementation details.

Memento and inheritance

As I explained above, every class that implements `IOriginator` is responsible for its own `TMemento` descendent. This is declared in the implementation section of the module where the Originator class is declared, thus hiding it from the rest of your application. At first sight, this seems to limit the extensibility of our solution where inheritance is involved, since you might want to make your `TMemento` objects follow a similar inheritance tree to that followed by your Originator objects. Clearly, if the `TMemento` object definitions are private, then you cannot create descendents of them. This is one of those solutions where aggregation comes in handy, and it is probably best explained by example. Imagine for a moment two classes, `TBudget` and its descendent

```
procedure TForm1.SaveState(Sender: TObject);
begin
   if FChanged then
   begin
      UndoBuffer.Push(GetState);
      RedoBuffer.Clear;
      FChanged := False;
   end;
end;

procedure TForm1.UndoExecute(Sender: TObject);
var
   State : TMemento;
begin
   RedoBuffer.Push (GetState);

   State := UndoBuffer.Pop;
   SetState (State);
   FChanged := False;
end;

procedure TForm1.RedoExecute(Sender: TObject);
var
   State : TMemento;
begin
   UndoBuffer.Push(GetState);

   State := RedoBuffer.Pop;
   SetState (State);
   FChanged := False;
end;
```

Listing 1 – SaveState, UndoExecute, RedoExecute.

```
type
   TTransactionManager = class
   private
      FCareTaker : TCaretaker;
      FInTransaction : boolean;
   public
      constructor Create;
      destructor Destroy; override;
      procedure BeginTransaction;
      procedure Add (AOriginator : IOriginator);
      procedure CommitTransaction;
      procedure RollBackTransaction;
      property InTransaction : Boolean read FInTransaction;
   end;
```

Listing 2 – Object transaction manager.

`TSpecialBudget`, that represent some business objects. The `TBudget` class creates `TBudgetMemento` objects to hold its internal state, while `TSpecialBudget` creates `TSpecialBudgetMemento` objects to do the same job. Obviously, `TSpecialBudget` cannot see the definition of `TBudgetMemento`, but it *can* call `TBudget.GetState` and `TBudget.SetState` to retrieve and set its ancestor's `TMemento` object. All we need to do in `TSpecialBudget.GetState` is get and store the ancestor's state by calling `inherited GetState`. In `TSpecialBudget.SetState`, all we need to do is pass this stored state back to the ancestor by calling `inherited SetState`. The third demonstration program shows how this looks in code.

Object transactions

Objects don't exist in isolation. They interact with other objects, often in ways that mirror the transactional approach you see in database applications. Having moved from using database tables as the primary means of storing and representing information, it would be useful to get back the transaction support that databases offer. The main case we need to worry about is when a transaction fails: you have changed the state of a number of objects, then one of the objects raises an error. For example, two bank account objects involved in a funds transfer where the source account has insufficient funds. In a database transaction, you would roll back the transaction and all would be restored to the state before you issued 'begin transaction'.

We can extend our Memento and Caretaker classes to let us do transactions on objects very easily. Listing 2 shows the extended `TTransactionManager` class. We call `BeginTransaction` to start a transaction, and add our business objects by calling `Add`. If the transaction succeeds, we call `CommitTransaction`, which just re-initialises the `TTransactionManager`. If the transaction fails, we call `RollBackTransaction`, which undoes all of the changes to all of the objects taking part in the transaction. You could even do nested transactions by making `TTransactionManager` also support the `IOriginator` interface, and passing the nested transactions to a global transaction object. See the third demonstration program.

Other ways

Another design pattern, Command, suggests encapsulating all application tasks as objects, and storing a list of them. Every task (or Command) knows how to reverse its effect, so undo/redo is achieved by either asking Command objects to either apply or un-apply themselves. Encapsulating every action as a command requires a lot of programming, though this approach may be more appropriate if the cost of getting and setting an object's whole state is very expensive. ■

Mark Smith is a contractor specialising in Delphi. You can contact him at msmitha@cix.co.uk or say hello at a Borland Users Group meeting. Call 01980 630032 for details.

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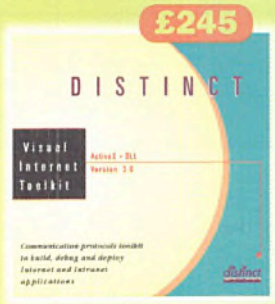

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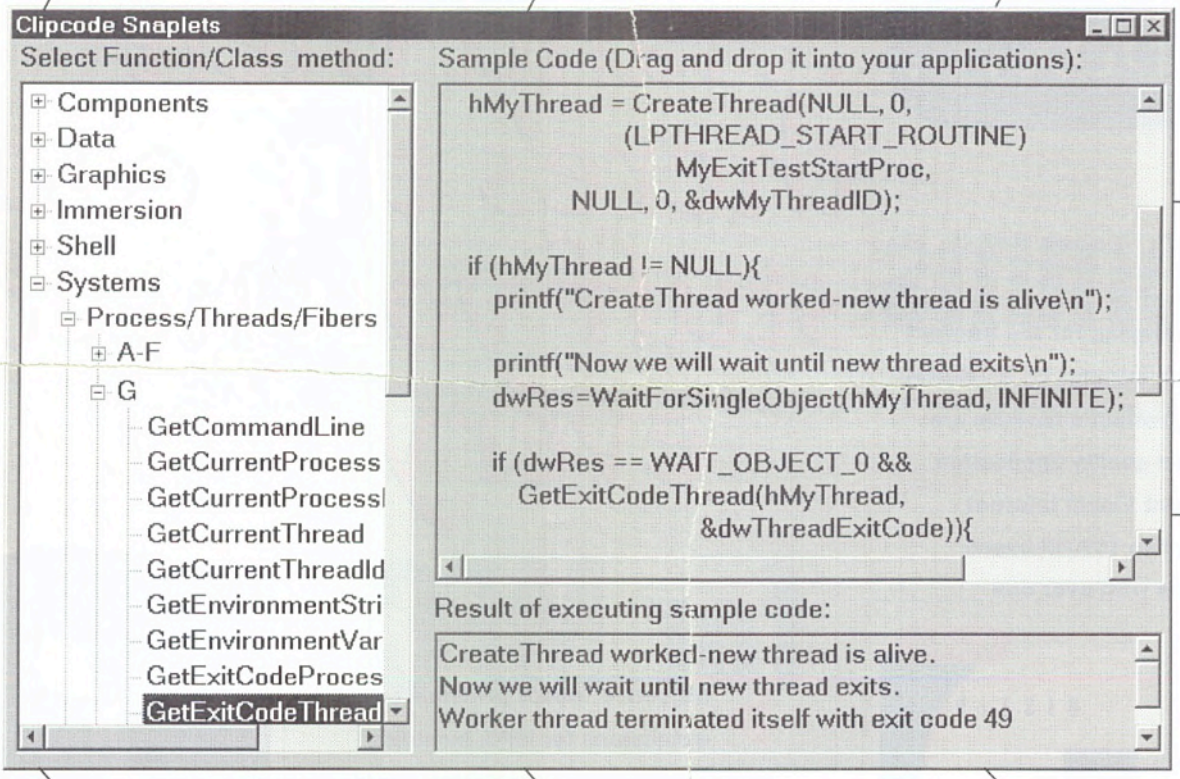

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Cryptomatic

Using the Java I/O package and discussing the basics of the Java I/O model, Tom Guinther presents a cryptic challenge. There's a prize in it, somewhere.

