THE SOFTWARE DEVELOPERS' MAGAZINE

EXE

FEBRUARY 1999

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Eric Allman interviewed

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EXE: The Software Developers' Magazine is independent and not affiliated to any vendor of hardware, software or services. It is published by: **Centaur Communications Ltd, St Giles House, 50 Poland Street, London W1V 4AX. EXE Advertising/Editorial/Production Telephone:** 0171 970 6541 **Fax:** 0171 970 6741 **Advertising email** markp@exe.co.uk **Subscriptions** Tel: 0171 292 3706 Fax: 0171 970 4099 email: execirc@centaur.co.uk. EXE is available by subscription at £35 per annum (12 issues) in the UK: see subs card between pages 10 & 11. The magazine is published around the 1st of the month. To subscribe or if you have a subscription query, please call 0171 292 3706 or write to Dianne Henry, EXE, (address above). We can invoice your company if an official company order is provided. Back issues are available at £3.50 each. *'A Subscription implies that this journal will be sent to the subscriber until one of the three expires' (AG Macdonell.)* **Editorial.** Address all editorial enquiries and comments to The Editor, EXE, (address above) or email to editorial@exe.co.uk. We welcome letters, opinions, suggestions and articles from readers. These may be edited. Information contained in EXE is believed to be correct. If errors are found, we will endeavour to publish a clarification in the next issue. **Copyright** Material published in EXE is copyright © Centaur Communications Ltd. Articles (or parts of articles) may not be copied, distributed or republished without written permission from the publishers. All trademarks are acknowledged as the property of their respective owners.

Repro & Typesetting: Atelier Dataset Ltd **Printer:** St Ives (Roche) Ltd. **Front Cover Picture:** Hulton Getty **ISSN:**0268-6872

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News & Views

Borland Developer's Workshop

Special Price Bundle of Borland's Development Tools

Borland Developer's Workshop is a new bundle of Borland's popular dev tools. It is available in Standard and Professional variants which include the respective versions of Delphi 4, C++Builder 3 and JBuilder 2. Why don't you save some money and get one of these bundles?

WinDK for Windows CE

Are You Developing Device Drivers for Windows CE?

WinDK for Windows CE is a full-featured device driver development tool for embedded systems and industrial control developers using Windows CE. It makes it easier to create new drivers and also lets you port existing drivers created with WinDK for Windows NT & WDM. WinDK for Windows CE integrates into the Visual C++ IDE and supports Bus Master DMA, overlapped I/O, request queuing, shared interrupts, full enumeration of ISA, PCI & PCMCIA buses and sample source code and tutorial documentation. And it is completely royalty free!

Wise InstallManager

Are You Suffering From Registry Rage?

Wise InstallManager is the new state-of-the-art installation tool from Wise Solutions that provides an easy, bullet-proof way to install applications over a network without file and registry conflicts. Those annoying DLL file conflicts that send systems crashing and users screaming to help desks - often called "DLL Hell" - now can be almost completely avoided. Wise's exclusive new ConflictManager screens files, icons, and registry keys across multiple Windows applications to spot potential file conflicts that may occur during installation. It also includes all of the advanced features in Wise InstallMaster.

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Trellix 2.0

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From line-editor to IDE

I never used a goose quill and ink to write on parchment. I started using a microcomputer in my teens. You can work out how old I am! Until then most of my writing was done using any old pen or pencil on a sheet of paper. I never liked it. My handwriting is hard to read and I just don't enjoy the physical act of moving a pen on paper. It's clumsy. Since my encounter with a microcomputer most of my writing has been done in a text editor or wordprocessor of some sort. Ironically, I've started to 'handwrite' more since I bought a Palm III. I often 'write' email messages on it when I'm out and about or just sitting comfortably at home. Okay, it's Graffiti, not plain handwriting. I've not yet reached the stage of dictating to my PC...

All these different input/recording methods and the associated technologies probably have an impact on what is written. With pen and paper, one tends to try to avoid having to correct mistakes so one spends more time thinking before committing to paper. When using a computer, it's so easy to write sloppily and correct afterwards that one tends just to fire off shorter sentences with typo and grammatical errors and then make a second pass to correct most of them. Since screen technology only allows for a limited number of lines to be displayed, text modifications tend to be relatively local. When an article or a book is badly written or subbed, the impact of the wordprocessor is often noticeable: correct spelling but wrong word, bits of sentences that have obviously been moved around. When a text has been worked on purely on screen, it's not uncommon to have very similar paragraphs far apart, ie they were not visible on the same screen.

Writing technology has evolved tremendously through the years, from engraved tablets and Egyptian papyrus to the latest rev of everyone's favourite wordprocessor. (Such an evolution on such a timescale is not surprising. It leaves humans time to adapt and exploit the technologies to their best.) The shorter timespan covered in the first paragraph is just twenty years. Enough time to get familiar with one technology, only for it then to be displaced by the next one.

Let's turn to the art of writing computer programs, ie software. I'll put aside all the different language evolutions, new microprocessors, peripherals, and so on. Let's just concentrate on the transition from concepts held in the head to a written representation from which executable code can be generated more or less automatically. Back to when I was a teenager. At that time, most languages had their very own editors, all with their own conventions. Assembly was sometimes written in assembly and sometimes directly in hexadecimal. Basic had its line numbers. Writing code for UCSD Pascal was a very different activity than for Turbo Pascal. Interpreted languages such as Lisp or Smalltalk even had their own environment on some specialised hardware. The glorious days of the Lisp Machine. Then I started to use independent editors. Programs like ed or sed, where code was entered line by line, and commands were issued to modify the code entered. Then came the luxury of full-screen editing with tools such as Emacs. Eventually the days of the IDE started. Along the line came pretty-printers, grep, coloured syntax, code and class completion...

In the early days, I was thinking much more about the code I was writing before I actually entered it, I even resorted to handwriting some bits on scrap listings. This resulted, consciously or not, in compact code.

This is not a definite chronology, I continued to use line-editors at the same time I was using Emacs. When doing all the editing locally the speed impact was negligible, but when editing from a VT terminal connected to a remote computer via a 1200 bps connection, having a remote echo for each and every character was painfully slow. Now, unless you have the latest fastest meanest hardware, the all-singing and dancing IDEs can feel just as painfully slow.

The impact of the evolution of code writing technology is amazingly similar to the impact of the evolution of prose writing technology. In the early days, I was thinking much more about the code I was writing before I actually entered it, I even resorted to handwriting some bits on scrap listings. This resulted, consciously or not, in compact code. Short variable names and tight algorithms. With the advent of more visual and interactive environments (and a better knowledge of computer science), I started to use more meaningful variable names and even included some comments. However, the code is not only more verbose but is probably less refined. Time that was spent purely on the functional aspect is now spent on the look – ie readability.

If you have kept listings of software you wrote many years ago, try to find them and compare the style with what you write today. The impact of the editing technology is rarely noticed (unless something goes wrong, like the editor crashing) but it does influence the way we write software.

David Mery

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MIDAS – everything turns to objects

Inprise has enhanced its MIDAS (Multi-Tier Distributed Application Services) suite. MIDAS 2 sees the simplification of distributed databases with new transports and database features, and there are data schema optimisations, and user interface improvements. One of the key features is MIDAS Client for Java, which delivers Java-based thin clients on any platform. Previously, MIDAS-based solutions operated exclusively in the Microsoft Windows environment.

MIDAS 2 is designed to simplify and speed the development, integration, and deployment of thin-client, distributed-database applications. It manages data access across all application tiers, from the client to the database server. Fast remote-data access and intelligent data synchronisation are designed to optimise network bandwidth.

To enable the deployment of distributed business objects, the MIDAS feature set includes: distributed datasets and transaction processing; cross-platform thin-client applications and applets; high-speed database connectivity; high server availability with fail-over safety; load balancing; connection pooling and resource management; and briefcase mode/mobile database operations.

New features include: a completely cross-platform and cross-product distribution system with native Corba support using Inprise VisiBroker; optimised database connectivity; connections to more database file formats with support for easy access to non-BDE (Borland Database Engine) datasets, and Data Grid enhancements support visualisation of advanced Oracle8 ADT types.

MIDAS 2 sees the ability to use a provider that will work from any `TDataSet` descendent (`TDataSetProvider`), and the basic provider is no longer tied to BDE. All relevant field properties can now be passed to the client, so that the server can specify things like `DisplayName`, `EditMask`, etc, and have that propagate to the client automatically. There is the ability to send calculated fields from server to client, and control which fields get sent (via the Fields Editor).

MIDAS applications can be developed with all of Inprise's enterprise tools, including JBuilder, Delphi, and C++Builder, and MIDAS 2 supports Java, CORBA, and COM/MTS. Users can manage their MIDAS-produced applications through integration with the Inprise Application Server.

MIDAS Client for Java is intended to simplify the development of cross-platform, Pure Java thin clients for distributed-database applications. It includes a set of Java Beans, or components, designed for JBuilder 2. These Pure Java components give developers cross-platform client access to multi-tier MIDAS applications.

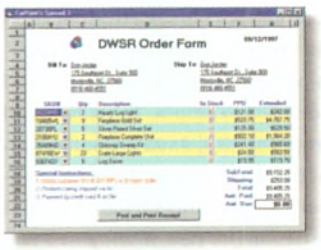
The Inprise slogan is that MIDAS gives you access to 'Any Data, Any Time, Anywhere' with support for any distributed computing standard and platform.

w *www.inprise.com/midas*

Spread straight from your data

Spread 3, from FarPoint Technologies, is a spreadsheet component for creating data source front-ends, managing the display of up to 2 billion rows and columns of data using an enhanced Virtual Mode.

There are a number of new features. There is full support for Visual Basic 6.0 and Visual C++ 6.0. It allows developers to bind Spread 3 to ActiveX Data Objects (ADO) 2.0 using OLE DB, Data Access Objects (DAO), or Remote Data Objects (RDO). The 32-bit versions can import and export spreadsheet files in Microsoft Excel 97 format, and export spreadsheet files as HTML. There is a Print Preview facility. And the combo box cell type can be enhanced by using the FarPoint List Pro fpCombo control (sold separately).



Other facilities include support for OLE drag and drop, creating text tips, loading data to or from an integer or float array, customising the background and text colour for selected cells, setting more than one border colour and style for the same cell, and finally, it provides IntelliMouse support.

Spread 3 retails at £249 from Contemporary Software, and it includes a 32-bit ActiveX, VBX, and 16- and 32-bit DLLs. Upgrades are £130.

w *www.contemporary.co.uk*

Patching

Version 5.0 of Pocket Soft's .RTPatch Professional DLL provides an interface for the distribution of patches from within InstallShield Professional 5.0 and above. The patch building program compares an old system with a revised system and creates a difference file (the patch). Once the patch is built it can be delivered by an InstallShield Professional application. Version 5 also allows patching of open files so that end-users don't have to exit a program during the process. For non-InstallShield users, .RTPatch Professional 5.0 can search and update the Registry and `INI` files on local and remote drives. There are new examples of how to use the Patch Apply DLL with C++, VB, and Delphi.

The cost for a single user licence, which includes support, is £700. It can be evaluated and purchased from the PtS website.

w *www.pts.com*

ClassExplorer Pro 2.1, from toolsfactory, is a development tool to bring code **navigation**, creation, and documentation capabilities to Delphi and **C++Builder** environments. It enables the generation of an online help system for a project's classes and routines.
www.toolsfactory.com

There are versions of **Visual Basic** 6.0 Enterprise Edition and **Visual C++** 6.0 Professional Edition designed specifically to run on Compaq's 64-bit **Alpha** processor. Licensed users of Enterprise editions can receive copies at cost of shipping only.
www.microsoft.com/vstudio/alpha

IBM's **WebSphere** Application Server, Standard Edition 2.0, includes Enterprise **JavaBean** support and the new IBM HTTP Server based on the **Apache** web server. For Solaris, NT, and AIX the Standard Edition is £497, the Advanced Edition £3750.
www.software.ibm.com/websphere

Informix will support the Open Information Model (OIM), a specification for representing metadata as defined by **Microsoft** and the Meta Data Coalition (MDC). The specification is intended to ensure **interoperability** of tools, applications, and repositories for the reuse of metadata.
www.informix.com

Metrowerks will expand support within **CodeWarrior** for the AMD-K6 and AMD-K7 families of microprocessors. This applies to developing apps for Windows CE running on **AMD** microprocessors and for developing embedded system apps running on AMD microcontrollers.
www.metrowerks.com

Microsoft counts down to the millennium

Microsoft has unveiled a range of new tools and information resources to help deal with the 'millennium bug'. The tools and resources represent a new phase of Microsoft's Year 2000 compliance program, which has previously focused on product testing.

In addition, to support those who use recent (but not the most current) versions of Microsoft products, it will maintain Year 2000 compliance for products such as Windows 95, Office 97, and SQL Server 6.5 through January 1, 2001. This policy will apply even if newer versions become available. Meanwhile, Microsoft has said that all its future products will be Year 2000 compliant.

Among the new tools announced is the Microsoft Y2K Product Analyzer, which provides PC users with an easy way to tell whether their Microsoft software is Year 2000-compliant. The Product Analyzer scans a user's hard drive and provides an inventory of Microsoft products. It then compares this inventory to Microsoft's Year 2000 compliance product guides, identifies any products for which the user should download a free software update, and provides the URLs.

A beta release of Product Analyzer was scheduled for January, and the product launch will be in February. It will be available free of charge from the Microsoft website. It is a stand-alone tool designed for individual machines. But corporations with enterprise networks will be offered a similar tool in the Systems Management Server (SMS) 2.0, scheduled for release by February.

SMS 2.0 features a compliance database engine made with the code used to create the Product Analyzer; the database engine identifies Microsoft software across a network that requires updates, and advises on where to obtain the updates. The SMS database can be customised with compliance data from other software vendors.

Other new Y2K tools unveiled this week include the Y2K Resource CD. This quarterly CD-ROM will soon be available free of charge. The first version includes Microsoft product guides, white papers, and Year 2000 info. In the second quarter, the CD will also offer assessment tools and other Y2K information related to hardware, operating systems, applications, documents, custom code, and data interfaces. Subscriptions can be obtained at *www.microsoft.com/technet/topics/year2k*. Microsoft has also developed three date migration add-in tools for Excel 97.

w *www.microsoft.com/technet/topics/year2k/tools/tools.htm*

Linder Software has released the latest version of its compression libraries, **LSPzip**. It is aimed at VB, VC++, C++Builder, and **Delphi** developers looking to read or write to `.zip` compressed libraries. It costs $169 for a single-user licence.
www.alberts.com

Beta software for Object Design's **eXcelon** XML data server is available for free from the Web. It enables the building of enterprise **web** applications using **XML**, and can be used as an application cache for existing data sources. It will be commercially available in the first quarter of 1999.
www.objectdesign.com

LabVIEW 5.1, the development environment for measurement and automation, streamlines the creation of web-enabled applications. It integrates the math and interactive **analysis** capabilities of The MathWorks' **MATLAB** and National Instruments' HiQ. There's a new 3D graph control.
www.natinst.com

Adobe's **Web Bundle** incorporates Adobe PageMill 3.0, the web page **authoring** and site management software, and Adobe ImageStyler 1.0, the web **graphics** design software. Available through Adobe Direct, it costs £125.
www.adobe.com

Sequiter Software's **CodeBase for Java** is a database library that provides fully functional client/server **database** access over the **Internet** and intranets. At 50 K for the full library, it can enhance Java applications without adversely affecting download times.
www.highlander.co.uk

We support JDK 1.2 too

Following on from Sun's release of the Java 2 platform (aka JDK 1.2) a number of companies have incorporated its facilities into their own products: Rogue Wave, Metrowerks, Compuware, KL Group, and Forté. Inprise has also announced support in its JBuilder family of Java development tools and its Inprise Application Server.

Rogue Wave's Tools.h++ Professional, Money.h++, and StudioJ class libraries feature JDK 1.2 support. For example, Tools.h++ will provide further C+++ and Java interoperability. Java object serialisation will allow communication between C++ and Java applications built with JDK 1.2. Alternatively, the virtual streams format can provide a 'common language' between the two. Money.h++ will use the JDK BigDecimal classes for greater precision when performing conversions, and StudioJ will provide complete class library compatibility, including support for JFC, and incorporate the new JIT compiler.