The Java language includes quite a bit of runtime support to make writing Java applications and applets both possible and easier. Without `java.lang`, `java.util`, `java.net`, `java.io`, and `java.awt` we would all have to work a lot harder and the success of Java as a platform would be severely limited. Because I/O is such an important aspect of application development, I want to spend some time discussing the basics of the Java I/O model (embodied in the package `java.io`), and I will provide a sample application that produces Cryptograms via a Filter stream.

Which came first, input or output?

The Java I/O model is based upon streams, a metaphor for a sequence of data that flows from the producer (output) to the consumer (input). Data in a stream flows in one direction (from producer to consumer) although two streams can be combined to create the illusion that one stream carries information back and forth (typically creating a dual producer/consumer relationship).

In more tangible terms, there are two primary classes: `InputStream` and `OutputStream`. These are the root of the `java.io` hierarchy and have design implications for the `java.net` package. The `InputStream` defines methods that deal with reading input:

```
public abstract class InputStream {
   public abstract int read() throws IOException ;
   public int read(byte b[]) throws IOException ;
   public int read(byte b[], int off, int len)
          throws IOException ;
   public long skip(long n) throws IOException ;
   public int available() throws IOException ;
   public void close() throws IOException ;
   public synchronized void mark(int readlimit) ;
   public synchronized void reset() throws IOException ;
   public boolean markSupported() ;
}
```

The `OutputStream` class defines methods that deal with writing output:

```
public abstract class OutputStream {
   public abstract void write(int b) throws IOException;
   public void write(byte b[]) throws IOException ;
   public void write(byte b[], int off, int len)
          throws IOException ;
   public void flush() throws IOException ;
   public void close() throws IOException ;
}
```

Both classes are `abstract` and require one primary method be implemented by a deriving class. For `InputStream`, the primary method `read()` reads a byte from the underlying input stream. For `OutputStream`, the primary method `write()` writes a byte to the underlying output stream. None of the other methods of either class need to be implemented or overridden because they all have reasonable default functionality (or they can be implemented using the primary `read()` or `write()` method).

The other methods are: `skip()`, which reads over a sequence of bytes, `available()`, which is used to determine if data can be read or written without blocking, and `mark()` and `reset()`, which together remember a specific position within the stream and can restore that position. The ability to mark and reset is not supported by all stream types (the keyboard for instance) so use the `markSupported()` method to find out if the capability is provided. The `OuputStream` provides the `flush()` method, which is important since some derived classes may buffer information. Invoking `flush()` forces any data that has not been written to the underlying stream to be written, but does not guarantee that the underlying operating system has written the data (the OS may also perform buffering). The very important final method, `close()`, is used to release any resources the stream is using. This includes large buffers and operating system resources. Although these resources will be released once the object is finalised by the garbage collector, explicitly calling `close()` is recommended and is a good way to avoid subtle problems that might be caused by retaining an open handle to a file.

Before I give you a brief rundown of the other classes in `java.io`, I want to explicitly suggest that when you write code that processes I/O you use the `InputStream` and `OutputStream` classes directly. This allows your I/O processing code to be completely independent of the underlying stream, allowing your code to work without changes on any of the existing stream types, or any future stream types that are derived from `InputStream` or `OutputStream`.

Streaming and filtering

When it comes to streaming there are two general types of classes. The first type of class represents a 'physical' input or output stream. This includes `FileInputStream`, `StringBufferInputStream`, `ByteArrayInputStream`, and `PipedInputStream`. Note that, with the exception of `StringBufferInputStream`, each class has a corresponding output stream.

The `FileInputStream` reads input from a file and `ByteArrayInputStream` makes an array of bytes appear as an input stream. A `StringBufferInputStream` makes a Java `String` object appear as an input stream, and because it's easy to create a `String` from an array of characters it also serves as a way to make an array of characters streamable. The `PipedInputStream` and `PipedOutputStream` facilitate inter-thread communications via a stream.

The second type of class is referred to as Filter streams, and they perform 'logical' operations on information that is read from a 'physical' stream (or another Filter stream). They are derived from the base class `FilterInputStream` or `FilterOutputStream`. The number and types of Filter streams are limited only by your creativity, but a few useful ones are already included in the `java.io` package. The `BufferedInputStream` and `BufferedOutputStream` exist to make I/O operations more efficient by reading larger amounts of data from a potentially slow physical device (such as a file). A `PrintStream` provides formatted output of data, and is the class type for `System.out` and `System.err`. The `PushBackInputStream` is a filter that allows data to be put back into the input stream so that a subsequent read will reread the data. This is useful for code that needs some look-ahead functionality (such as a parser).

Any number of Filter streams can be chained together to create a more complex filtering of input and output.

Byte versus character streams

All the classes I have talked about are based on byte streams, and the underlying information in the physical stream is byte sized. This can cause problems with efforts to internationalise your application. The primary reason is that a byte is just not enough information to express more complex character sets (such as Kanji). In an effort to address this issue, JDK 1.1 introduced character streams that operate on 16-bit Unicode characters. This required a whole new set of classes, which are based on the two `Reader` and `Writer` classes. The functionality between the `Reader` and `InputStream` class and the `Writer` and `OutputStream` class is almost identical. As you might expect, instead of having a `FileInputStream` you have a `FileReader`, and instead of a `BufferedOutputStream` you have a `BufferedWriter`. For more information see the JDK 1.1 documentation.

The Cryptomatic sample program

In order to illustrate one possible use of a `FilterReader` or `FilterInputStream` I wrote the Cryptomatic Java application. It is a simple encryption scheme that, given a series of alphabetic characters, substitutes different characters based upon a random shuffling (and reshuffling) of the normal alphabet. The overall effect is to create a garbled but decodable translation. For humans, this simple encryption presents just enough of a challenge to be called a puzzle, and they are popularly referred to as *Cryptograms*.

The implementation is broken into three separate classes. The primary encryption engine, class `Cryptogram`, is responsible for translating individual characters, strings, and arrays of characters from their normal representation into their encrypted representation. The implementation is relatively straightforward and primarily consists of a routine to randomly redistribute the letters of the alphabet (creating a lookup table) and an `Encrypt()` method that is overloaded in six or seven different forms (for flexibility).