Metrowerks should have begun to ship CodeWarrior Professional Release 4 for Solaris, featuring full support for Sun's Java 2 (as well as support for JDK version 1.1.6). It is priced at £325. Similarly, Compuware will incorporate the technology in an upcoming release of NuMega DevPartner for Java, its suite of productivity tools. KL Group's JClass Enterprise Edition 3.6, the suite of JavaBeans for building GUIs, works with the newly released Swing component kit. Prices start from £1679.

Finally, Forté has announced that 1.2 will be the basis for its forthcoming Java-based application environment. It will enable the development of 100% pure Java applications.

w *www.roguewave.com* w *www.inprise.com* w *www.metrowerks.com*
w *www.klg.com* w *www.forte.com* w *www.compuware.com/numega*

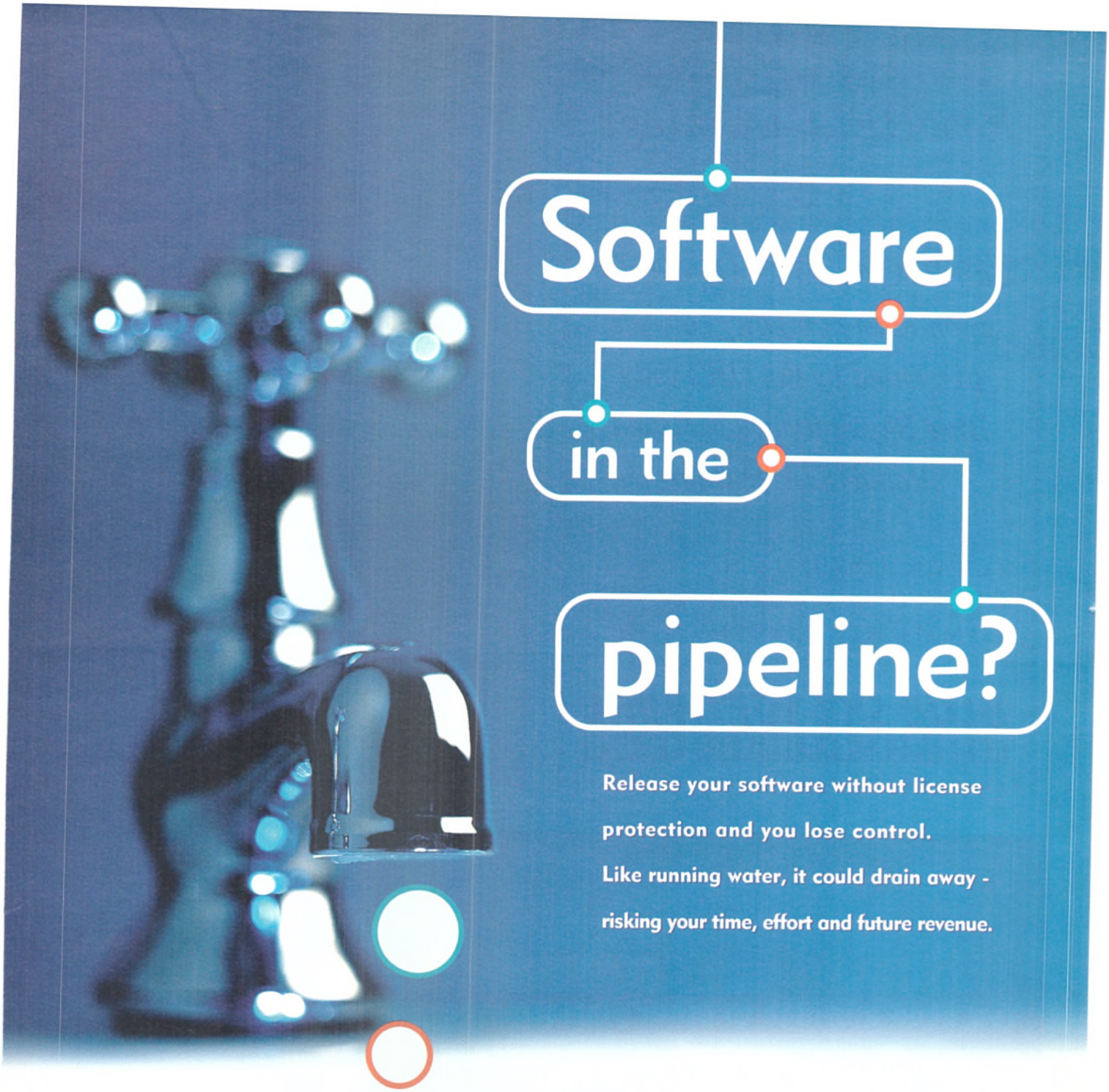
CodeWarrior for Java

CodeWarrior Professional for Java is a Java-only version of the multi-language CodeWarrior tools from Metrowerks. Like the multi-language product, it will include support for both Macintosh- and Windows-hosted development. Solaris-hosted tools are sold separately – CodeWarrior Professional for Solaris has just been released (see *We support JDK 1.2 too*). There is a CodeWarrior Academic for Java, its lower cost reflecting licensing restrictions. Both products have a Release 4 version level, to be consistent with the current multi-language product

Metrowerks is currently beta testing RAD tools for both Macintosh- and Windows-hosted Java development. These RAD tools will ship on the Release 5 tools, due after Spring 1999.

CodeWarrior Professional for Java Release 4 is priced at £135. The academic version costs £57.

w *www.fullmoon.com*



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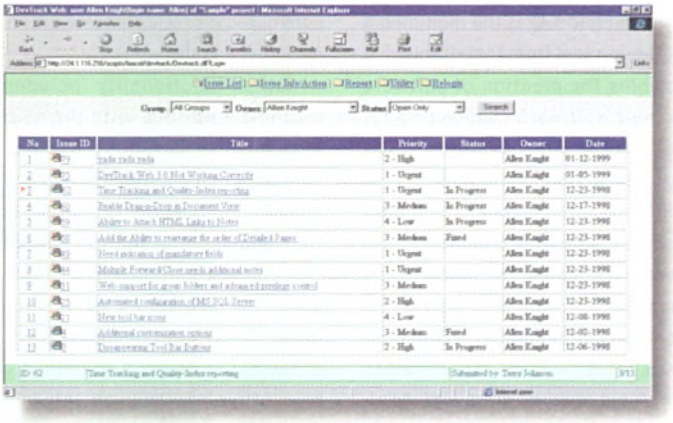
Keeping up with defect-tracking

DevTrack 3.0 is TechExcel's defect- and project-tracking tool targeted specifically at software development teams. It tracks and manages defect information, HTML links change requests, and project related documents.

New features in DevTrack 3.0 include time tracking, enhanced user customisation, improved integration with DevTrack Web (pictured), and SMTP support for email. With this release, TechExcel has changed the name from PowerTrack to DevTrack to emphasise the place of software development.

DevTrack's interface consists of three dynamically switched views. The Main View records Issue information and tracks project activities. The Report View displays project data in presentation-quality reports and graphics, while the Document Control View manages project-related documents and HTML links.

It provides workgroup functionality through either a DevTrack interface or a Web browser, extending access to remote team members and customers. DevTrack Web enables remote users to submit and forward issues, view detailed issue history, and produce customisable reports.



Using OWL (Open Workflow and Lifecycle) modelling, DevTrack allows the definition of flexible workflow processes for tackling software defects. Issue lifecycle tracking can be done from creation through to QA. In terms of data access, there is ODBC support for industry-leading databases, including Microsoft SQL Server, Sybase, and Oracle

DevTrack 3.0 can be purchased from System Science, and TechExcel provides a fully functioning evaluation copy that can be downloaded from at *http://www.devTrack.com/*.

DevTrack 3.0 is the fourth commercial release of DevTrack, and TechExcel is a Microsoft Solution Provider that specialises in information technology consulting and software development.

w *www.techexcel.com*

Intercepting the incidence of bugs

Elsinore Technologies' Visual Intercept Studio, is a Microsoft Visual Studio add-in of its Visual Intercept product. It's a project-oriented incident management (or bug tracking) system that can be used with all the Visual Studio tools that support plug-ins: VB, VC++ and VJ++ (all up to version 6.0). Version 1.0 of InterDev is currently in place, with support for 6.0 imminent.

Visual Intercept Studio provides a floating toolbar in Visual Studio, which provides basic incident management functionality. Users can log new incidents, check on incidents of interest, receive notifications, associate contact information with identified bugs, and launch the full Visual Intercept Manager.

Visual Intercept 1.1 itself is integrated with Microsoft Visual SourceSafe. You can import a VSS project hierarchy straight into Visual Intercept, and associate particular bugs with particular files and versions in the source code control.

In terms of security, Visual Intercept has a role-based security system, which lets you set various levels of control on a per-project, per-user basis. It uses an open backend database for greater user choice: Access, SQL Server, Oracle, Sybase, and FoxPro are supported. The Crystal Reports Engine is used for generating pre-built reports on incident data.

For a limited period, Visual Intercept Studio is included in Visual Intercept 1.1, of which a trial copy can be downloaded. You must have the Visual Intercept Manager (v1.1 or higher) installed to use the Studio add-in. The list price of Visual Intercept Studio is $99.

w *www.elsitech.com/addin/vistudio.html*

Cutting the rope bridge

The Mathengine SDK is aimed at game and simulation software developers. Mathengine, pioneering 'gamephysics', is a framework for endowing 3D objects with physical attributes, allowing 3D simulations to have natural behaviour in real-time.

The company quotes the example of a shoot 'em up game involving pursuit over a rope bridge. Ideally, the bridge would sway correctly from side to side as weight is transferred. Should the ropes be cut, any pursuers would realistically exit stage left. Gamephysics, they claim, will help increase realism and change our experience of 3D simulations.

It replaces scripted scenarios with real-time physical dynamics. Programmed via an API, it has a set of algorithms designed to handle most situations in classical physics that are likely to be encountered when creating a virtual world.

w *www.mathengine.com*

Simware's Salvo Server 4.0 and **Salvo Impact 2.0** form an application development and deployment environment for Microsoft Transaction Service (MTS) and COM enterprise applications. The release features Salvo COM object support through a COM interface to access Salvo **business rules**
www.simware.com

Mabry Software has announced that all of its **ActiveX** custom controls and COM objects support the new Euro currency symbol. The company avows complete **Euro** and Y2K compatibility and functionality across its line of products.
www.mabry.com

Unicom is presenting a European conference to discuss and debate the commercial implications of **Open Source Software** (23 March, London). Richard Stallman, founder of the **GNU** project, Mark Cox, of the Apache Group, and Simon Muchmore, of Intel, are among the speakers.
www.unicom.co.uk

IBM's **XML Parser** for Java has been updated to v1.1.9. This version supports W3C Proposed Recommendations for Namespaces in XML, there's better documentation, and bug fixes since version 1.1.4. See the **IBM** XML website for numerous XML-related offerings: standard specifications, **tools**, and samples.
www.software.ibm/xml/index.html

W3C has released version 2.0.0 of **Jigsaw**, its Java web server, which is an **Open Source** project. It sees HTTP 1.1 compliance, and there's a Servlet API providing a mechanism for invoking Java programs on servers.
www.w3.org/Jigsaw

The wizards of demonstration

Stingray's **Objective Toolkit/X** 2.0, the ActiveX version of Objective Toolkit, delivers GUI features to **VB** 6.0 users, including the ability to dock or float forms. New **UI** features include a ShortcutBar, a navigational tool that organises groups of icons into a collection of sliding groups. It costs £295 per developer.
www.stingray.com/otx

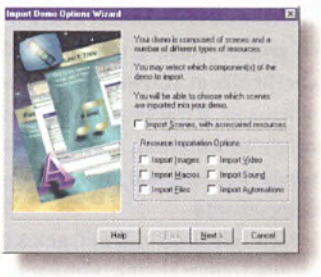
Version 3.50 of the **Opera** browser sees the implementation of **CSS1** support, Transport Layer Security, and Java support via a plug-in from Sun. File Upload, an Offline **Browser** Mode, Name Completion, and a Turbo Mode add to the feature set. There is new functionality for the Download window, and there are user-defined toolbar icons. It coincides with the launch of a web-based email service, OperaMail.
www.operasoftware.com

The CT Media Resource Development Kit (RDK) is a new SDK for Dialogic's CT Media telephony server software. **Dialogic** claim CT **Media** is the industry's only CT development platform for developing **CT** servers that can support multiple applications from different vendors. Prices will be announced on its full release.
www.dialogic.com

DemoShield 5.42 is the multimedia authoring tool from InstallShield. It enables the creation of software demonstrations, including help tutorials, pre-sales demos, and CD browsers. This latest version provides a point-and-click design environment with pre-formatted multimedia templates. DemoShield can be used to create demonstrations for distribution on CD-ROM, floppies, or live playback on the Internet.

A set of quick-start wizards allows users to incorporate pre-formatted backgrounds, graphics, navigation, and sound effects. The enhanced DemoWizard establishes the demonstration's structure by offering templates with different graphical themes (including communications, corporate, international, and cartoon).

Other functionality includes on-the-fly-editing, with the user word processing within the design view for a fast approach to text and layout editing. There is a property find-and-replace feature, which can change globally, in a single step, the attributes of various demo objects throughout a scene or the entire demo. And there are four other wizards: an Internet Save Wizard to prepare demos for viewing live on the Web or as a stand-alone effort; an Automation Wizard to create and coordinate simulations and text; a QuickObject Wizard to automate the implementation of sound, video, buttons, and animations; and finally, Build Action Wizard, which adds interactivity and navigational features to demos, without scripting.



DemoShield 5.4 has a suggested list price of $495, and it can be ordered from the InstallShield website. Version 5.42 represents a maintenance release. It is available for download.
w www.installshield.com

Classic and HTML – RoboHELP Office 7.0

RoboHELP Office 7.0 includes RoboHELP Classic, RoboHELP HTML Edition, and 12 other Help tools. The Help authoring suite from Blue Sky Software automates the creation of all HTML Help features and allows the import of existing WinHelp projects.

New features in RoboHELP Classic 7.0 (for the old WinHelp format) include a Smart Index Generator, a Macro Assistant, a Browse Sequence Builder, customisable project templates, an enhanced Image Workshop, docking Component Gallery and Explorer tool palettes, improved cross-platform WebHelp (an HTML and Java-based solution), and a new Diagnostic report.

New to the RoboHELP HTML Edition is the ability to generate printed documentation directly from underlying HTML files, the automated creation of expanding text and drop-down text, multi-topic property editing, four new reports and improved file management. The Smart Index generator and enhanced WebHelp also appear for this Edition.

The international version of RoboHELP Office 7.0 is now available at a list price of $938.

It supports 10 international language versions of MS Word.
w www.blue-sky.com

Perl Resource Kit for Win32

An update of the O'Reilly & Associates Perl Resource Kit (Win32 Edition) is available. This first update, Service Pack 1, can be downloaded from *http://www.ActiveState.com/prk*. It means that all the enhancements made to Perl since the Kit was originally released are now available to Win32 Perl users. Info about the kit can be found at the URL *http://software.oreilly.com/*.

There are two important updates. First, the core of the update is based on the latest version of Perl (5.005_02, which is non-beta). This brings the Win32 Edition up to date with Active Perl 509, plus the Win32-OLE module, version 1005. Second, installing the update gives the latest versions of Perl: Perl for ISAPI, ActiveState Perl Debugger, PerlCOM, PerlCtrl, and Perl2exe.

Service Pack 1 also contains a number of bug fixes.
w www.ActiveState.com/prk

Books received this month

Publisher	Title	Author	ISBN	RRP
Wrox Press	ADSI ASP	Steven Hahn	1-861001-69-x	£27.49
John Wiley & Sons	Computer Security	Dieter Gollmann	0-471-97844-2	£22.50
O'Reilly	Java Servlet Programming	Jason Hunter & William Crawford	1-56592-391-x	£24.50
Wrox Press	JavaScript Objects	Alexander Nakhimovsky & Tom Myers	1-861001-89-4	£36.99
O'Reilly	MCSE: The Electives in a Nutshell	Michael Moncur	1-56592-482-7	£14.95
AP Professional	Tcl/Tk for Real Programmers	Clif Flynt	0-12-261205-1	£34.95
Wrox Press	XML Applications	Frank Boumhrey, Olivia Direnzo, et al	1-861001-52-5	£45.99

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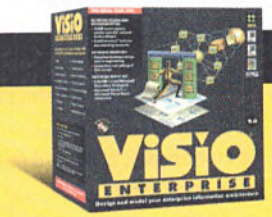

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Home alone

Would you pay full price for a computer that was sold 'as seen'? Probably, you already have done. Jules investigates home computers.