The second class, `CryptogramReader`, is a Filter stream derived from the character-based I/O class `BufferedReader`, which is an extension of `FilterReader`. I chose the character I/O classes simply as an exercise, although you could argue that the program stands a better chance of being internationalised because it uses the Unicode character set. Still, the program is designed around the Latin-1 character set, and any attempt to port it would probably involve other non-trivial code changes. Originally, I began with an implementation that used the more common byte I/O classes and once everything was working I performed a quick conversion (it took about three minutes). The conversion involved a few type changes (from `byte` to `char`) and miscellaneous typecasts.

The `CryptogramReader` class creates an instance of class `Cryptogram` to perform the encryption as characters are read from the stream. This involves overriding the primary `read()` method of the underlying filter, `BufferedReader`. The implementation is almost trivial, as my primary goal was to stay out of the way of the logic in class `BufferedReader`. Class `CyrptogramReader` allows `BufferedReader` to perform the actual I/O operation and, once it is complete, class `Cryptogram` is used to encrypt the result. The only complication comes from my addition of the `readParagraph()` method. This is designed to read a paragraph of text, apply encryption to that paragraph, and then reset the Cryptogram encryption scheme so that the next paragraph is encrypted using a new character mapping. This allows a text file that contains multiple unique phrases to be encrypted as a collection of puzzles. The final class, `Cryptomatic`, is the application that ties it all together. When you run Cryptomatic and specify the name of a text file, each paragraph within the file is encrypted using a distinct encryption scheme.

This sample application includes a small file, `phrases.txt`, which contains a few quotes that make interesting Cryptograms. The file is listed below:

```
The rhetorician would deceive his neighbours, the
sentimentalist himself; while art is but a vision of reality -
Yeats

A man may fish with the worm that hath eat of a king, and eat of
the fish that hath fed of that worm - Shakespeare

New opinions are always suspected, and usually opposed, without
any other reason but because they are not already common -
Locke

I have called this principle, by which each slight variation,
if useful, is preserved, by the term of Natural Selection -
Darwin
```

Running the Cryptomatic program on this results in the following:

```
Alm vlmanvyxyjf qnhrs smxmycm lyt fmyblonvt, alm tmfaydmfajryta
lydtmri; qlyrm jva yt oha j cytynf ni vmjryaw - Wmjat

S usj usm obak lbgk gkh lfzu gksg ksgk hsg fo s ybji, sjd hsg fo
gkh obak gksg ksgk ohd fo gksg lfzu - Aksyhawhszh

Yzv nmtytnyd fsz fkvfwd djdmzxczr, fyr jdjfkkw nmmndzr, vtcpnjc
fyw ncpzs szfdny ljc lzxfjdz cpzw fsz ync fkszfrw xnaany -
Knxbz

T pfoz xfkkzr cptd mstyxtmkz, lw vptxp zfxp dktqpc ofstfctny,
tu jdzujk, td mszdzsozr, lw cpz czsa nu Yfcjsfk Dzkzxctny -
Rfsvty
```

The binary and source for the Cryptomatic application can be found at the usual place on EXE OnLine in `Cryptomatic.zip`.

Cryptogram challenge

I present Cryptograms to my kids all the time and, just to keep them on their toes, I sometimes throw in one or two phrases originally encoded in French or Spanish. I don't want to do anything so devilish to you, but I am going to leave the following Cryptogram for your edification and enjoyment. It is a semi-obscure quote by a rather famous gentleman. For those brave souls who successfully endeavour to unravel the phrase in the shortest possible time, your kind editor will furnish you with a worthy prize. (A signed copy of *The Java Programming Language* by James Gosling – Ed.) As a possible tiebreaker, provide the name of the person being quoted. The Cryptogram Challenge is:

```
Zmr ohrwzktb, "Pmgz kw zmr qhdqtwr te mhlgb jker?" mgw vrrb
gwars zklrw
pkzmthz bhlvrd; kz mgw brfrd drxrkfrs g wgzkwegxztdc gbwprd;
qrdmgqw kz
strw btz gslkz te whxm gb gbwprd.
```

Good Luck!

Tom Guinther is a freelance software developer specialising in systems software and internals. He can be reached at tomg@nh.ultranet.com.

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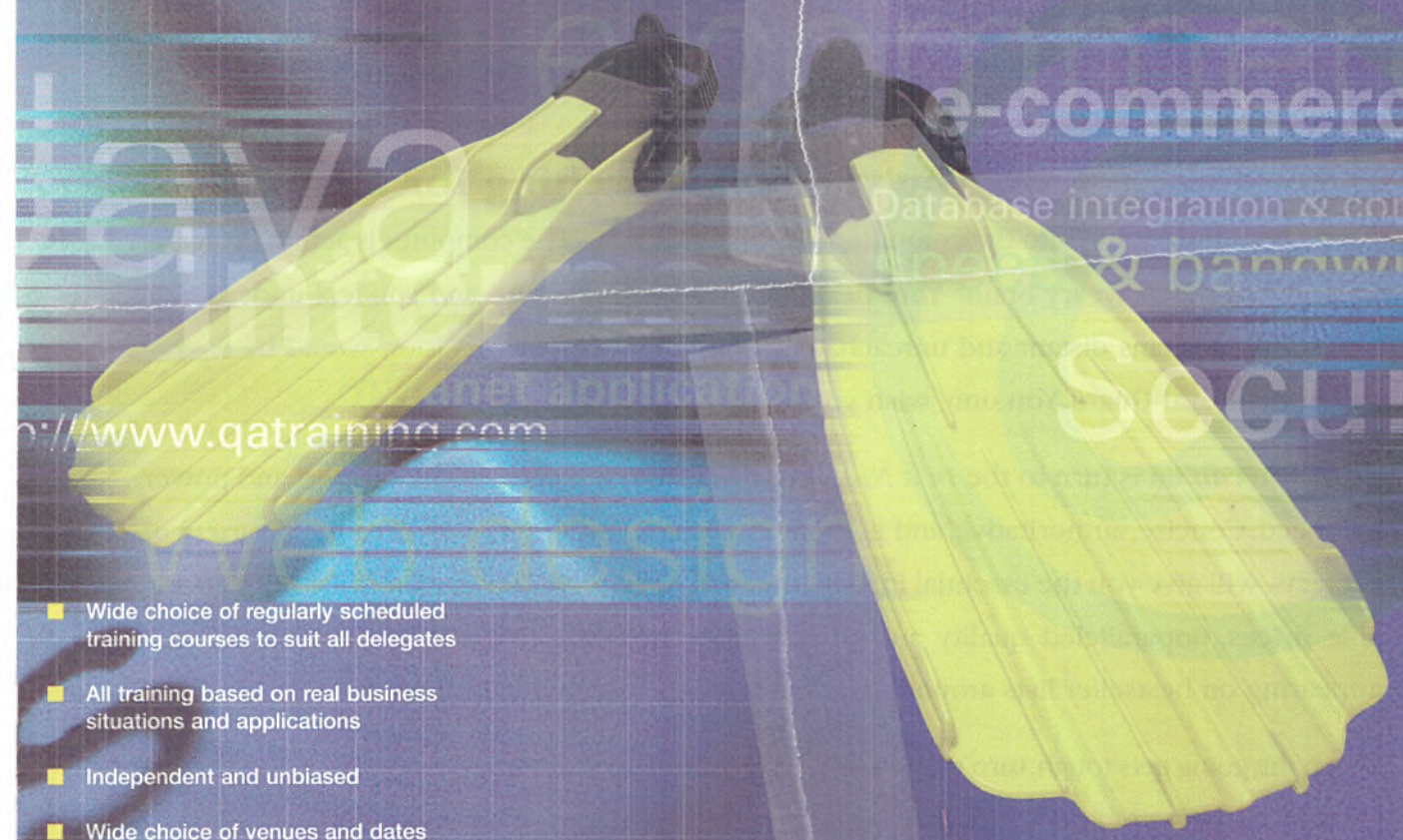

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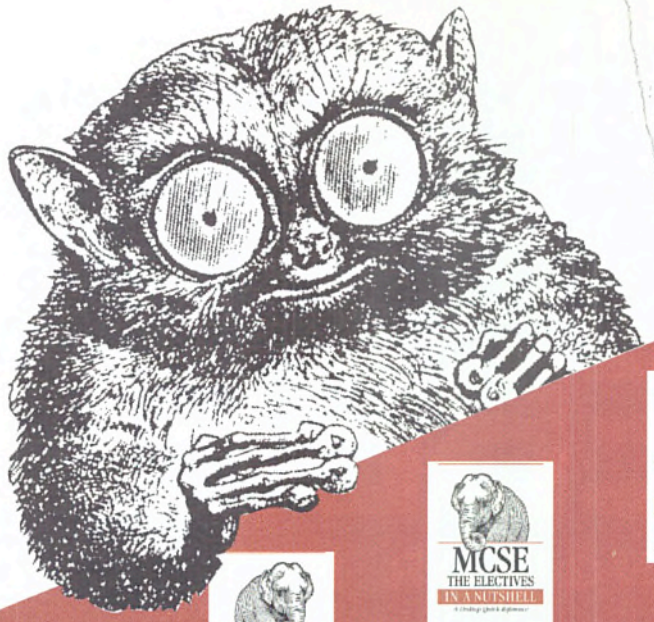

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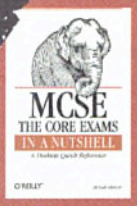

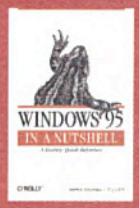

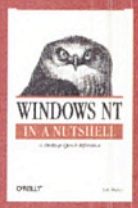

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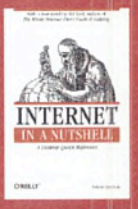

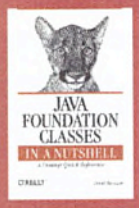

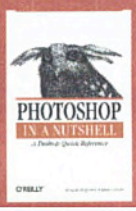

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Defining access to data

Jon Perkins explains the use of the Data Environment Designer – a graphical tool to create data access definitions – in the construction of Visual Basic 6 applications.

In November I outlined the basics of OLE DB, the ADO layer, and its use in Visual Basic 6. In addition to this new data access model, Microsoft has provided new or updated tools that are intended to give the developer a more sophisticated means of defining access to data sources. In this month's column I'm introducing the Data Environment Designer (DED), a useful tool that provides the facility to create data access definitions at design-time.

For any Visual Basic 5 users that discovered the RDO-based User Connection Designer (UCD) the DED is intended to be a more sophisticated ADO-based successor. If you weren't even aware of the User Connection Designer, then don't worry, you weren't alone. In fact most developers seem to have missed it. Not surprising really, because Microsoft never seemed to do much to bring it to the attention of the development community. This time around, however, the software giant has made a greater effort in publicising its data tools. Because of the general lack of knowledge that exists concerning the User Connection Designer I will not attempt to provide a comparison with its successor, but will instead start from basic principles. Anybody who did get to master the UCD will be pleased to know that it is still provided for backward compatibility.

The DED is a graphical tool that helps you to define Connection and Command objects based on underlying databases. Once such a definition has been created then the DED object is recognised as a valid data source for data-bound controls. Such a definition can include multiple Connection objects to provide access to numerous databases at different locations. Although the technology is built upon ADO, which is itself built upon the highly flexible OLE DB, the ability to connect to sources of data is limited to relational databases rather than the more diverse forms of data that OLE DB can provide access to. In the examples that I provide here I have chosen SQL Server as the source of data although it could just as easily have been an Access database. I chose to stick with SQL Server in order to make the point that the Command objects can be based around stored procedures as well as straightforward SQL statements.

Defining a DED

As with all projects it is necessary to plan beforehand what data you are going to need, how best to structure it, and how you are going to both store and retrieve it. In this case we can fortunately make use of the ever-useful *pubs* database that is installed along with SQL Server. If you are more familiar with Access, or Oracle, or whatever, then you still should be able to follow the discussion. Having said that, you should be prepared for minor differences resulting from the use of different data sources.

To make a start with the DED you can either create a new Standard EXE Project or you can create a Data Project. If this is your first time, I suggest that you create a Standard EXE Project so that you can see for yourself how to add a DED into a project. To set up the project definition select `Add Data Environment` from the Project menu. This action automatically creates a reference to both the Microsoft Data Environment and to ADO itself, and consequently you should have a Data Environment window pop into existence. Notice, too, that a new category folder – Designers – will have appeared in the Project window.

Within this initial `DataEnvironment1` instance there also exists a default Connection object, as yet undefined. To set appropriate values either right-click the `Connection1` object and select Properties, or just select it and press the Properties button on the toolbar. This action presents a dialog that allows you to choose which of the installed OLE DB drivers you want to use. In this case select the Microsoft OLE DB Provider for SQL Server. The Next button takes you on to the next tab page, which is concerned with establishing the actual server-connection details. This part of the process is self-explanatory: select a server from the drop-down list, enter login information, and provide the database name. The useful Test Connection button allows you to establish immediately whether the information that you have provided is correct. The Advanced and All tabs allow for more specific performance tweaks to be made to the connection profile such as timeouts and packet sizes. Some of this information is available in the Properties window, as are the settings for design-time and runtime connection username/password pairs, should you have a need to differentiate them in this way. You can also rename your Connection object to something more meaningful, perhaps to include the name of your server (in my case, `conGalileo`).

Adding Command objects

Having defined the Connection object you can start adding associated Command objects – while ADO itself does not enforce a strict hierarchy as RDO did, the DED does impose this kind of structure among its object types. To create a Command object right-click the Connection object and select Add Command, or choose the Add Command button from the toolbar. As before, you then need to edit the properties for this object. Within

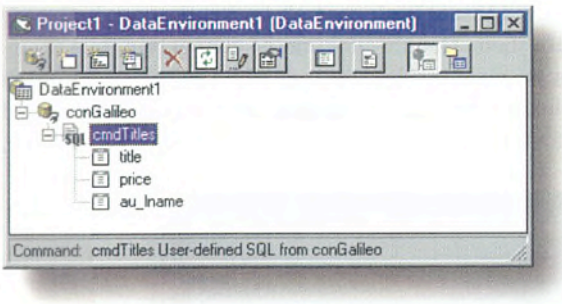

Figure 1 – Data Environment window.