One of the things that I value about my job is that, alongside the often very technical contracts I get, there are some very basic ones. These basic ones are important because it's so easy to forget, when writing drivers and building hardware, that there is a user waiting at the end of the development process. A user who is interested in getting a job done and who is not at all interested in the engineering in the box.

One such is a sweet old lady who works for, among others, a Christian mission in the East End of London. She relies on her box to handle accounts, publications, and grant applications. It's her office, and she's proud of it. She treats it as she does her real estate; keeping it tidy, learning how to operate it, and so on. She looks after it as well as she's able, and looks to me for the stuff she can't handle. Because it's so important to her, she bought a fully-built system from Time (because it is a big company with a good rep) and paid loads of extra money for its extended warranty. Zero headaches is what she was buying, and she didn't mind paying extra for it.

Zero headaches was not what she got, however. When the machine broke down (with a damaged file in the *iosubsys* directory – sound familiar?) she called me. I tried to fix the hardware problem, and it wouldn't fix. I tried to reload Windows, but the master CD was corrupt. We called in the warranty. For a whole week she tried to call the support line, and nobody answered. She tried faxing, and the fax machine just rang. Eventually, she got through to the hardware line, who said it was a software problem, and sympathised that the software line was over-subscribed, but complained that it wasn't their problem.

Eventually a call to head office got the promise of a repair. They'd be round to pick up the machine the following Monday – not Monday, said Sweet Old Lady, that's my father's funeral. Wednesday was agreed. The van showed up in the middle of the funeral, and was sent away. It didn't show up on Wednesday, but did on Thursday. A week later, the machine came back, with the hard disk wiped. Apart from the masses of files she was using ('You should have backed them up,' said Time. 'How,' asked SOL, 'when the computer won't start?') she had also lost all the bundled applications and operating system, and couldn't reload because the master CD was still kaput.

The situation has now been passed to Trading Standards, who sadly shook their heads. Computers are notoriously unreliable, and computer companies simply can't afford to honour their after-sales commitments. Even when customers pay extra (sometimes, as in the case of my SOL, lots extra) the benefit is pretty worthless.

Techies don't mind computers going wrong, in fact most secretly welcome the challenge. Big companies don't mind the computers being difficult, because they can employ people to get dozens of nearly identical computers just right for them. But the techies market was mined out ten years ago, and the business market is virtually saturated now as well. The next big market (and it will be enormous) will be home use.

Home users want games that work with a quiet confidence. They want hard disks that don't become cluttered with registry data and screens that don't become cluttered with icons. They want something that works most of the time, even as the demands placed upon it change. Present computers force users to lift the bonnet, so they are encouraged to mess about in a way that is inconceivable when translated to cars or hi-fi. But, users demand that computers don't keep going wrong, and when they do go wrong that they can be mended (rather than made worse, as Time did to SOL's machine), and if they don't get that, they won't buy any more computers. They'll buy videodisk players and Internet set-top boxes and games consoles and central heating controllers, and though these things might have computers on the inside they'll have neither disk drive nor keyboard on the outside.

If home users don't buy computers, that's serious. This huge market is the only untapped vein for cheap hardware, and without it the present pared-to-the-bone prices can't last – either box prices will rise, or all sales will become high-volume or bargain basement. It's also the only outlet left for niche or experimental software, because when all development is either embedded controllers or Enterprise word-processors, copying a floppy disk and a manual will not be enough to distribute software – you'll need to duplicate the hardware to run it on as well.

Business, too, will suffer. If small-scale home machines can't be kept running at realistic cost, then what hope has a large network? Businesses are naturally very conservative, particularly when it comes to the data that keeps their operations alive. We're seeing now the (purported) growth in popularity of the thin client (a step back in time twenty years, to the days of dumb terminals and mainframes) precisely because thin clients protect networks from the worst of the malice and incompetence of their users. It's only a small step for companies to declare a moratorium on software upgrades until such upgrades have been proved on other sites not to damage data, not to confuse operators, not to crash during installation, and to deliver a genuine benefit commensurate with the risks and costs. In such an environment, how will software ever be proved?

Ultimately, the problem revolves around the fact that the increasing sophistication is being driven by Windows in its various incarnations, and Microsoft doesn't carry the can (directly) for the problems this causes. It is the suppliers who must evolve solutions to enable them to manage the complexities on behalf of their customers, and the suppliers are doing no such thing. If they're not careful, they'll have no customers left to supply, and if even brand-new computers are routinely sold unwarrantied, prices will erode to the point where even big suppliers can't make a living. ■

If your computer has broken down, you can phone Jules on 01707 662698 for help. If it hasn't, you can email him at mayhem@jules.cix.co.uk.

Reaping the benefits of C++

Dear Sir,
Neil Hewitt complains that C++ has now become too complicated (*Technobabble*, November 1998). As a C++ programmer, I have some sympathy with this view, although I'm sure that a careful study of its design criteria and objectives would probably demonstrate that nearly all its current features have sound reasons for their inclusion. That is, there will be certain kinds of problem for which the new features are well adapted.

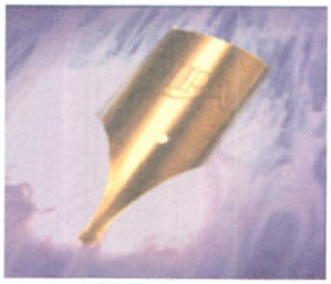
However, having recently had to do some maintenance work on a pure C program, I think using even a very restricted subset of the current C++, perhaps just classes without inheritance and with just some basic standard library features for strings and collections, is far preferable to using C.

Although C++ is complex, I believe that once one has acquired a certain level of competence one is unlikely to want to return to C and is in fact likely to find the latter quite unpleasant. Moreover, it is not necessary to master the entirety of C++ in order to reap its benefits.
Kevin McFarlane
kevin@atech.globalnet.co.uk

Missing link

Dear Sir,
In your SoapFlake (*Exploding the PC as we know it*, EXE, January 1999), you consider 'cheap wireless links with sufficient bandwidth' the main, if not the only, 'missing technology' for 'the PC and all its incarnations [to] move from the foreground to the background'. There are many other obstacles to such a great goal. First and foremost software reliability. How do you reset an embedded computer when you do not have a keyboard? Memory leaks and other trivia of desktop software have to be completely eradicated. And one of the advantages of wireless appliances is for them to be mobile but there again battery technology needs to improve seriously. I think one year is a bit too soon for all that you suggest to occur, and I notice that with this 'explosion' the 'thinness' of clients is not a part of the scenario.
Steve Megson
email address supplied

The problem of reliability is an important one, I didn't cover it much because I think it will be easier to solve when appliances start to appear that are focused on doing one, or just a few, tasks well instead of looking for universality. Battery technology is improving. Anyway I've given myself a full year... *David Mery*



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

Resolutions

Dear Sir,
I was interested to read your New Year predictions in the January issue. New Year is also a time for making resoltuions. As far as computing is concerned, I believe we would all benefit from adhering to the following:

- Never install something on my PC unless the reason is good enough to justify at least one day of inactivity on said computer (should installation foul up).
- Never (ever) install any software (demo/games) from any CD on the front of any magazine.
- Keep my virus software up to date (maybe you can see where I'm coming from).
- Do not follow that link to another curious site that may just be interesting, but is already a diversion from a diversion from what I dialled up the Internet for, over an hour ago!...

These are a few to be getting on with. I certainly intend to keep them – especially the last, as my phone bill will be a constant monthly reminder.
Robert Shelton
Rob@alt2600.freeserve.co.uk

Well, as this magazine has not (so far) provided cover-CDs, I will not take issue with you. (I wonder if I can guess the particular title involved.) However, the installation one is surely a bit harsh. What is the bleeding edge of technology – the very latest beta releases, et al – without some 'bleeding'? - Ed

Salary survey

Have you already filled in and sent back the Salary Survey questionnaire? If not, why not do it now? You can find it bound in the January issue between pages 52 and 53 and as a loose insert in this issue. The more completed questionnaires we receive, the better the picture we'll be able to depict and the more benefit you'll get from it. We took on board the comments you made on last year's survey and cater better for contractors. Also, this year as an added incentive, for each questionnaire we receive we'll give one pound to a charity of your choice: either the Bletchley Park Trust (*www.cranfield.ac.uk/ccc/bpark*) or the Disaster Emergency Committee Hurricane Appeal (*www.oneworld.org/ oxfam/atwork/emerg/mitchdec.htm*).

Bletchley Park used to be 'Britain's best kept secret'. This is where, during the second word war, German codes were decrypted. It is now open to the public and is creating a museum of computing. One of its activities has been the rebuild of Colossus, (one of) the world's first computers.

The DEC is an alliance of UK aid agencies that provide food, clean drinking water, shelter, and medicines to the people of Central America as a relief to the disaster caused by Hurricane Mitch.

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Patricia Deardorff

Eric Allman
Mail matters

Open Source, startup companies, email trends, and sitting on a goldmine. These are some of the topics covered by Eric Allman, the man behind the sendmail program, when Peter Collinson caught up with him at the LISA conference in Boston.

Eric Allman is the author of `sendmail`, the mail transfer agent that 75-80% of systems on the Internet use to relay and deliver email. Last year, he surprised many people by starting a new venture: Sendmail Inc, a company that sells and supports the mail system.

I talked to him at the LISA (Large Installation Systems Administration) conference in Boston in early December 1998. Allman had had a busy conference: he'd given the keynote talk, taught some tutorials, and participated in a panel session on mail systems.

I think that when I talked to you last, in 1995, you were just leaving academia for a startup.

That company turned out to be a bad match for me, partly because of the commute from Berkeley to Silicon Valley and partly because the job didn't properly fit my personality. I learnt a lot though. I began to understand what has to happen at a startup. I left and became a consultant for a short period.

For some time I had been trying to figure out a way where I could make `sendmail` self-sustaining. I'd been supporting `sendmail` for a long time with no pay. It was taking more and more time, and I had gotten to the point where I couldn't advance `sendmail` because, even with the help of other volunteers, I was busy supporting the installed base.

My dream was to create the 'Sendmail Consortium', and I registered *sendmail.org* to support it. The idea was to get perhaps five or so companies together and they would kick in some modest amount of money, like $50,000 a year. Sounds a lot, but for large companies like Sun or IBM, it's one third of an engineer when you include all the costs.

Of course, since all these large companies are using `sendmail`, they would all be delighted to be able to have input into the program and make sure that new versions came out, at what was a very trivial cost for them.

Well, I suggested this notion to the companies, and was turned down by them all, with only one exception who said 'fine that sounds great'. Everyone else said: 'No, why should we do that, you are going to give it to us anyway. We'll get the same thing for free that we will get for the money' or 'Sure, but we want to own it when it's done, it's got to be our intellectual property'. This was unacceptable.

I was feeling pretty discouraged and met up with Greg Olson, an old friend of mine. I first met Greg some 16 or 17 years ago when he worked for me. He was a very good engineer, but I was not a particularly good manager at that time. I decided to fire myself. I said: 'I am not doing a good job, we need to find someone who can. I want to go back to being an engineer.'

To my utter chagrin, they promoted Greg to be my manager. Normally, promoting somebody to manage their old boss is a recipe for disaster. However, he handled it very well and we got along famously. He was much better at managing upward in the company than I had ever been. He also felt that I was the stronger technical person, so he let me do the technical management, which I was good at. We had a very very good working relationship.

As I said, he was very good at managing 'upward' and it wasn't long before he was promoted again and was no longer my boss. Although we saw each other off and on, I lost track of him. It turns out that in the intervening years, he had been VP of Engineering, VP of Services, VP of Support, VP of Sales, VP of Marketing, VP of Business Development... but he had never been a CEO (Chief Executive Officer, Managing Director in UK terms).

So, I ran into Greg, and at that point he had quit his job. Ironically, the startup he had left was in the building next door to the one I had been working in. I had heard he had moved from Berkeley to Silicon Valley, but I had no idea he was working in the building next door to me. At that point he was doing consulting on marketing and business development. He said: 'Well I do company finance and setup for a living, let me look into things for you. I'll do it for free because you are an old friend.'

Greg went off and did some market research. When he came back he said: 'Did you know that you are sitting on a goldmine? Everybody wants a supported version of this product. Everybody I talked to is using `sendmail`, and they love it. They don't want to move to anything else because they say that `sendmail` is incredibly reliable and robust. They are really very happy with it, with the exception that it's hard to configure and that there is no official support'.

It's interesting that the flak you got after the Internet Worm didn't figure in this. I know you've done a lot of work since then, and I would have expected the halo effect to have persisted.

The Worm was a long time ago, and it's true that there still are people that think that `sendmail` has a bug every month. Well, I urge you to look at the CERT logs yourself, it's been years since CERT published its last advisory on `sendmail`.

You and Greg Olson had established that there was a possible market...

He came and said, 'this is spectacular and really unusual'. He started to do some other research and found that the market share was between 75% and 80%. He suggested that I could set up a real company, and still give away the source code: I had made it clear that maintaining free source distributions was a requirement. And finally, he wanted to be involved.

One of the mistakes that people like me make is to say 'I've got this great product, I want to start a company, and of course, I should be CEO'. Well, I am not a CEO.

Frankly, I could not imagine a better CEO than Greg Olson. I don't know how people start companies, go out shopping for a CEO, and pick somebody they haven't met before. Trust is really what it's about. I trust Greg and I was able to hand over the keys to the company with a strong confidence that he wasn't going to stab me in the back.

And you've had time to make more releases...

Yes, version 8.9 first came out in Open Source, and is just now coming out in the commercial version. The intent is to keep releases coming. The only question is how long should there be between the releases. We are not sure what the answer to that is yet.

You are using the Open Source version as a bug testing release?

Certainly, bug testing is one portion of it, but this is only one factor in the equation. Having lots of people with lots of different needs looking at the code works in our favour – they examine, they hack, and they contribute new features and new algorithms. This is good for us, and good for the Net. Also, from a brashly commercial perspective, selling people a new version of something they are already running is easier than selling them on a whole new product.

You are using a different model from Aladdin Enterprises with ghostscript. Aladdin places its code into Open Source after some time has elapsed. If you really want the latest new features, which some companies do, then you can pay and get the release now. Otherwise you can wait and get it after a year or so.

Yes, we are doing the reverse. However, we may follow the Aladdin model for some of our products. For example, we've developed a graphic user interface that's used to configure `sendmail`. We are selling that. It's not part of our Open Source release. But it is not out of the question that the GUI will be released as Open Source at some

It made the papers and gained Open Source a lot of legitimacy. However, Netscape just offloaded one part of its business that was not earning much money.

point in the future. I am not saying that this is definitely going to happen, I don't know, but my guess is that there's a good chance of that.

On the other hand, there are features that we want to put in that absolutely have to come out in the Open Source version. For example, take a new feature of SMTP – SMTP authentication. It does no good to have SMTP authentication available to a small number of sites; we want it to be available to the maximum number of people at the same time. To be as useful as possible, we want to spread it as far as possible, and it will go into the Open Source.

Do you have a feeling that people upgrade sendmail on their machines? Microsoft makes a living because on the whole people don't upgrade operating systems, most people live with what's on their box and don't change it. Do you think that people change sendmail?
Certainly. At my tutorial this week, there were 240 people or so, and one of the questions I always ask is: 'What version of `sendmail` are you running?' And when I asked how many people were running the vendor-supplied version of `sendmail`, maybe twenty people put their hands up. The rest had all downloaded the Open Source and compiled it.

When you started Sendmail Inc, there were some people in the press, and other places, that took some swipes at you for doing so.
One of the concerns is that we are doing a 'technology grab', taking Open Source and sealing it up. There are *many* examples of that happening. The only way that I am going to convince the community that I am not going to steal the source, is to build a history of not doing it.

Who owns sendmail now? The company or you? The company.

Well, there might be a fear that when you sell the company, whoever then runs the company will close the source.
I don't believe that 'Sendmail, the company' is likely to be viable without Eric Allman. The company is certainly a startup, with serious investors, but it's a company where I hold a very unusual position. It's an unusual company in many ways. Very few companies start out holding an 80% market share for its product. Very few companies start out with the kind of reputation that `sendmail` enjoys. Very few companies start out with a fully debugged and working product, most start with an idea and there's lots of R&D to be done.

The other issue is 'what's going to keep somebody else from doing exactly the same thing?' – taking the Open Source from me and selling/supporting `sendmail`. The answer is '*they* don't have Eric Allman'. Everybody knows that I *am* `sendmail`. Maybe this is bad, maybe there's a cult of personality, and to certain extent there is, it's actually rather embarrassing to find myself a 'superstar'. Right now, that cult of personality is very good for the company.

Well, that's what's held Linux together.
Absolutely. One of the things I said in my keynote was that, in my view, all the really successful Open Source products have an individual or a small core of people that act as the arbiters of good taste. Linus is the obvious person for Linux.

With BSD, it used to be Bill Joy. Apache has the rather small core team. Perl has Larry Wall, and to a certain extent, Tom Christiansen.

Perl's an interesting case. On the surface, they seem happy to put out new releases so that old code is broken. You seem to be always worried about backward compatibility.
Well, I am definitely worried about compatibility and to be fair, Larry is too. I'm going to be controversial here. I never thought that Perl 4 was a good language, it grew like mushrooms in the night. Perl 5 was a *much* better language, but Larry wasn't willing to go the final step and completely destroy backward compatibility for the sake of making an even better language. He did make a reasonable attempt to make most (not all, but most) Perl 4 programs run using Perl 5.

There's a load of noise being made about Open Source. It seems to be thought of as anti-Microsoft in some ways.
It's popular to hate Microsoft – it gives you a lot of reasons to hate it – and I don't think there's any doubt that this feeling has fuelled Open Source. However, if Microsoft was suddenly to put all its products into Open Source, people would still hate Microsoft. However, if Microsoft was warm and cuddly, but still had closed source, Open Source would still be an issue, but probably not so popular.

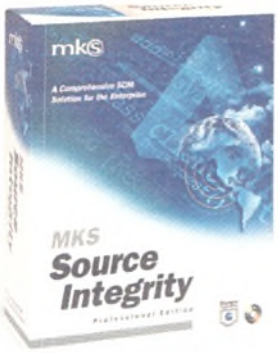
I suppose that an icon of Open Source is the release of Mozilla by Netscape.
One of the things that I said in my keynote was that I doubt Netscape's long term commitment to Open Source. I am really amazed that I haven't had someone come up to me at this conference and say 'how dare you, the release of Mozilla was one of the great Open Source events'. Well, I suppose that it was, in the sense that it made the papers and gained Open Source a lot of legitimacy. However, Netscape just offloaded one part of its business that was not earning much money. It hasn't opened up its servers, for instance.

I wonder how much input Netscape has had from releasing the source.
I suppose that they have got some things. For example, Netscape was never able to do strong encryption, and it appeared from Australia within some small number of hours of the Netscape release. It's an interesting question how much community feedback is actually present in the latest release of the Netscape browser.

Well I suppose that Netscape was in a cleft stick, it was going along fine until Microsoft decided to challenge it. Do you think that you are in a similar position, with Microsoft Exchange, for example?
The obvious answer to that is 'yes, of course'. We have a better opportunity to co-exist with Microsoft's operating systems than Netscape did. You can run `sendmail` on your Internet node and 'back-end' into Exchange, but you can't really back-end into your browser.

I wouldn't be surprised if Microsoft would really like to own this space. However, it is a little busy right now, and for a while, it is going to tread a little carefully. But this issue is definitely a concern. It's hard to predict the future. I'm not noted for doing that too well.

Where is mail going? What are the newest trends?
The email standards are very clearly going towards MIME. Netscape and others are trying to encourage people to go towards the HTML MIME type as the main interchange standard. At the moment, mail



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The kind of application where the measure of success is that nobody knows that you are there, which is a useful metric of how good server software is.

messages are being sent with both HTML and plain text, so if you open the mail it will adapt to your system.

Business likes using HTML, because they can find out when you read the mail since their web server can be hit when you pull a graphic. Also, they can tailor their mail message so that you see what they want you to see when you read the mail, rather than defining its contents when they send it.

The only change that was necessary for `sendmail` to handle MIME was to support eight-bit attachments. MIME works by sending a special header in the mail message, and `sendmail` doesn't need to interpret the message, it's an issue of how the mail is displayed. Since `sendmail` doesn't do display, MIME can just pass through. I think that there will be pressure to move toward richer formats.

One of the things that you get from Lotus Notes and Exchange, but not in any interoperable way, is Calendar Management. This is Unified Messaging; there will be some work done on standardising this area. I think that IETF (Internet Engineering Task Force) has a working group on this area.

What's authenticated SMTP going to give us?
Authenticated SMTP provides a way of identifying a machine that is sending mail, essentially identifying each endpoint for the duration of the SMTP interchange. For example, when you are relaying mail you want to know who it is you are really relaying for. If you have someone who is on the road, and they call in from some unknown IP address, then you know that it really is them sending mail, because you have some cryptographic identification of the machine that is sending the mail.

Relaying is the biggest problem with SPAM. Will authenticated SMTP help?
SPAM is with us to stay, as inevitable as junk postal mail or falling leaves. I don't think that authenticated relays will stop SPAM. It will just get it down to manageable levels.

I don't object to using the Net for commercial purposes, and to a certain extent that's going to include 'marketing' that some people will think of as SPAM. I don't want to see people stop using the Net for marketing, but I'd like to see a reduction of the unwanted mail, so that it's targeted. After all, when I receive a catalogue from some place that sells computer stuff or tools, technically that's unsolicited mail, but I collect interesting tools and it's neat to look through the latest techno-tool catalogue.

You are obviously developing new products with Sendmail Inc; you've talked a little about the configuration GUI...
The big step that's in Sendmail Pro is the GUI. It also includes a lot of documentation. One of the biggest wins on the package is the online documentation. Instead of having to find the appropriate place in the 1,000 page `sendmail` book (see *Further reading*), you can click on a button and the information is there. The online text is also at a different level. We have three technical writers in the company, actually we have as many writers as we have engineers. This addresses the problem of 'this is hard to understand' that many people perceive with `sendmail`.

We are selling technical support, so that there is someone you can call up and get answers, who will hold your hand. And we are doing support for companies that have mixed mail systems on site (it costs more of course). We're getting lots of uptake; our problem is finding consultants fast enough. We are turning away business because we don't have the staff, and no company likes to do that.

I suppose that the people you are trying to hire are hard to find...
And with unemployment in the industry hovering at approximately zero percent, getting people is very difficult.

And do you plan to develop user agents as well?
No. User agents are a totally different area and I don't think that we have the expertise. What we will probably do is team up with a company that makes user agents and develop an integrated product. There are some things that are hard to do, calendars for example, because you have to know that the user agent can handle the data. I can see us teaming up with somebody in the future to do that.

What about message stores?
We do plan to work on message stores in the Sendmail Server product, which is some way down the line. We know how to do servers, but user agents require a different kind of mentality. A lot of the people we have at Sendmail came out of the database world, and are not necessarily used to working on email, but they are used to working on mission-critical server applications. The kind of application where the measure of success is that nobody knows that you are there, which is a useful metric of how good server software is.

Our Sendmail NT product that we purchased from Metainfo is `sendmail`, plus a message store, plus a POP server. It replaces Microsoft Mail. It's not really high performance, because NT still isn't a high performance platform. However, it does the job.

To end on a personal note, where do you see yourself in five or ten years?
(Laughs) Well, being a Principal in a thriving startup takes more time than I had expected, so I suppose my first hope is to get back to coding. One possibility is that I'll be able to split off a 'Skunk Works' from Sendmail, and essentially go back to what I used to do – find interesting problems, do a good hack, and give it away. But this time with more resources. Of course, another possibility is that I'll go back to the University, a place that I love dearly. It seems to be my pattern to keep going back, so who knows? ■

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

Further reading

In case you are wondering about the 1000 page book that Eric refers to in this article, it's *sendmail* by Brian Costales with Eric Allman. It is published by O'Reilly and Associates (ISBN 1-56592-222-0) and is into its second edition.

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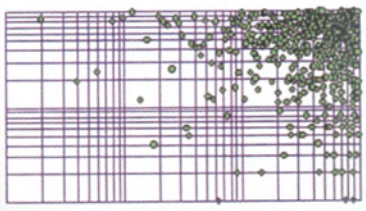

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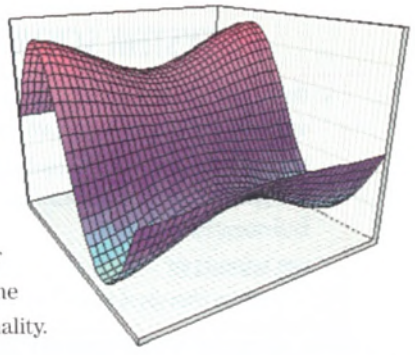

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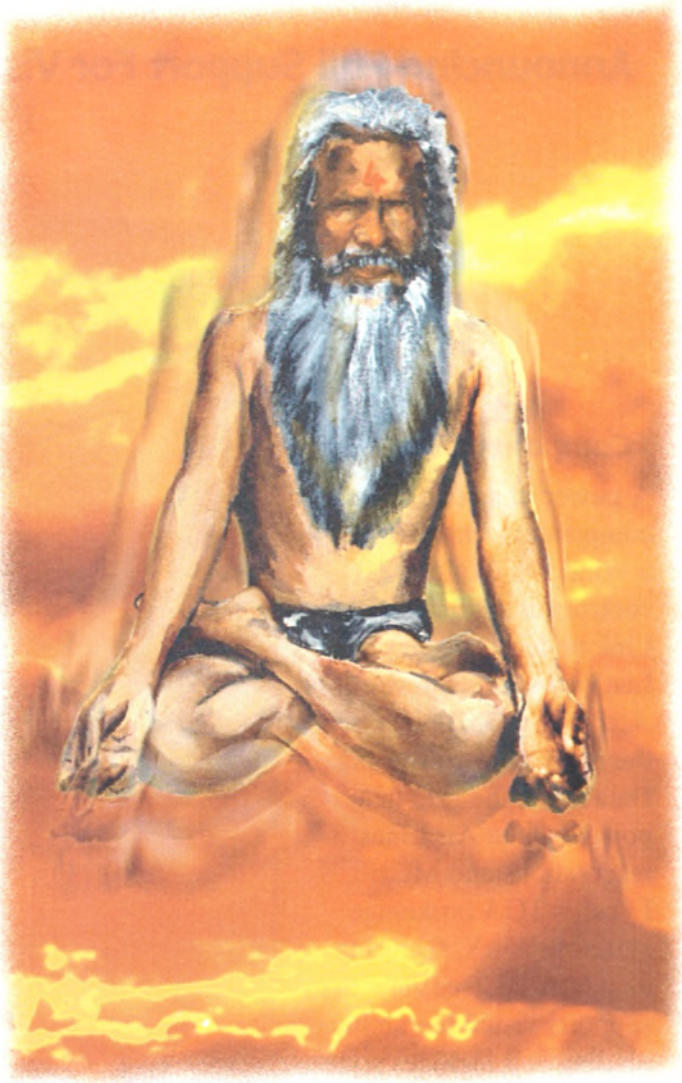
Release 4 sees further fine-tuning of the core of BeOS. With performance improvements, a change of compiler and tools, bus manager device drivers, and a new Media Kit, Duncan Wilcox believes that it is unbeatable for developers.

The unbearable lightness of BeOS



Daren Mason

Since its first public appearance in late 1995, BeOS has periodically been getting press attention, often because of the partnerships involved, sometimes because of technology and innovation. BeOS Release 4, released last November, was introduced with a fanfare of announcements with the intent of capturing media attention. And the announcement of Intel investing in Be certainly achieved this.

We are used to seeing the 'Wow factor' and software-coolness decline as new versions are released. This is often true for an unnamed software giant, as code bloat and relatively tight deadlines impose early, buggy releases. Luckily, R4 follows Be's tradition of semi-annual, incremental updates: the core of the OS is an optimised and fine-tuned R3. Plus there are a few new or radically improved system components. In other words, there is more to R4 than press-oriented announcements. It is, without any doubt, the best BeOS release to date.

Toolchain

The change with the most impact is the switch of compiler and tools. The x86 version of BeOS Release 4 uses the ECGS compiler – the GCC variant developed by Cygnus, also used in some Linux distributions – and related linking and debugging tools.

Be documents a speed improvement of between 5% and 130%, with an overall application-performance improvement in the 50% area. In the real world, the compiler-related speed differences are visible and confirm Be's figures, as any computation-bound application easily shows. The system, on the whole, feels noticeably faster and snappier but it is hard to tell how much is due to the compiler and how much is due to the changes in the app_server, in the video device driver architecture, or general tune-ups across the system. For example, on the same hardware the Chart application (a simple star-fly-by demo) jumps from 40 frames per second when compiled on R3 to 70 when compiled on R4.

The performance figures include the performance hit related to the use of relocatable code (see *ELF versus PE* for details), which seems to be minor. The use of shared code makes BeOS more memory efficient, offsetting memory exhaustion time.

Regarding debugging, a sore spot of R3, there's good news. Be is developing a native graphical debugger, BDB, currently only available in beta but already functional, stable, and quite useful. While waiting for features in the Be debugger, the text-only `gdb` can finally be used.

On the down side, compiler differences have broken binary compatibility: R3 binaries don't run on R4. This is bad news for users upgrading from R3 to R4 on Intel. However, all medium/large developers have committed to porting their applications to R4, welcoming the performance increases.

Again, the above only applies to x86. While Be won't admit it, the PowerPC platform appears to be in maintenance mode (and it only makes sense given the shrinking market share and the hostility of Apple).

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Media Kit

The big news in R4 is – we should probably say *finally*, given BeOS' 'Media OS' moniker – a new Media Kit. The redesigned Media Kit deals with audio, video, and any time-dependent media in a modular, extensible way.

The fundamental classes allow developers to wire and manage a graph of nodes. Each node processes a snippet of media – a few milliseconds of audio, a frame of video, and so on. There are a few stock nodes for managing input and output of common file formats, and more should come in the form of downloadable updates, but developers can build their own nodes that will extend the Media Kit for the benefit of all Media Kit user applications.

The media_server is a process, constantly running, that synchronises media processing nodes against a single time source, timestamping media fragments. The time source for media is usually the audio card itself.

The standard format for audio data is single precision floating point, for an audio quality that respects the quality of the source. Many modern PCI audio cards are capable of processing floating point audio directly, a good match for the Media Kit.

Traditionally there is a trade-off to be taken, in non-dedicated equipment handling media in real time, which makes time-dependent media processing a delicate balance. As an example, let's consider what an audio card does during audio playback. An audio card can be thought, in simple terms, as having two output data buffers. While one buffer is being transferred through the digital to analogue converter (DAC) to the output, the other buffer has to be filled by the software performing the playback. When the buffer being played is empty the audio card switches buffers and signals the event through a hardware interrupt. The interrupt is caught by the audio card driver that tells the software to fill the empty buffer.

The response time to the hardware interrupt – interrupt latency – is not instantaneous, but it has to be shorter than the time required by the sound card to play a buffer, otherwise the pauses in audio generation will result in ugly hisses and crackles.

Using larger buffers solves the problem, but brings another one: audio latency. The larger the buffers, the longer it will take from the application to the physical audio. It can be unpleasant to play a game where you shoot and hear the sound half a second later.