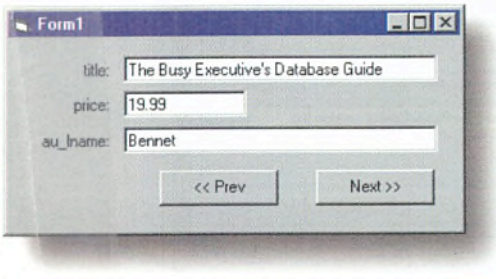

Figure 2 – The resulting Form1, with data!

the General tab of this dialog you can choose to use a table as a source of data, or you can use a predefined view, a stored procedure, or you can define your own SQL statement. As would be hoped, this dialog comes with a SQL query builder that allows you to drag and drop tables onto a query definition. Existing foreign-key relationships are identified and automatically associated, where appropriate. SQL statements are automatically created as the graphical definition proceeds.

We can close the query builder window when we are done. The remaining tabs on the properties dialog allow for a more complex definition of the Command object. The Advanced tab allows the lock type on the data to be specified (the default is for read-only) and it allows you to specify whether the cursor should exist on the client-side or the server-side. After the OK button has been pressed the resulting DED window is shown in Figure 1, within which you can see that I have also renamed the command query to the more appropriate `cmdTitles`.

Drag and drop design

Once the DED definition has been completed the Command object can be dragged over to a form and dropped, at which time the real power of this technology can be seen. The form now contains three bound text box fields and three labels, the latter of which can be freely altered without messing things up. I've also added two navigation buttons. On the assumption that `Form1` is still your startup form, invoking a run of the project should cause the text fields to be instantly populated. The results can be seen in Figure 2. The lengths of the three text fields are exactly as the DED originally decided, as are the types of controls chosen for each underlying data type. These default control types can be altered for each data type by clicking the Options button within the DataEnvironment window. Figure 3 shows the ADO data type `adDBTimeStamp` being changed from the default TextBox control to the Date Picker control. (Investigations by my colleagues at The Mandelbrot Set have revealed that the DTPicker control supplied with Visual Studio 6 is not entirely millennium compliant, so beware!) Alternatively, performing a drag and drop of a Command object with the right-hand mouse button provides a popup menu at the drop point, allowing you to choose between a data grid, a hierarchical flex grid, or the bound controls.

The various components within the Data Environment window are similar to standard Visual Basic controls in that they can have code associated with them. Double clicking the connection item (`conGalileo` in my example) displays the code edit window for this object showing that, in this case, it exposes the full set of events that you would normally get for a Connection object, namely `BeginTransComplete`, `CommitTransComplete`, `ConnectComplete`, `Disconnect`, `ExecuteComplete`, `InfoMessage`, `RollbackTransComplete`, `WillConnect`, and `WillExecute`. The `cmdTitles` object displays a similar collection of events, but interestingly the code object is now called `rscmdTitles` to highlight the fact that we are dealing with a `Recordset` object that has been spawned from the Command object.

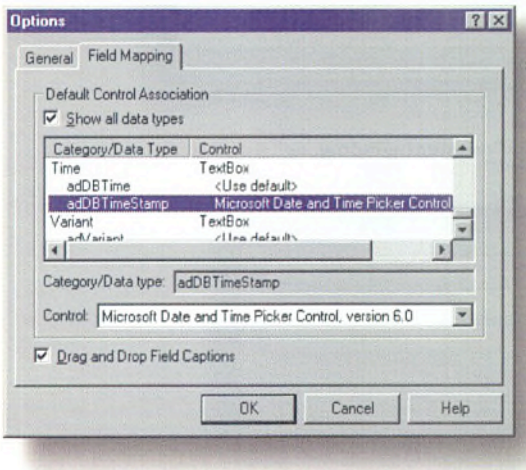

Figure 3 – Changing the default VB control for a specific ADO data type.

```
Private Sub cmdNext_Click()
   If Not DataEnvironment1.rscmdTitles.EOF Then
      DataEnvironment1.rscmdTitles.MoveNext
   End If
End Sub
Private Sub cmdPrev_Click()
   If Not DataEnvironment1.rscmdTitles.BOF Then
      DataEnvironment1.rscmdTitles.MovePrevious
   End If
End Sub
```

Listing 1 – Prev and Next button implementations.

```
Dim env As New DataEnvironment1
Dim rs As New Recordset

' Run the query first
env.cmdTitles

' Get a handle on the results
Set rs = env.rscmdTitles

' Do something with the data
Do While Not rs.EOF
   Debug.Print rs(0)
   rs.MoveNext
Loop

' Free up resources
Set rs = Nothing
Set env = Nothing
```

Listing 2 – Controlling when the Command will be fired.

The form in Figure 2 includes the two command buttons that I've added to navigate through data. Listing 1 shows a minimalist set of code (ie no error handling, as usual) that illustrates this code-based manipulation. I've included the check for the `BOF` and `EOF` conditions to prevent errors being raised from any attempts to navigate off the end of the set.

Now add a little code

A downside to this drag and drop design is that you don't have any control over when the Command object will actually fire. If it is bound to a set of controls on a form, then the Command object will fire when the form is loaded. This won't always be a problem, but it could be if, for example, connection resources are tight. Remember that the version of SQL Server that is supplied with Visual Studio Enterprise Edition can only have a maximum of five connections open at any one time.

The Data Environment object that you define can be used entirely programmatically without the need to drag and drop, and then you *can* control when the Command will be fired. Listing 2 shows a simple example of this programmatic access. Note that the default behaviour of this model requires you to make a call to the actual Command object before you can connect to the returned record set instance.

The ability to drag fields onto a form in order to create bound controls is perhaps the most memorable part of the DED technology. The fact that they can be programmatically manipulated means that they can also be used in middle-tier non-UI components just as effectively. ■

Jon Perkins is a freelance Visual Basic developer and a Microsoft Certified Solution Developer. He is a contributing author of Advanced Microsoft Visual Basic 6 by The Mandelbrot Set, published by Microsoft Press. Contact him at www.jonperkins.com.