The only solution is to use buffers as small as the system interrupt latency allows. Interrupt latency for 'real time' threads on BeOS is at most one millisecond. This is a lot better than the other common desktop OSs, which often have a hard time guaranteeing 5 ms. The Media Kit, while very powerful and flexible, owes a lot to the foundation it lies upon. (Listing 1 shows an extremely simple example of audio file playback.)

```
void playsound(char *path)
{
   BSound *sound;
   BSoundPlayer player;
   entry_ref ref;
   BEntry entry(path, true);
   BSoundPlayer::play_id id;

   if(entry.InitCheck() == B_OK)
   {
      if(entry.GetRef(&ref) == B_OK)
      {
         sound = new BSound(&ref);
         if(sound->InitCheck() == B_OK)
         {
            player.Start();
            player.SetVolume(1.0);
            id = player.StartPlaying(sound);
            sound->ReleaseRef();
            player.WaitForSound(id);
         }
      }
   }
}
```

Listing 1 – An extremely simple example of audio file playback.

How fast is fast?

While it is hard to describe, most people using BeOS for the first time feel the system to be very responsive and 'fast'. Since the hardware is the same, it must be the software that makes the difference.

The architecture of the system, and of the programming kits, requires and encourages the use of multiple threads. However, parallelism is nothing without fine-grained locking, or exclusive use of a resource only when really necessary.

As an example, consider a window that displays a running animation. The window, like every BeOS window, is a thread running a message loop, with a corresponding thread in the application server (or app_server). While programming in a multithreaded environment is always harder than in a single-threaded environment, the Application Kit makes it simple to spawn another thread at a different priority that draws the animation.

This simple window will have three threads: one for the message loop, guaranteeing that the window will always be responsive; one for drawing the animation, guaranteeing that the animation will always be smooth; and one in the app_server for rendering the drawing commands issued in the application, which integrates the window with the rest of the user interface. As an example of fine-grained locking, when the user drags the window title bar, the app_server will lock the window only when actually moving all the window pixels to a new position.

The fine-grained parallelism throughout the system and applications, coupled with the fine-grained locking, really makes a difference.

R4 does introduce a few new features that perform better in the application/app_server client/server environment. First, any view

Figure 1 – In this screenshot a few changes to the BeOS look are visible. The Windows 98-style title bar is little more than an Easter egg, but the desktop background image and some touches here and there improve the look over R3.

PE versus ELF

BeOS R4 uses the ELF (Executable and Linking Format) executable format, replacing the PE (Portable Executable) executable format used in R3.

This switch is not the reason for the break in binary compatibility, in fact different executable formats might, to some extent, be transformed one into the other. However, different C++ compilers normally have different and incompatible implementations of C++ features, like name mangling, virtual method pointer table (vtable) layout, RTTI information structure, exception handling, and so on.

In fact, because of support for Win32, Cygnus also supports PE – although PE support tends to lag behind ELF support. But if the compiler switch isn't related to the executable format switch, then why did Be choose to switch over to ELF?

Once Be decided it had to break binary compatibility it was logical to pick the better executable format, and there are a few areas where ELF offers advantages over PE.

ELF has a richer set of debugging information embedded into the executable, which makes life easier for debuggers and, of course, users of debuggers.

The table of exported symbols in an ELF executable is directly usable at link-time, allowing developers to link applications directly against shared libraries instead of having to link them against the export libraries. A small difference on the outside that reflects a cleaner architecture inside.

Aside from the file format there's the question of loading conventions. There are two common ways of loading code: 'pure code' and 'patched code'. With 'pure code' conventions, global symbols are referenced by indirection through a special register, sometimes called a table of contents register or base register. With 'patched code' conventions, global symbols are referenced directly in the code. Since the location of symbols is resolved at link-time but the linker doesn't know where they will end up at load time, relocation of symbols is demanded to the loader, which patches the symbol references in the executable at load time.

Loading conventions are related to file format in that the PE format can really only use the 'patched code' conventions. In R4, all code is generated with the `-fpic` switch of `gcc`, for position independent code. The generated code reserves one register that is used as a pointer to local data. In other words, it is perfectly relocatable.

It is obvious that this brings a performance hit, as registers are a scarce resource on x86 processors. Additionally, patched code uses slightly fewer instructions since it doesn't have to load the base pointer of a called function and restore it when the function returns. Be engineers have stated that in real world code any complex piece of code spills registers to main memory anyway, and in the end the execution speed difference is minimal.

Position independent code is usually reserved only for shared libraries, which tend to be used at the same time in different address spaces. The memory management subsystem benefits a lot from position independent code, since it can map the physical memory segment containing the code in multiple address spaces, whereas the old executable format forced duplication and relocation of the code.

The BeOS system architecture encourages the use of position independent code not only for shared libraries but also for applications. Replicants (portions of applications loaded into others) are a good example of code sharing that is not in a shared library, blurring the distinction between applications and shared libraries.

within a window can have a background bitmap instead of a solid colour, by using the `BView::SetViewBitmap` method. The bitmap is handled in the app_server, which will render the bitmap directly without having to go through the application when the view has to be painted. This saves some flickering or slow window update. Second, just like for the line array functions that let an application issue multiple line rendering commands in one efficient app_server transaction, the new `BeginViewTransaction` and `EndViewTransaction` will package view manipulation functions in one app_server transaction. This is particularly interesting since, for example, moving or resizing a view would trigger an expensive clipping-region recalculation. Third, user interface controls can now asynchronously send events to the window they are in while they are being manipulated. Before R4, user interface controls were manipulated from within the main message loop, thus messages directed to the same window would queue up waiting for the loop to run again.

Live queries were a feature of BeOS DR8 (when the filesystem contained a database) that were reintroduced in the BeOS Preview Release, working on the file system attribute indexes. They allow an application to be instantly notified of changes to a view of the file system, letting it give some nice feedback.

R4 extends the concept of 'watching' the filesystem to other system catalogues: the list of running applications, the list of system MIME types, and so on. The spirit is that polling wastes CPU time, and should be avoided.

Drivers

Previous versions of BeOS have been refining the device driver architecture, converging towards an elegant and efficient structure. While there is still a lot of flexibility as to how a device driver might be built, the R4 driver structure has many advantages.

Typically, drivers have to adhere to two interfaces: one dictated by the hardware, and one dictated by the layer of software that controls the driver. In other words, many systems overload the device driver code with the high-level interface and accessory functionality, creating stability and latency problems to the environment where the driver runs: the kernel.

With some exceptions, under BeOS drivers only control hardware, and publish an interface that makes sense for the specific hardware. Higher-level layers are typically handled by a function-specific system daemon, and device-specific shared libraries plug into the daemon adapting the device interface to the daemon interface, with the advantage of running in the daemon's protected address space.

For this reason device drivers are very simple to write and debug. For example, porting the video driver in an X Window system server to a BeOS video driver is a matter of removing portions of unneeded code. And X drivers are a lot simpler than, say, Windows video drivers.

The simplicity of BeOS drivers means that it has been possible for Be to keep under control the maximum amount of time during which any driver keeps interrupts disabled. While the interrupt handler might be triggered immediately, it's the user code taking appropriate action that counts.

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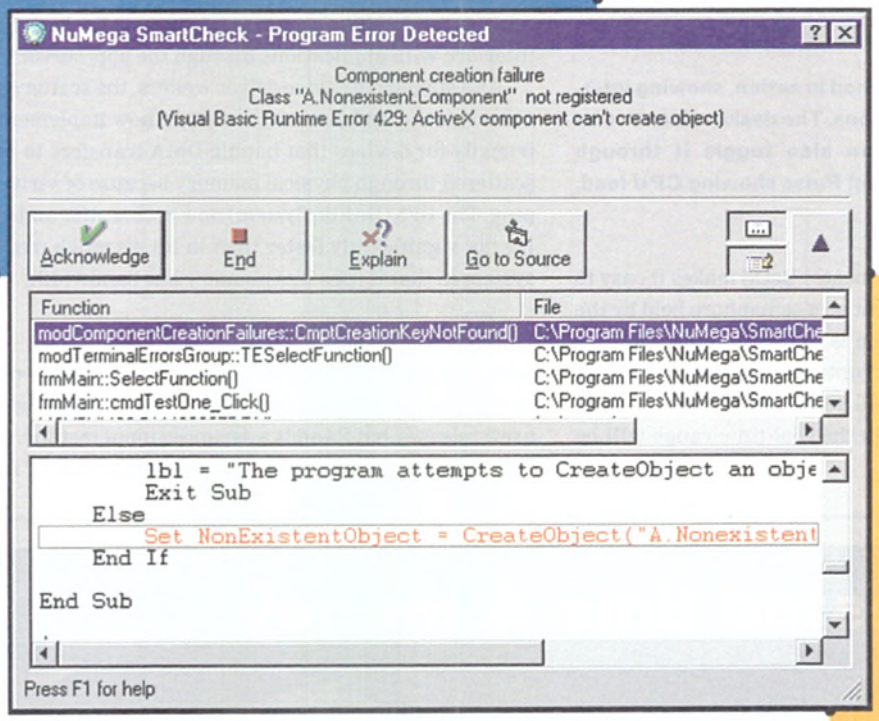

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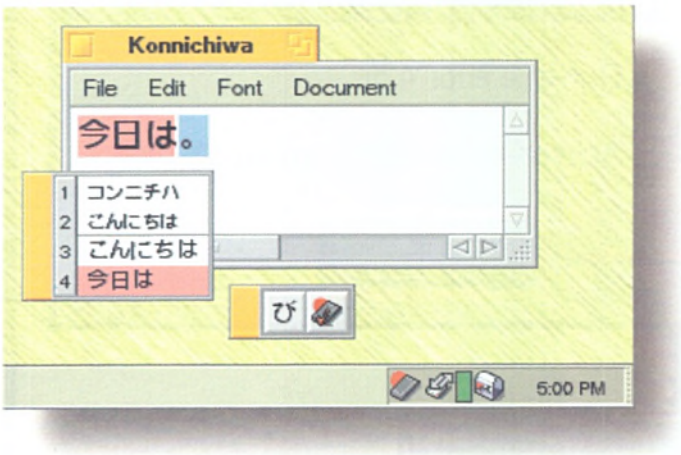

Figure 2 – The new Japanese input method in action, showing international support in the stock applications. The deskbar icons comprise: the Japanese mode (you can also toggle it through ALT-spacebar), the PPP monitor, a mini Pulse showing CPU load, and the e-mail monitor.

The fine-grained threading that permeates BeOS makes it easy to dedicate one soft real-time thread to wait on a semaphore held by the device driver. The scheduling quantum is the parameter that ultimately determines the maximum interrupt response latency: within one millisecond the running thread will either block or will be preempted, and threads with a priority in the real-time range will be immediately executed.

In R4 Be has introduced bus manager device drivers, metadrivers that handle SCSI, IDE, and USB buses. This simplifies development of drivers for devices attached through a bus.

Drivers have always been demand loaded, but with the proliferation of supported devices the process has become a bit slow, so in R4 the filesystem that handles the */dev* directory uses a specific directory structure within */beos/system/add-ons/kernel/dev/* to identify the driver binary based on the requested driver name.

The video driver has also been reworked a bit. Video drivers are now split across a kernel driver that handles interrupts, video card registers and video memory mapping, and the high-level add-ons that interface with applications through the app_server.

As a support to device driver writers, the scatter/gather functions `readv_pos()` and `writev_pos()` are now implemented. This is very friendly for devices that handle DMA-transfers to and from buffers scattered through physical memory because of virtual memory mapping. The BFS (Be File System) now uses scatter and gather, and while it's not significantly faster than in R3 it's much more friendly to the system in that it uses less memory bus bandwidth.

Not forgetting...

R4 is the first international version of BeOS. Unicode UTF-8 (Universal Character Set Transformation Format 8) has been supported for a few releases, but R4 adds a Japanese input method. An input method is a library that interacts with the system stream of input events, han-

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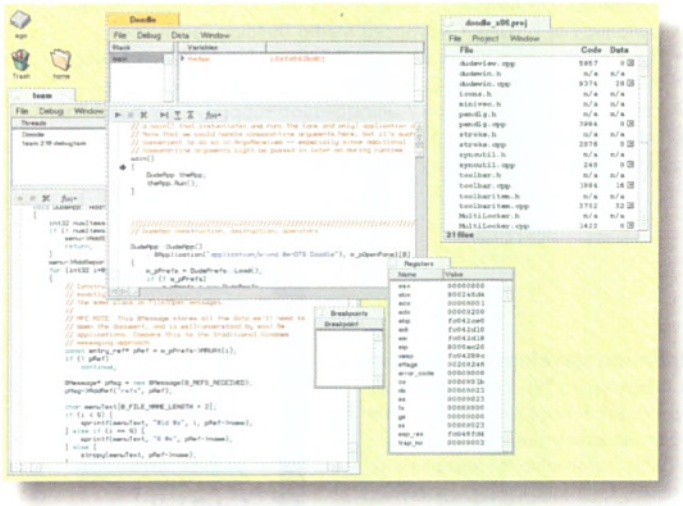

Figure 3 – The beta Be debugger in action. The BeIDE on Intel now supports gcc directly.

dled by the new input_server. Additionally, the input_server provides clean support for other input devices (eg digitising tablets) and recording and playback of user interaction.

The look and feel of the user interface has been subtly changed. However, what is only an Easter egg (see Figure 1) might turn into a nice pluggable look and feel architecture.

Finally, colour transparency has been added, greatly improving user feedback. For example, dragging an icon in the Tracker now shows a translucent icon being dragged.

Applications?

In the end, users buy BeOS if they see applications, and developers write for BeOS if they see users.

Who has to bite first? Sure, BeOS is a nice system for users, but from my point of view it's simply unbeatable for developers, and it's even better in R4. And for developers starting out with BeOS, R4 now includes a free development system on both PowerPC and Intel, plus over forty sample programs with source (often the applets or the demos included with the system).

In a time when some companies boast how many lines of code they've added to their OS, Be brags about how many they've removed. In the words of a Be engineer: 'The app server is about 25,000 lines of code slimmer.' And there are two or three more releases before 2000. In any way you want to read the sentence, it's refreshing. ■

Duncan Wilcox is a freelance consultant and programmer. You can contact him at duncan@mclink.it.

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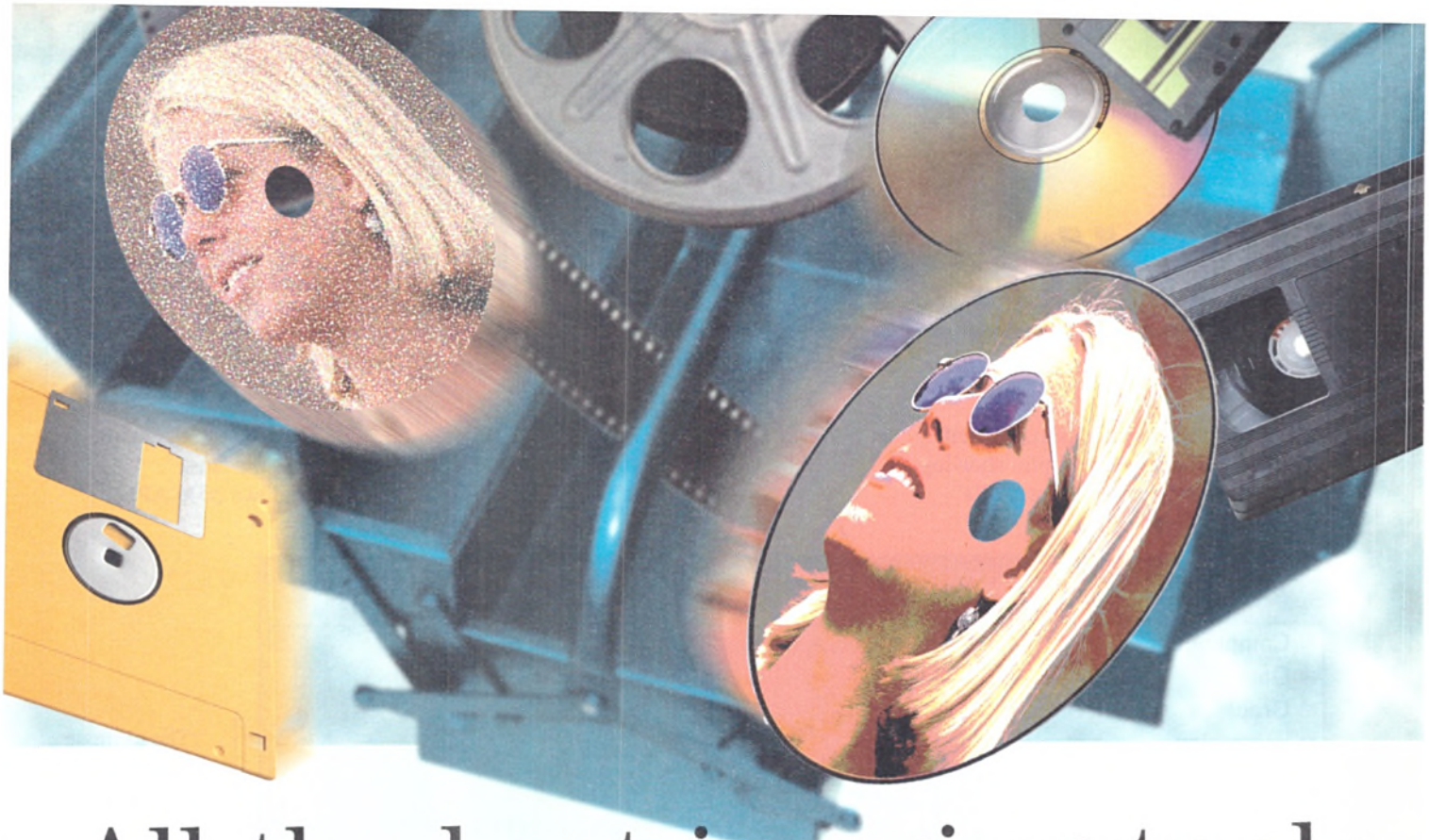

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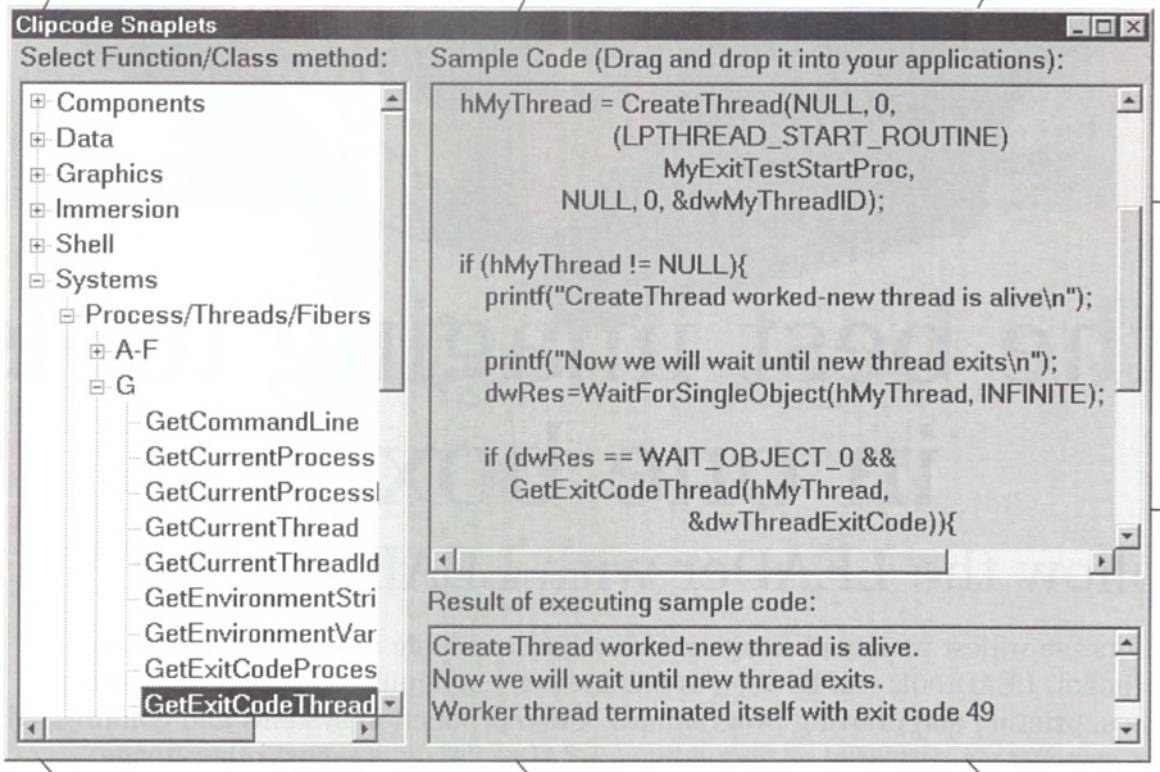

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The MRU list

Dave Jewell continues his tour of undocumented Windows shell features, exploring the functionality behind Most Recently Used lists.

In the December issue of EXE, I described a number of undocumented dialogs contained within Microsoft's `SHELL32.DLL` code. This month, I'm going to continue my explorations by looking at some of the shell goodies contained within `COMCTL32.DLL` – the common controls DLL.

As I pointed out last time, you use this information at your own risk, and you should particularly be aware of the fact that Microsoft's undocumented routines frequently differ between Windows NT and Windows 9x according to whether or not they take Unicode string arguments.

Most Recently Used lists

From a purist's point of view, you'd expect Microsoft to have put all the common utility routines into the SHELL32 library, or preferably into the generic `SHLWAPI.DLL`, but sadly this is not the case. It turns out that there's a very incestuous relationship between each of these system components and it's not always obvious what goes where, a good case in point being the implementation of MRU (Most Recently Used) lists. As you'll no doubt appreciate, most self-respecting programs now implement MRU lists in their user interface, allowing an application to display (for example) a list of the ten most recently opened files as additions to the file menu.

A good example of the shell's own requirement for MRU functionality is the drop-down combo-box shown in Figure 1. This is part of the 'Find Files/Folders' built into Windows Explorer, accessible through the Tools menu. As you can see, Explorer maintains a list of the last few search phrases you specified. Not surprisingly, the necessary persistent information is stored in the Registry. You can see how it works in Figure 2 – this is a view into the Registry (using Microsoft's REGEDIT utility) of the data corresponding to the MRU list in Figure 1.

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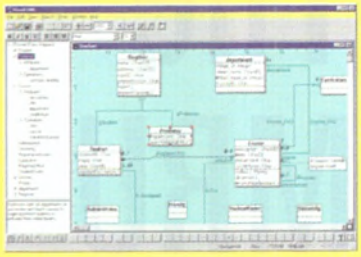

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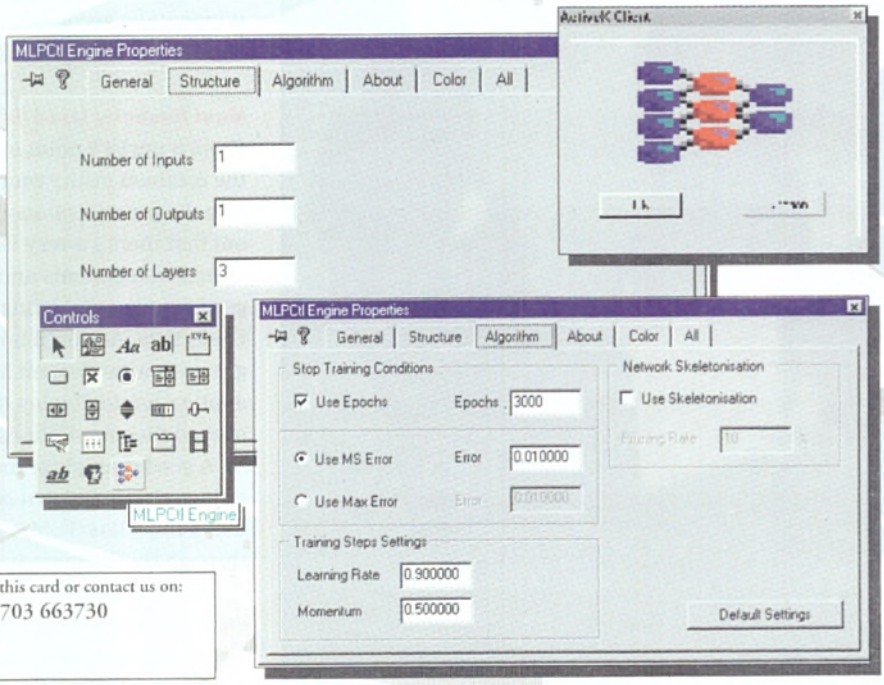

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The MRU information is located within an area of the registry reserved for use by Explorer, located off a key called `Doc Find Spec MRU`. Within this key, the most important Registry value is `MRUList`, which acts as an index into the other values within the list. As you'll see from the illustration, there are ten different string values defined, each named with a single letter of the alphabet. The string contained in the `MRUList` index specifies which of these entries are in the list and (at the same time) defines the order in which they appear. Thus, by convention, an MRU list for a drop-down combo generally starts with an empty string, and this is represented by the value 'a' that appears first in the index. This is then followed by the 'i' string, and so on. An advantage of this approach is that when the user selects an existing item from the list only the order of items in the list needs to change (the most recently 'touched' item moving to the top of the list) and only the index value needs to be rewritten.

Unsurprisingly, to create a new MRU list you use the `CreateMRUList` routine, which is defined later. As with the previous article, I declare the function prototypes using Delphi, but if you're a C++ or VB programmer, you should easily be able to convert into the language of your choice.

```
function CreateMRUList (var CreateInfo:
                        TMRUCreateInfo):
                            THandle; stdcall;
external 'comctl32.dll' index 151;
```

The `CreateMRUList` routine, which lives in the `COMCTL32.DLL` library, takes a single argument that is a pointer to a structure of type

```
procedure TForm1.FormCreate(Sender: TObject);
var
  idx: Integer;
  mrul: THandle;
  mruInfo: TMRUCreateInfo;
  buff: array [0..255] of Char;
begin
  mruInfo.dwSize := sizeof (mruInfo);
  mruInfo.dwMaxItems := 10;
  mruInfo.dwFlags := 0;
  mruInfo.Hive := Hkey_Current_User;
  mruInfo.szSubKey := 'Software\Microsoft\Windows\
                      CurrentVersion\Explorer\
                      Doc Find Spec MRU';
  mruInfo.dwCompareProc := Nil;
  mrul := CreateMRUList (mruInfo);
  if mrul <> 0 then try
    idx := 0;
    ComboBox1.Items.Clear;
    // delete next line to remove empty
    // string display
    ComboBox1.Items.Add ('');
    while True do begin
      if EnumMRUList (mrul, idx, @buff,
              sizeof (buff)) = -1 then break;
      ComboBox1.Items.Add (buff);
      Inc (idx);
    end;
    ComboBox1.ItemIndex := 0;
  finally
    FreeMRUList (mrul);
  end;
end;
```

Listing 1 – Creating a handle to the Explorer's Find File MRU list.

Okay, maybe it's not the most brilliant piece of software design, but on the other hand you're not likely to need more than 29 entries in an MRU list.

`TMRUCreateInfo`. In turn, it returns a handle to the newly created MRU list. Here's what the `TMRUCreateInfo` structure looks like:

```
TMRUCreateInfo = record
  dwSize: Integer;          // size of the data structure
  dwMaxItems: Integer;      // max items in list
  dwFlags: Integer;         // bit flags
  Hive: hKey;               // handle of root key
  szSubKey: PChar;          // name of subkey location
  dwCompareProc: Pointer;   // sort procedure callback
end;
```

In time-honoured fashion, the first field, `dwSize` is the expected size of the data structure and must be correctly initialised in order for the call to succeed. The next item, `dwMaxItems`, specifies the maximum number of items that the MRU list can hold. Don't bother setting this field to a value greater than 29 because if you specify a larger number, it will be internally limited to 29 anyway. Why 29? As you can see from the screenshot, single letters are used to identify the position of each item in the MRU list, and this is done with the letters 'a' through to 'z' in conjunction with '{', '|', and the Unix pipe character, '|', giving a total of 29 different possibilities. Okay, maybe it's not the most brilliant piece of software design, but on the other hand you're not likely to need more than 29 entries in an MRU list.

The `dwFlags` field specifies the type of MRU list that's required. Figures 1 and 2 both illustrate the workings of an MRU list that stores a string as each item. However, as we shall see, it's also possible to create MRU lists that store arbitrary chunks of binary data for each item. As far as I can see, there are three possible bit-flags that you can specify via the `dwFlags` field. These are given below:

```
const
  fMRU_BinaryList  = 1;
  fMRU_CachedWrite = 2;
  fMRU_WriteANSI = 4;
```

By default, an MRU list will be created so as to hold string data. By setting the `fMRU_BinaryList` flag, you'll get an MRU list into which binary data can be stored. The `fMRU_CachedWrite` flag affects the way in which data is written to the disk. If this bit flag is set, then not everything is written out to disk until the list is released from memory. Finally, the `fMRU_WriteANSI` flag appears to force string data to be held as ANSI strings when working under Windows NT. By default, the NT version of COMCTL32 will store string data in NT's native Unicode format. This flag has no effect when using the Windows 9x version of the COMCTL32 library.

As you'd imagine, the `Hive` field allows you to specify the so-called Registry 'hive' under which your MRU list is stored. You would typically set this to one of the predefined root keys such as `HKEY_CURRENT_USER`. In a similar manner, the `szSubKey` field specifies the location of your MRU list within the root key that you've specified. As ever, bear in mind that this field is a pointer to an ASCII string under

If you create MRU lists comprised of 24-bit colour graphics files and your Registry melts down, then please don't come crying to me!

Windows 9x, and a pointer to a Unicode string under NT.

Note: Under NT, there are actually two implementations of `CreateMRUList`. There's `CreateMRUListA`, which has an ordinal number of 151 as described above, and there's a Unicode version, `CreateMRUListW`, which has an ordinal value of 400.

The final field in the `TMRUCreateInfo` data structure is `dwCompareProc`. This is used to pass the address of an application-specific compare procedure, which is used to sort the items in the list. For the sake of brevity, I haven't provided function prototypes for the comparison function. If you're working with a string list, then the comparison function takes two arguments that are pointers to the string data. If you're working with binary lists, then the first two arguments point to the raw data of each entry being compared, and a third argument indicates the number of bytes to compare. In both cases, an integer value is returned in a manner similar to the operation of the standard `strcmp` routine. Obviously, when supplying a custom compare procedure, you'll need to ensure that the routine is defined with the `CALLBACK` attribute (C/C++) or as a `stdcall` routine (Delphi) in order for the correct calling conventions to be used.

The good news is that if you don't want to mess about with application-supplied comparison routines, you don't have to. If you set `dwCompareProc` to nil, then the internal code will use the standard Windows `lstrcmpi` routine for string lists, and a built-in byte comparison routine for binary lists.

Working with MRU lists

Okay, so we've created our MRU list – now what? The thing you'll most often want to do is add a new item to an MRU list. Assuming that you're working with string lists, you'd do this via a call to `AddMRUString` as shown below:

```
function AddMRUString (hMRUList: THandle;
                       szString: PChar):
                            Integer; stdcall;
external 'comctl32.dll' index 153;
```

It should be obvious that the first parameter corresponds to the MRU list handle returned from the `CreateMRUList` call, and the second parameter is the string you want to add. You would typically call `AddMRUString` when (for example) closing a dialog in which the user has entered some string value that you wish to add to a drop-down list, as in the case of the aforementioned Find Files dialog. When `AddMRUString` is called, the internal code checks to see if the specified string already exists in the list. If it does, then the index string is massaged so as to move the referenced string to the front of the list, thus implementing the MRU behaviour. If the string wasn't previously in the list, then it's added. If this causes the list to exceed its stated capacity, then the LRU (least recently used or oldest) string is removed from the list.

The `AddMRUString` function (in its ANSI string form) is supported by both Windows 9x and NT, the latter implementing it as a wrapper around the native Unicode form of the call which, for the sake of argument, we'll call `AddMRUStringW`. This `AddMRUStringW` has an ordinal number of 401 in the COMCTL32 library.