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Airedale Recruitment

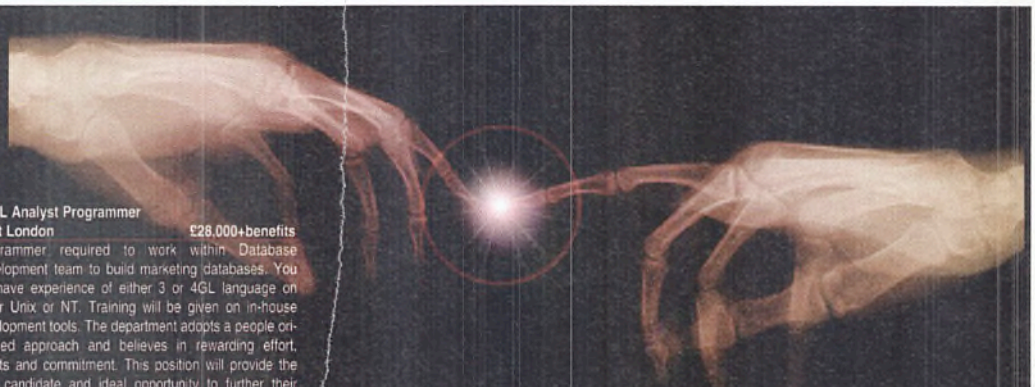
Software Design Programmer
Reading **£30,000 + benefits**
Our client requires a Software Design Programmer to work within a small design group. This person should have design skills within Windows environment encompassing Visual C++, MFC, and preferably have skills in OO, SDK, OLE and SQL.
Ref: 95275/1
Email: simon.vickers@haymarket.com

Analyst Programmer
London **£45,000**
The successful applicant will take a leading role in the design, development and support of key infrastructure systems within this leading financial organisation. You will need to have an in-depth knowledge of software development using C/C++, Unix and one modern RDBMS. Team leadership and management experience advantageous. This is an exceptional opportunity to enhance your technical skills further in a client-facing role.
Ref: 732/4
Email: ian.dykes@haymarket.com

Senior Software Engineer
Herts **£20,000 - £35,000**
My client is looking for senior and junior software engineers working with C++. For the junior positions, a minimum of 1 years experience is required and for the senior positions a minimum of 2 years. These roles can be either contract or permanent depending on your preference and will be based at the client site. The company has an excellent reputation within its field and provides an excellent benefits package for successful candidates.
Ref: 38268/1
Email: polly.brittain@haymarket.com

3/4GL Analyst Programmer
West London **£28,000+benefits**
Programmer required to work within Database Development team to build marketing databases. You will have experience of either 3 or 4GL language on either Unix or NT. Training will be given on in-house development tools. The department adopts a people orientated approach and believes in rewarding effort, results and commitment. This position will provide the right candidate and ideal opportunity to further their career.
Ref: 45665/3
Email: leigh.carrick.moore@haymarket.com

Snr Project Programmer/Developer
London **£30,000+benefits**
This young & innovative company of software & communications professionals are seeking a programmer who can fulfil the role of Senior Programmer on their web based team. You should have at least 12 months experience in building commercial Web sites also an expert in developing solutions using some or all of the following: ASP, HTML, MS Access, SSL, PGP, Java, VBScript, JavaScript, Perl, PerlScript.
Ref: 91274/2
Email: tony.georgiou@haymarket.com



Senior C++ Developer
City **£25-40,000**
This London based trading company and options specialist has an urgent vacancy for a senior C++ developer with experience in a Unix environment. The duties associated with this position consist of the development and support of the risk, pricing, order routing and automated trading applications. Although a successful candidate need not come from the financial industry, they will almost certainly come from a high performance real time Unix programming background.
Ref: 93053/7
Email: leigh.carrick.moore@haymarket.com

C++ Analyst Programmer
Central London **£30,000 + benefits**
Working for a small but very successful company supplying bespoke financial software solutions. Dealing with clients such as Lloyds, Reuters and other corporate names, you will be given the opportunity to deal with the whole project lifecycle, providing bespoke solutions and expertise to client problems. You will be using the latest technology in this very friendly, relaxed environment. Candidates should have 3 years experience of C++ on NT with a willingness to be cross trained into other areas. The package includes bonuses and performance related targets.
Ref: 90434/1
Email: katherine.smith@haymarket.com

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Our client is a software house focused on developing innovative messaging & business intelligence software for the worldwide corporate market. The company was established in May 1996, born out of its sister company, a market leader in IT solutions for the global shipping and logistics industries.

Their core product is a packaged tool that sits alongside any OLTP system looking for business exceptions, like debtors due over a certain period of time. If any are found, the product sends an electronic mail out to the relevant users alerting them of the event that has just occurred, enabling business events to be monitored by easily set 'Alarm Bells'. It is pioneering the concept of automated messaging.

Our client has a high quality product, supported by a young, dynamic, creative and experienced team - both technically and commercially. With offices in both California and Southern England the future is set for tremendous growth.

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All positions will offer the opportunities, challenges and the rewards commensurate with a company planning to double in size over the coming months. You will be committed to total quality, excellence and success at both an individual and company level. You will be self sufficient and enjoy being a pro-active team member. You excel in a fast moving, dynamic environment.

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Background in Object Oriented development using **Visual Basic** plus experience of some of the following:
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- **Test Manager / QA**

Initially a hands on role but you have the desire to grow the role and the team to keep pace with this demanding function. You will be tasked with responsibility for internal quality and test issues.

- **Technical Author**

Ideally proficient using **Robohelp** otherwise a good knowledge of another help authoring tool. Experience in producing **.hlp, .html** and **.pdf** files is essential. You will have responsibility for document management within the company.

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Or drop me a line at dsofer@centaur.co.uk

Vision iT Recruitment, Bessemer House
3 Canon Harnett Court, Wolverton Mill
Milton Keynes MK12 5NF

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Visual C++ -Telecomms

London **Up to £30,000**

A small but well-established and successful software consultancy to the mobile Telecomms sector require developers with at least two years of commercial experience in Visual C++ MFC. You will be developing tools for mobile network optimisation and enhancement.

Ref:JA-101/E

C++ – JAVA – NT – UNIX

London **£30,000 + Bens**

This is a wide ranging role from designing solutions, and creating specifications to writing code. You must possess skills in C++, C, Java, HTML, NT or UNIX, and Coldfusion and be familiar with Internet and Web technologies. Working on projects at the forefront of the Web.

Ref:LP-102/E

Delphi Developers

London **Up to £35,000**

My client, a major insurance underwriter has an ongoing requirement for GOOD Delphi Developers. You must be an experienced client server developer with a minimum of 2 years of Delphi. Ideally as much version 3 as possible, plus exposure to Sybase or SQL server.

Ref:AR-103/E

MAD FOR IT – Visual Basic

Manchester **Up to £32,000**

Have you got at least 1 years Visual Basic programming experience in addition to Windows NT exposure. Do you fancy developing & designing GUI customer support interfaces, for international client base? Then this is the opportunity for you!!!!!

Ref:CH-104/E

Visual C++ MFC

Cambridge **Salary to £36,000**

Experienced Visual C++ MFC developer with at least 3 years commercial experience in a development environment is required. Ideally you will have skills in graphical application and device driver development as well as knowledge of DirectX, ActiveX, COM and OpenGL.

Ref: PG-105/E

3DFX, VOODOO & Glide

Watford **£28,000 + Bens**

Well known in the fast growing graphics market, this company produce the latest graphics systems including Voodoo II cards. We are looking for a software engineer with experience of graphics technology and device drivers. Good C++ or Visual C++ programming skills for 95/98/NT are essential.

Ref:MD-115/E

Oracle Development

Middlesex £30-50,000 + Ex Bens

One of the 12 most influential companies in IT. Cutting edge US software house now require Oracle developers with a minimum 2 years gained in commercial development of Oracle applications and similar RDBMS. Degree educated and Major Vendor experience preferred

Ref:MB-106/E

DIGITAL &/OR DSP

Hayes, Middx **£40,000 p.a.**

This multimedia company require a person with a very high technical aptitude. You will have at least 2 years Digital knowledge and DSP, including DSP boards (SHARC, MSDN). Other useful skills include CAD, Cadstar, Analogue,'C' and the competence to be a senior engineer.

Ref:NB-107/E

JAVA – Expert

London (City) **£40,000 upwards**

JAVA developer required by this high level consultancy. You need to be degree educated and possess excellent JAVA experience (at least 3 years) along with JDK and J-Builder. With development projects on NT & UNIX, experience of both is required.

Ref: DL-108/E

C, C++, J++, Delphi, SQL (Software Engineers)

Fleet,Hants **to £35,000**

Experienced Software Engineers for a software house required with a broad mix of skills to include C/C++, J++, Delphi, SQL on Windows NT, Unix (SCO, Solaris, AIX or Linux preferred). Any Oracle or SQL Server would be advantageous. If you have all or some of the above and want experience on all!!!

Ref:JS-109/E

Visual C++ Prototyping

Cambridge **to £30,000 + Bens**

A unique opportunity has arisen with a Scientific Software House to work on a brand new development, producing Prototype Visual C++ applications for an Oracle v8 Database. You need to be a flexible Team Player with an interest in working in the very latest technologies.

Ref:ID-110/E

Visual C++/Visual Basic

Nr Tonbridge, Kent **to £28,000**

Visual C++/Visual Basic, OOD Software Engineers are required to develop diagnostic medical products based on DNA imaging. Good academic background required with a strong knowledge of either Visual Basic or Visual C++ with a strong orientation towards O/O Design.

Ref:RR-111/E

Delphi Team Leader

Weybridge, Surrey
to £37,000 + Benefits

Delphi team leader required to work for a leading information company. You will lead a team of developers through the entire product lifecycle, as well as upgrading existing systems. You will have at least 2 years Delphi experience with 6 months held in a Senior Hands on Position.

Ref:NN-112/E

Visual Basic

Epsom, Surrey to £25,000 + Bens

Visual Basic developer required to work for a leading Software Development house. You will be working with some of the best Visual Basic developers in the country and you will be working on market leading software packages. You will have at least 6 months VB development experience.

Ref:GR-113/E

Visual C++/JAVA

Watford, Herts **to £22,000**

Visual C++/Java Developers required by UK's leading centre of expertise on building and construction. You will be a recent graduate with a degree in an IT related subject and have either academic or commercial experience of Visual C++ and Java.

Ref:JC-114/E

Tel: 01908 319600
e-mail: mail@visionit.co.uk
Fax: 01908 319638
web: www.visionit.co.uk

Freebie of the month

'Say it with flowers', the old adage says. Nonsense! 'Say it with booze' wins every time, as Unify is only too well aware. Not content with sending us a rather impressive bottle of distinctly non-shabby champagne of reasonable (1995) vintage to celebrate a profitable quarter earlier this year, the bods from Egham have done it again with a bottle of frankly damn good bubbly of an even more impressive vintage – this time all the way back to 1992. As you can see from the picture, it even comes with its own copper-coloured container, not to be confused with a certain battery with the copper-coloured top – this doesn't last anywhere near as long, but then you can't get blotto on electricity unless you're Marvin the Paranoid Android or Kryten from Red Dwarf. Or R2D2. Or C3PO. Well, you get the idea. Suffice it to say that we enjoyed this particular freebie. It may not get to sit in our trophy cabinet (or wine cellar) like most of its fellows, but nonetheless it beats the pants off Eau de Windows.

Far be it from us to solicit bribes, but if you're looking for freebie ideas that will be genuinely popular with journalists, if not our doctors, then SEND US MORE BOOZE!

Hic. I think I need to go and lie down now.

Contract programming 101 – a glossary

Contractor	A gambler who never gets to shuffle, cut, or deal.
Bid opening	A poker game in which the losing hand wins.
Bid	A wild guess carried out to two decimal places.
Low bidder	A contractor who is wondering what he left out.
Engineer's estimate	The cost of construction in heaven.
Project manager	The conductor of an orchestra in which every musician is in a different union.
Critical path method	A management technique for losing your shirt under perfect control.
OSHA	A protective coating made by half-baking a mixture of fine print, red tape, split hairs, and baloney usually applied at random with a shotgun.
Strike	An effort to increase egg production by strangling the chicken.
Delayed payment	A tourniquet applied at the pockets.
Completion date	The point at which liquidated damages begin.
Liquidated damages	A penalty for failing to achieve the impossible.
Auditors	People who go in after the war is lost and bayonet the wounded.
Lawyers	They go in after the auditors and strip the bodies.

Thanks (inevitably) to Dave Dorrell for this one.

Blast from the past

Continuing our series, 'The Things They Say', we dug deep into the archives to bring you further choice nuggets of foot-in-mouth gags, this time from Cliff Saran – who still holds the title 'EXE's shortest Editor' despite stiff competition from the present incumbent (*watch it! – Ed*). That's height, by the way.

'Arguably, the best thing that could happen to Borland would be to become acquired by Novell.' – Cliff dabbles in insider dealing, May 1994

'It all pivots on that sin-bin of programming, the black box... Keeping programmers in the dark is a recipe for delivering inefficient applications that don't make the best use of available resources.' – delivering a sharp rebuke to all those silly people who like OOP, July 1994

'So the computer industry has its share of eccentrics but so has every other. That doesn't mean we are all like that though. If we were we'd all be billionaires.' – Cliff reveals the big secret all those 'I made £300,000 in six weeks!' adverts have been hiding, Sep 1994

'A well-written program does not need any comments.' – Jan 1995

'OOP could well be the right way to proceed. But one thing is certain. C++ is not.' – I'm sorry, what was that he said about comments? Feb 1995

'Ignoring warnings is rather like driving blindfold. We can go only so far before we crash.' – poignant (and somewhat prophetic) words from Cliff's last editorial column in April 1995.

Next month – something different. And, hopefully, funnier.

And finally

The head of the government's Y2K bug-solving council, Action 2000, must be kicking herself gently in the backside right now after apparently admitting to *The Observer* that she thinks people should stock up on food and other supplies before the nation's services grind to a halt on January 1, 2000. Gwyneth Flower allegedly said: 'Anyone sensible would plan for this. Because we don't want to see panic buying in the weeks leading up to next Christmas, consumers should think about this in advance.' We wondered just what the well-prepared software developer might want in his Year 2000 survival kit.