If you wish to store binary data in your MRU list, then you'll need to use the `AddMRUData` call defined as follows.

```
function AddMRUData (hMRUList: THandle;
                     Data: Pointer;
                     DataSize: Integer):
                          Integer; stdcall;
external 'comctl32.dll' index 167;
```

Like the `AddMRUString` routine, this function takes a handle to the MRU list. It also takes a pointer to the abstract data you want to store, and a third parameter that indicates the number of bytes to be stored. Looking at the Microsoft code, I couldn't see any obvious restriction on the amount of data that can be written using this call, but it should go without saying that if you want to store more than a couple of dozen bytes of data, the Registry isn't the best place for storage. If you create MRU lists comprised of 24-bit colour graphics files and your Registry melts down, then please don't come crying to me!

In both cases (`AddMRUString` and `AddMRUData`) the return value is an integer that represents the position in the list where the item has been stored. Since a newly added item always becomes the most recently used item, this returned value corresponds to the physical position in the list and not the logical position. To put this another way, suppose you add a new item 'Widgets' to an existing list. If the return value is five, it simply means that the string 'Widgets' has been placed into the 'f' location within the registry sub-tree corresponding to the MRU list as per Figure 2.

As noted earlier, you'd typically add an item to an MRU list when closing a dialog. In the same way, you'd generally populate a user-interface combo-box with the contents of an MRU list immediately before a dialog box is displayed (at `WM_INITDIALOG` time, `OnCreate`, or whatever vernacular is used by your favourite application framework and language). In order to do this, we need to be able to enumerate the contents of an existing MRU list. This is done via the `EnumMRUList` routine.

```
function EnumMRUList (hMRUList: THandle;
                      Index: Integer;
                      Buffer: Pointer;
                      BufferSize: Integer):
```

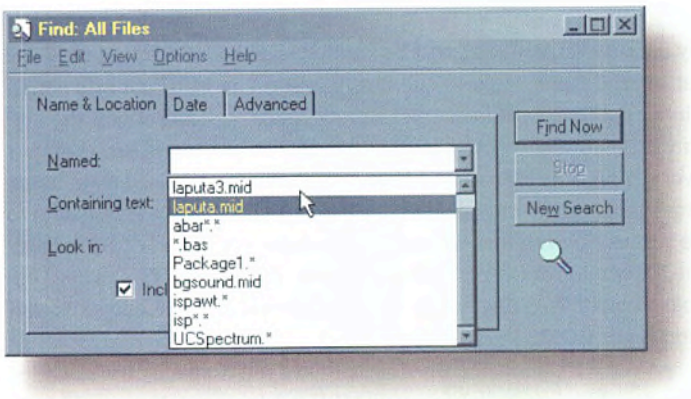

Figure 1 – The 'Named:' drop-down list in the Explorer's Find Files dialog is a good example of how the Explorer makes use of the built-in MRU list functionality discussed in this article. The big question is: does anything else use it?

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This is for visual compatibility with Explorer, but I hate the idea of combo-boxes that have an empty entry in them!

```
                                    Integer; stdcall;
external 'comctl32.dll' index 154;
```

As ever, the first parameter specifies the MRU list while the `Index` parameter tells COMCTL32 which item in the list we're interested in. Zero is the most recently used item while `n-1` is the index of the least recently used item, assuming there are `n` items in the list. The `Buffer` is a pointer to where the retrieved item data should be stored and `BufferSize` indicates the size of the buffer. If you're working with a string list, then `BufferSize` indicates the buffer size in characters (which could be two bytes per character if you're using Unicode) whereas if you're working with a binary list `BufferSize` will be a simple byte count.

In the case of a string list, `EnumMRUList` will return the full length of the list item in characters, even if the supplied buffer was too small to allow all the characters to be retrieved. Somewhat inconsistently, if you're working with a binary data list, then `EnumMRUList` will return the number of bytes actually copied. If you run past the end of the list (`Index` too large), then a value of –1 will be returned, but if you need to know how many items are in an MRU list prior to retrieving any data, then you can set `Buffer` to Nil and the return value will indicate how many items are in the list.

Note: In practice, `EnumMRUList` reports the number of items in the list as being one less than you might expect. That's because the first item (shown clearly in Figure 2) is always an empty string and `EnumMRUList` doesn't regard this as a valid item when returning the item count.

Putting this all together, take a look at Listing 1. This shows a fragment of working Delphi code that creates a handle to the Explorer's Find File MRU list, and then enumerates the list, copying each encountered item into a combo-box called `ComboBox1`. You should be able to adopt this code fragment easily for MFC, Visual Basic, or whatever.

Notice that the code manually inserts that first empty string into the combo-box and later sets the `ItemIndex` property to zero so that (when the combo-box first appears) no text is showing in the control, the empty string being selected. This is for visual compatibility with Explorer, but I hate the idea of combo-boxes that have an empty entry in them! If, like me, you find this an offence to your aesthetic sensibilities, then just delete the commented line of code. As well as removing the empty string, this will ensure that the combo-box appears with the last-used item selected, which I think is much nicer from a user-interface point of view.

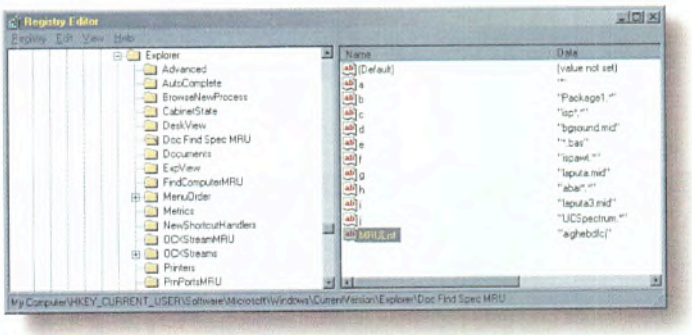

Figure 2 – Here's how Microsoft's MRU list code is implemented from a Registry eye's view. All MRU lists include an MRUList item, which provides a simple mapping from logical index value to physical index value and determines the order of items at the same time.

Incidentally, Listing 1 also introduces another MRU list call, `FreeMRUList`.

```
procedure FreeMRUList (hMRUList: THandle); stdcall;
external 'comctl32.dll' index 152;
```

As you'd expect, this frees up an MRU list handle created via `CreateMRUList`. If you created the MRU list using the `fMRU_CachedWrite` flag, then any pending data is written to the Registry at this time.

Where did that file go?

In addition to the functionality mentioned so far, it is possible to delete a specified item from an MRU list. Why would you want to do that? After all, the whole point about MRU lists is the way in which most recently used items gradually displace those items that are used less frequently – why should you wish to remove an MRU list item explicitly? It's really a question of user interface niceness – being able to remove an item from an MRU list is occasionally a good idea.

For example, if you have the popular Paint Shop Pro image processing program installed on your PC, look through the list of recently opened files appended to the `File` menu and try opening a file that's no longer present on your hard disk. If you do so, PSP will display an error message and you'll find that it also obligingly removes the file from the MRU list once it's discovered that it no longer exists. This is the sort of behaviour that we want to emulate, but to do so it's necessary to be able to make explicit deletions from an MRU list.

Somewhat ironically, PSP (which almost certainly doesn't use the undocumented MRU list API) behaves correctly here whereas Word 97 (which quite possibly does use these undocumented MRU list functions) doesn't behave as it should. In other words, Word 97 will complain if you try and access a non-existent file from its MRU list, but it doesn't subsequently amend the list to reflect the change. There must be a moral there somewhere...

Be that as it may, the API call needed to delete MRU list items is called `DelMRUString` and its function prototype is given below.

```
function DelMRUString (hMRUList: THandle;
                       Index: Integer):
                              Bool; stdcall;
external 'comctl32.dll' index 156;
```

Despite its name, `DelMRUString` is actually nothing to do with strings and will work quite happily with binary lists and string lists. (It should really have been called `DelMRUItem`, and the name is probably a historical throwback to a time before Microsoft thought of storing arbitrary binary data in MRU lists.) For similar reasons, there's no Unicode version of this call – one size fits all.

As you'd expect, the `Index` argument corresponds to the list position of the item that you wish to remove. This is the logical position in the list (ie zero for most recently used) and the return value is `True` if the operation was successful and `False` if unsuccessful – usually as a result of passing an invalid `Index` value. On the negative side, calling `DelMRUString` can potentially leave the internal data structures in a messed-up state (at least, in the NT 4.0 implementation), which can cause a crash when you next add an item to the list. Thus, it's

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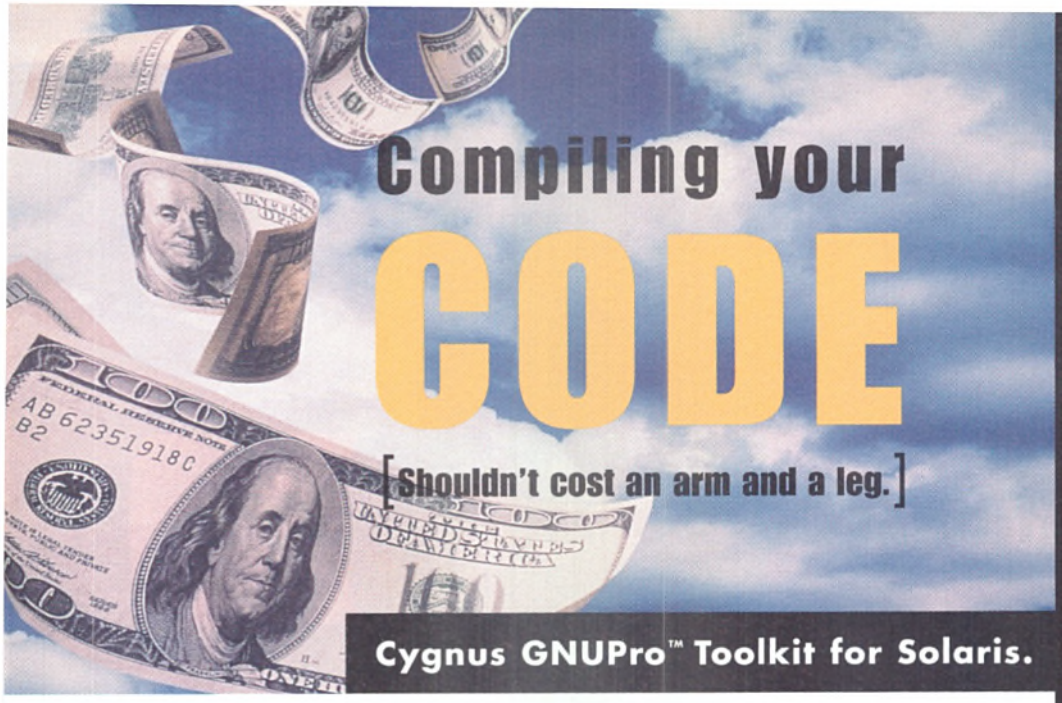

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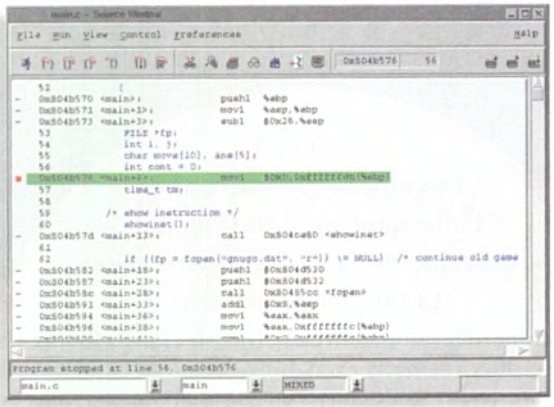

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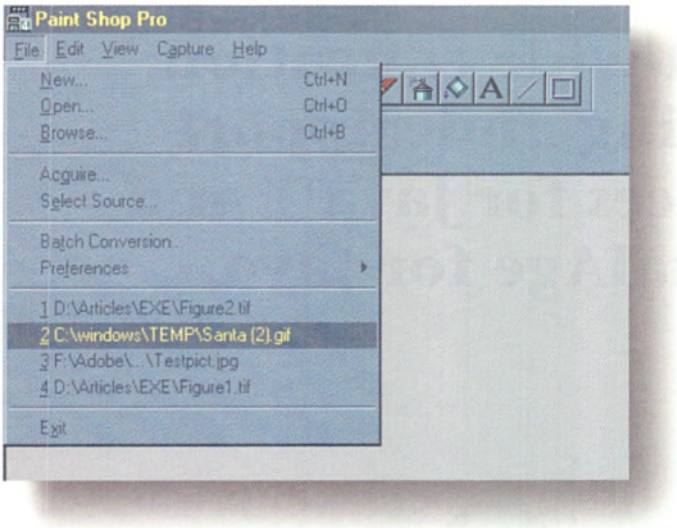


Figure 3 – Well-behaved Windows applications should always take care to remove entries from an MRU list when it becomes obvious that those entries are no longer valid, the classical case being a recently opened file that no longer exists.

advisable to close the list and reopen it immediately after calling `DelMRUString`.

The final two MRU routines are `FindMRUString` and `FindMRUData`:

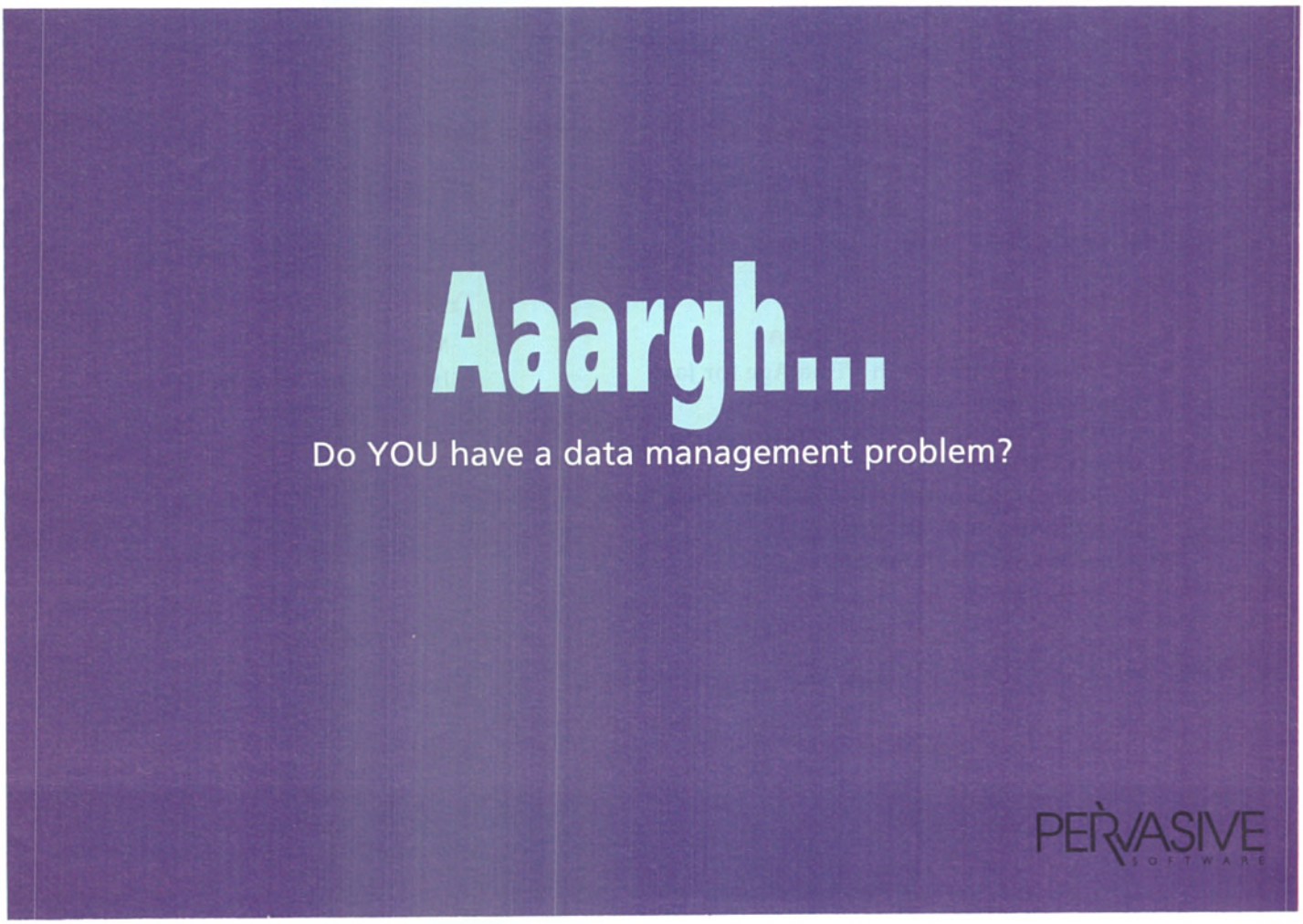
```
function FindMRUString (hMRUList: THandle;
                        szString: PChar;
                        var PhysIndex: Integer):
                              Integer; stdcall;
external 'comctl32.dll' index 155;

function FindMRUData (hMRUList: THandle;
                      Data: Pointer;
                      DataSize: Integer;
                      var PhysIndex: Integer):
                              Integer; stdcall;
external 'comctl32.dll' index 169;
```

You can use these two routines to search for specific entries in both string lists and binary lists respectively. In order to use these routines, you've got to know what string or binary data it is that you're looking for. And the only information you can get back is the logical position in the MRU list (returned as the function result: a value of –1 is returned if the specified item wasn't found) or the physical index into the registry sub-tree (returned via the `PhysIndex` argument). My use of Pascal `var` parameters rather hides the fact that `PhysIndex` is just a pointer to an integer, and you're at liberty to set this parameter to `Nil` if you're not interested in the physical index information.