50 cans of Jolt would be a good start, we thought. Plus fifty frozen pizzas – not to mention an antique freezer chest (without a controller chip – smart, huh?) to put them in. Circuit diagrams for the microwave so you can bypass the logic and activate the magnetron yourself. A big blanket – with the phones, email and postal service gone, smoke signals will be the obvious choice for long-distance communication. Then you need an antique *Space Invaders* or *Defender* arcade machine (which is so old it's doubtful real time clocks were even invented when it was designed). This will be a handy sideline because you can charge the neighbourhood kids £5 a time to come over and play when all their fancy PlayStations have bombed out. Not to mention a generator to power all this kit (if you're short of cash by this point you can always rig one up out of a bicycle and *lots* of those little bike-light dynamos, then pay the neighbourhood kids £4 a time to come over and pedal for an hour, thus still making a profit). Then, the ultimate survival tool: a copy of all three volumes of Knuth's epic *Art of Computer Programming*. Without a computer, you won't need them for coding, but they sure as hell will burn well... ■

One nostril hair, 17mm, gray

'[Microsoft] employees aren't quite the workaholics they once were... Why? Employees are no longer single. They are getting older (average age now 33) and more than half are now married.' – *The Guardian*

Minutes of the New Products Forward Planning Meeting held 01/04/99 in Conference Room D, Excel Block.

Participants: AndyV (VP New Media Products, Chair), BradyL (OS Development, Minute taker), RandyZ (Chief Programmer NepTune Project), MickyT (Marketing Division Spokesperson), HelenB (Senior Strategy Rep)

AndyV raised the implications of the take-over of Netscape by AOL. With full financial backing, an Open Source scheme improving its core browser technology by leaps and bounds, and a version 5 roll-out imminent, it was surely once more time to take the Netscape threat seriously.

BradyL concurred with most of what Andy said, and consequently would like to push for the improved concurrency programming model in the next beta of Windows 2000. The idea would be to offer much better multi-threaded JVM performance, while still retaining the option to offer API enhancements that would be Microsoft proprietary.

It might seem a bit late in the day to be addressing architectural questions, but flexibility was the name of the game. It was up to Microsoft to prove that it still held its market leadership position.

AndyV was not sure where BradyL was going with this. An architectural change at this stage would surely impact the shipping date, and it went without saying that this was one shipping date that they were not going to be able to miss without losing consumer credibility. AndyV said he thought that this point was so important that he had prepared a dramatic, six-feet tall 3D model to illustrate the development of the market up to the anticipated launch date, which he would like to show the meeting. AndyV brought in his model from outside the room.

MickyT said Not on the floor.

AndyV said What?

MickyT said Don't put that thing on the floor. Not unless you are sure that the Surgeon General has determined that the gold glitter paint you have sprayed on it is 100% safe and non-toxic when ingested by infants who may be crawling around.

AndyV enquired where in the room exactly were these infants that required the protection of the Surgeon General.

MickyT explained that, although there were no infants in the room at that moment, he was expecting MickyT Junior to be joining them in the next few minutes. It was the day of the month that the babysitter always had off to travel to town to get her facial done, and it was his, MickyT's, turn to look after Junior. He appreciated that this arrangement was not ideal, but that was the way the cookie had crumbled.

AndyV thought that 'not ideal' was darn right. He reminded MickyT that this was a serious meeting we are trying to have here. In the absence of MickyT Junior, he would now like to show his carefully constructed 3D sales model.

RandyZ opined that MickyT had a point, and that one could not be too careful in these matters. It had only been a few weeks since JenniferKatharineG had got the plastic cap of a whiteboard-friendly Wipeklean marker pen stuck in her left ear, and it had taken the whole of the Java development team making funny faces and goo-goo-goo noises to comfort her.

BradyL wondered perhaps if there was not room for the model on the table, although it was rather tall.

HelenB expressed surprise that MickyT Junior was not already walking. Her youngest, WayneB, who was born she remembered at the same time as MickyT Junior, had been walking for some time. In fact, next weekend she had thought to remove the training wheels from WayneB's bicycle.

MickyT enquired how HelenB had got the impression that MickyT Junior was not yet walking. Although it was true that MickyT was fond of the lateral transitioning mode, he had in fact been walking for some months, as was proved by this Polaroid.

RandyZ said Aaaaaaaah!

AndyV asked if he was going to be allowed to present his freaking sales forecast to the freaking meeting that he was freaking chairing, or was everyone going to sit around all day staring at freaking photographs of freaking kids.

BradyL observed that, since some of us appeared to be getting a little heated, perhaps now would be a good time to have a little comfort break. He said he'd get in a batch of sodas from the nearby kitchen.

MickyT said Oh God not more Cola. He emphasised that these days he found it excessively sweet and sticky, and that its fizzyness was bad for his digestion.

HelenB agreed with MickyT, and said she would not care if she never ever drank another Coke in the whole of her life. These days she carried around with her in her bag a selection of herbal teas, all naturally caffeine free, which could conveniently be made into refreshing drinks by simply adding boiling water. Perhaps MickyT would like to try one? Camomile and Nettle flavours were particularly good, in her experience, for water retention, while the Fennel and Good Afternoon and Vanilla kinds did wonders for

AndyV said, loudly, that he had had enough. This meeting would now come to order. The issue at hand was the renewed threat from AOL/Netscape. Microsoft had achieved and retained domination in these markets by anticipating this kind of crisis and responding to it in advance, and, and, and where the hell did HelenB think she was going now?

HelenB said it was Thursday.

AndyV agreed that it was indeed Thursday, but felt that by itself this was an inadequate explanation for her getting up and walking out of his meeting. As it happened, he had planned this meeting as an all-nighter. He recalled the good old days when a cabal of programmers had got Windows working in protected mode during one long 48-hour session, fuelled by pizza and Coke. This was the spirit required now to overcome the renewed Netscape threat.

RandyZ said it was all very well for AndyV to recall the old days, but Thursday was Barney the Dinosaur night on CBS, and after that he had promised to take the kids down to the new rollerskaterama.

MickyT said Good point about Barney. I'd better go too.

RandyZ and HelenB and MickyT then all left the meeting.

BradyL attempted to lift AndyV's model up onto the table. But it was too tall, and a piece broke off the top, and a ceiling panel fell down.

AndyV commented that That freaking did it and He didn't know why he freaking bothered.

The meeting was adjourned. ■

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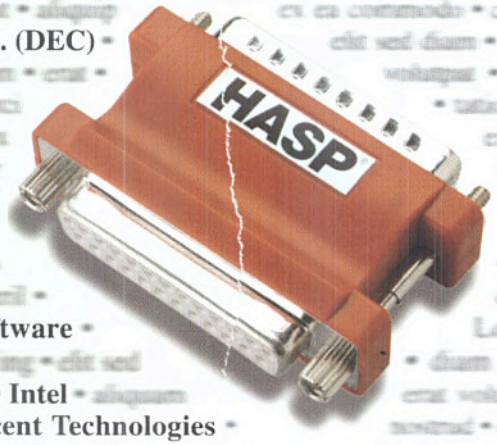

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