The `FindMRUString` routine takes a straight pointer to the wanted string, whereas `FindMRUData` takes a pointer to the binary data and a count parameter to indicate how many bytes of data are valid. The Unicode equivalent of `FindMRUString` exists in the NT version of the `COMCTL32` library with an ordinal number of 402.

Again, one's got to ask why you'd want to use these routines? Well, it depends very much how a particular application is written.



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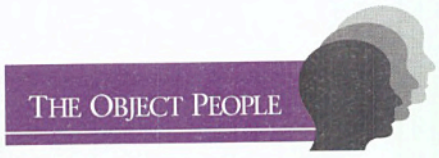

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On the one hand, Microsoft maintains that it doesn't create undocumented APIs for the use of its application developers. On the other hand, the MRU list API is a perfect example of just such an undocumented, general-purpose interface.

Given the need to delete a specific item from an MRU list upon discovering that the file no longer exists, and given that the `DelMRUString` routine takes a logical index, we obviously need to map a filename onto a logical index. I guess that's why the designer of this code provided the `FindMRU`*XXX* functionality. However, it goes without saying that this reverse mapping is essentially redundant since the logical index was used to obtain the filename in the first place – as per my example code fragment in Listing 1. Perhaps all one can infer from the existence of `FindMRUString` and `FindMRUData` is that maybe Microsoft's Explorer code isn't as well structured as it might be...

The $64,000 question

In this article, I've described the interface to an undocumented, but general-purpose MRU list API embedded within the COMCTL32 library, and used by the Windows shell, otherwise known as Explorer. The usefulness of these MRU routines is debatable: if you're a C++ programmer using MFC, then it wouldn't take long to knock up your own MRU class that provides superior functionality to the COMCTL32 code I've discussed above. Equally, if you're a Delphi developer, it would take very little time to create a generalised 'history manager' somewhat along the lines of the one that Borland/Inprise created for internal use within the Delphi IDE.

But to me, the most interesting thing about these routines is their very existence. On the one hand, Microsoft maintains that it doesn't create undocumented APIs for the use of its application developers. On the other hand, the MRU list API is a perfect example of just such an undocumented, general-purpose interface.

The $64,000 question, of course, is: does any other Microsoft code besides Explorer make use of this undocumented API? If the answer is yes, then this does some harm to the company's claim that it doesn't create undocumented APIs for its own use. If the answer is no, then Microsoft should at least endeavour to implement Explorer in a more seamless manner that doesn't leave quite so much underwear showing. ■

Dave Jewell is a freelance consultant, programmer, and technical author specialising in low-level systems programming under Windows and DOS. He is the author of Instant Delphi *published by Wrox Press. You can contact Dave at Dave@HexManiac.com.*

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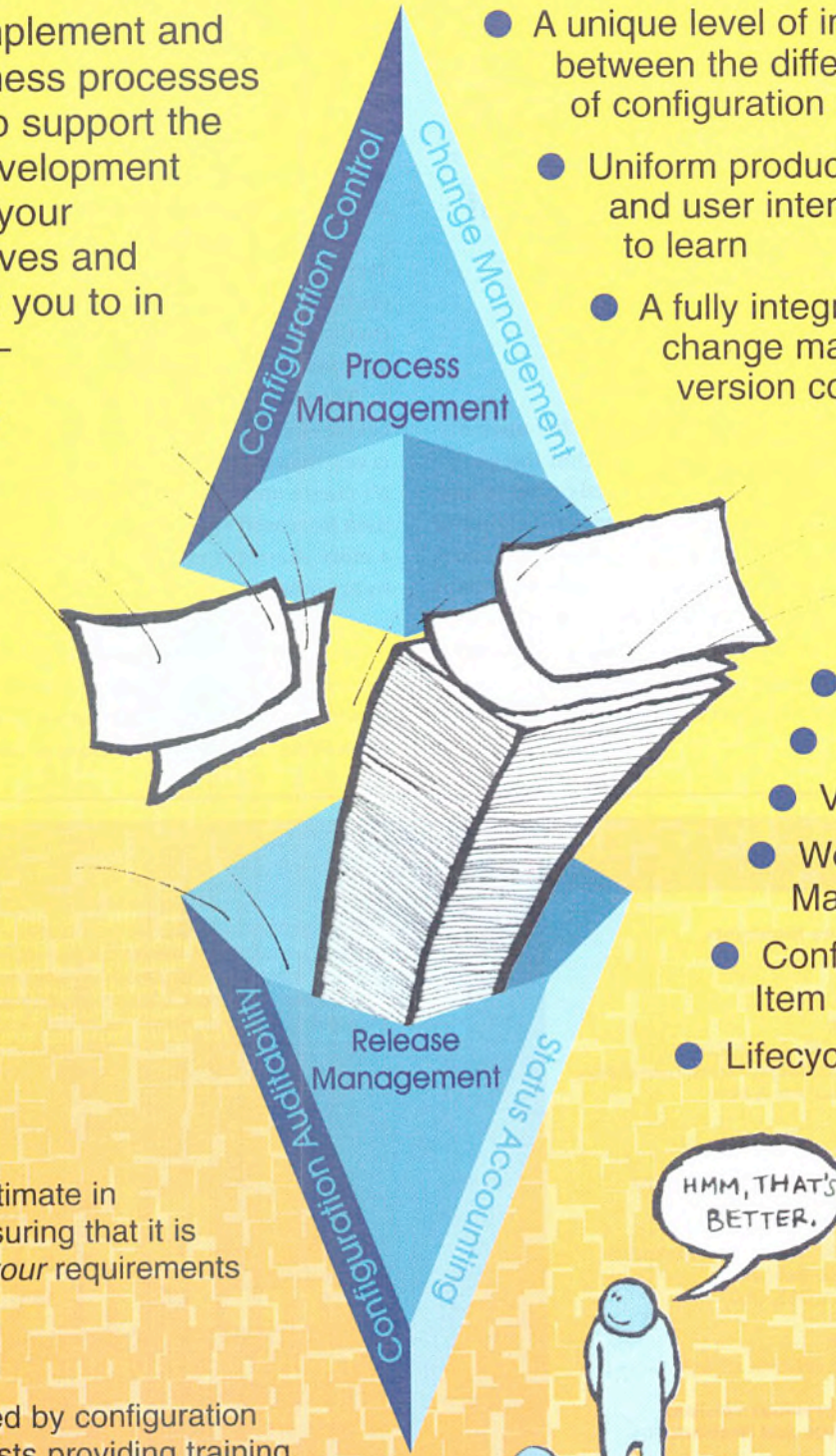

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Virtually assured destruction

Francis Glassborow looks at the handling of virtual destructors, and ponders about the trust put into computers and programmers.

A common piece of advice handed out in books on C++ is that every class that has a virtual member should have a virtual destructor. Based on this we have a common idiom for abstract base classes, which is to make the destructor a pure virtual member.

This idiom is rather odd because, unlike any other pure virtual function, we must provide an implementation. (We always have an option to provide implementations of pure virtual functions, though we will still have to provide another implementation in any derived class if it is not to remain abstract.) The reason we must provide an implementation even for a pure virtual destructor is that every class must have a destructor. When the destructor of a derived class is called it exits via its base class destructor.

Almost any attempt to destroy an object other than by calling its own destructor results in undefined behaviour. That means we must be careful in polymorphic hierarchies to ensure that the correct destructor is used.

When we write base classes we can have at least two different motives. The first is to provide a mould from which we can derive objects that are all sub-types of the base. This is the conventional 'is a' relationship with which many are familiar.

The second is when we are writing a 'mixin' type. Here we are not intending to provide a complete type, just an add-on extra. This extra is usually a pure interface that will be implemented in the derived class. For example:

```
class Chesspiece {
// provide an interface and common data structure for
// chess pieces
virtual ~Chesspiece = 0;
};
inline Chesspiece::~Chesspiece(){};
struct Persistent {
virtual bool writeTo(ostream &)throw() = 0;
virtual bool readFrom(istream &)throw() = 0;
// but what kind of destructor?
};
```

We can now create a persistent chess piece with:

```
class PersistentChesspiece
   : public Chesspiece
   , virtual public Persistent {
// whatever
};
```

To appreciate mixins you need to understand the benefits of using interfaces. Instances of types that inherit from `Persistent` can be identified at runtime by use of a `dynamic_cast<>` and will support the specified interface. It is usually correct to use virtual inheritance for interface types.

The problem is that the destructor of `Persistent` is part of the interface. The standard idiom is to provide a virtual destructor for `Persistent`. This is simplistic because most people would agree that it is conceptually wrong to destroy an object via such an interface. What we want is a mechanism that will prevent destruction via a `Persistent*` while allowing us to use a `Persistent*` to access the `public` interface.

Once our needs are specified like that, we may see the solution: use `protected` access. Consider:

```
struct Persistent {
   virtual bool writeTo(ostream &)throw() =0;
   virtual bool readFrom(istream &)throw() = 0;
protected:
   ~Persistent(){}
};
```

Note that we have no need to make the destructor a virtual member because it can never be called from outside, but only as a result of the destruction of an instance of a derived type.

When your base class includes virtual members, decide whether you ever want derived objects destroyed through pointers to the base class. If the answer is 'yes', you will need to define a `virtual public` destructor. If the answer is 'no' you still need to define a destructor, but this time with `protected` access.

ACCU Spring Seminars & Embedded Programming conference

Two events you might be interested in will take place at the Oxford Union in mid-April. On Friday April the 16th there will be a one-day Embedded Programming conference. Currently the speaker list includes such authorities as Professor Stephen Furber of Manchester University, Roger Barnett of Real Objects, and Dominic Sweetman of Algorithmics. On Saturday April the 17th the Association of C & C++ Users will be holding its first Spring Seminars day. ACCU hopes this will become an annual event. Bjarne Stroustrup will be providing a keynote: 'What is an Object, and What is Not'. This will be followed by seminars for C, C++, and Java developers. At the time of writing we have not tied down the complete program, however, the C++ seminars will be presented by Michael Ball and Stephen Clamage who together write the C++ Oracle column in *C++ Report*. The seminars for the three languages will be held in parallel so attendees will have to choose. The formal part of the day will finish with an endnote from me entitled 'The Benefits of Being Multi-lingual'.

For more details of these events check with Parkway Research (01491 875386) or visit either *www.accu.org* or *www.parkway.co.uk*.

My December column

I know I have quite a few very astute readers so when I arranged for the following code to appear I expected a fairly large amount of email:

```
int main(){
   char * strings [10] = "List";
/* other code */
   return 0;
}
```

But apparently those that spotted the problem decided not to say anything. If you are still mystified, remember that `"List"` might initialise either an array of `char` or a `char*` but not an array of `char*`. That definition should have been: `char *strings [10] = {"List"};`

This is an example of a widespread general problem in the software development industry: the failure to identify and correct published errors. Most of us have at one time or another wasted many hours trying to make a piece of 'expert' code work. We blame everything from the compiler producer onwards when in truth it is the ineptitude or carelessness of the author of the code. I have seen many hours wasted in argument about perfectly correct code, while blatantly silly code goes unremarked upon. I even see people advocate that the relevant language standard be changed to make their erroneous code work reliably.

The malaise is deeply rooted in the computer culture. Let me take a little space to relate an episode from almost twenty years ago that highlights this misplaced respect for computers and their priestly hierarchy.

An Oxford University-based research group was in the middle of a five-year project when the University Computing Labs replaced their mainframe. As a result, the software the group had been using had to be recompiled for the new machine. Greatly to the annoyance of the researchers, the attempt to recompile resulted in errors.

They took the source code to the programming department with a request that they fix it. When the programmers saw the code and the errors they apologetically informed the researchers that the program should never have compiled and that the results it had been generating for the previous three years were garbage.

What deeply shocked the programmers was the instruction from the research group that they should fix the program so that it worked exactly as it had before. In vain they tried to get across the concept that the results were meaningless. The research group was adamant that they wanted it to 'work' the same way as before.

You can understand that I am sometimes a little cynical about results published by research groups. I am also annoyed by those who want to throw all the blame on programmers. Some people get what they deserve.

Prize competition result

At the time of writing this column there are still eleven days to run before I pick a winner. However, I am disappointed by the lack of entries (one) to date. The problem is subtle but it has recently been discussed in some detail in the `comp.std.c` and `comp.lang.c.moderated` newsgroups on the Internet. The lack of response suggests that the overlap between the readership of EXE and those newsgroups is very small. I find this disappointing. The Internet is a great information resource, but only for those who use it.

James Barry won a copy of Matthew Austern's 'Generic Programming and the STL'. – Ed

Last 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");
```

This should output 'false'. Note that you are always entitled to compare pointers of the same type for equality. In this case, the type of `iarray` decays from pointer to array of four ints to pointer to `int`. This is one of very few allowed automatic pointer conversions and so the line does not generate a compile-time error.

```
  (iarray+4 == &j)? puts("true"): puts("false");
```

Again, the comparison is allowed, but this time the answer is implementation dependent though some claim it should always be 'false'. The point in question is whether the address of one past the end of an array can also be the address of an adjacent object. Technically, we could have a more complicated pointer that not only provides a conventional address but also identifies the complete object to which it belongs. For example, pointers could be composed of the address of the start of a complete object and the offset of the sub-object concerned. No current compiler does that (except for a couple of specialist debugging compilers). Unless the pointer includes information about the object as well as the exact element, there is no way that an executable could generally distinguish an address of one past the end of an array from the address of the next object if they are in contiguous memory. Most people would be a little upset if objects were buffered with unused space. The result is that you will get 'true' from many implementations and I can find nothing to worry about in that.

```
  for(j=0; j<4; ++j) printf("%d\n", data.a[j]);
  printf("%f\n", data.d);
```

This one is nasty. You wrote four `int`s to the `union` and are now trying to read a `double`. Most people will (if they think about it) explain that this will produce undefined behaviour. And so it should, because on some platforms specific bit patterns represent trap values for doubles. Unfortunately, the C Standard requires that it be implementation-defined behaviour. There is no reasonable way that an implementor can comply with that. With regret, it seems C9X will continue to make this unreasonable demand (on the basis that no one has complained).

```
  data.d=5.123;
  for(j=0; j<4; ++j) printf("%d\n", data.a[j]);
```

We have now written the data as a `double` and we are trying to read it as `int`s. Generally, this will work because trap values are not a normal characteristic of the representation of ints. However, the behaviour is still implementation-defined.

There is an exception to this: if we were to have used an array of `unsigned char`. Under those circumstances, we should always be able to read the data. However, that does not mean that we should always be able to write an array of char and read it as something else. Again, we should be bound by implementation-defined behaviour even though this is impractical.

```
  printf("%f\n", data.d);
  return 0;
}
```

This month's problem

While browsing through some code I came across the following:

```
Mytype a(0), b(2), c(3);
bool test = a || b && c;
```

What do I need to check in order to understand the significance of the second line and what side effects may result from its execution? ■

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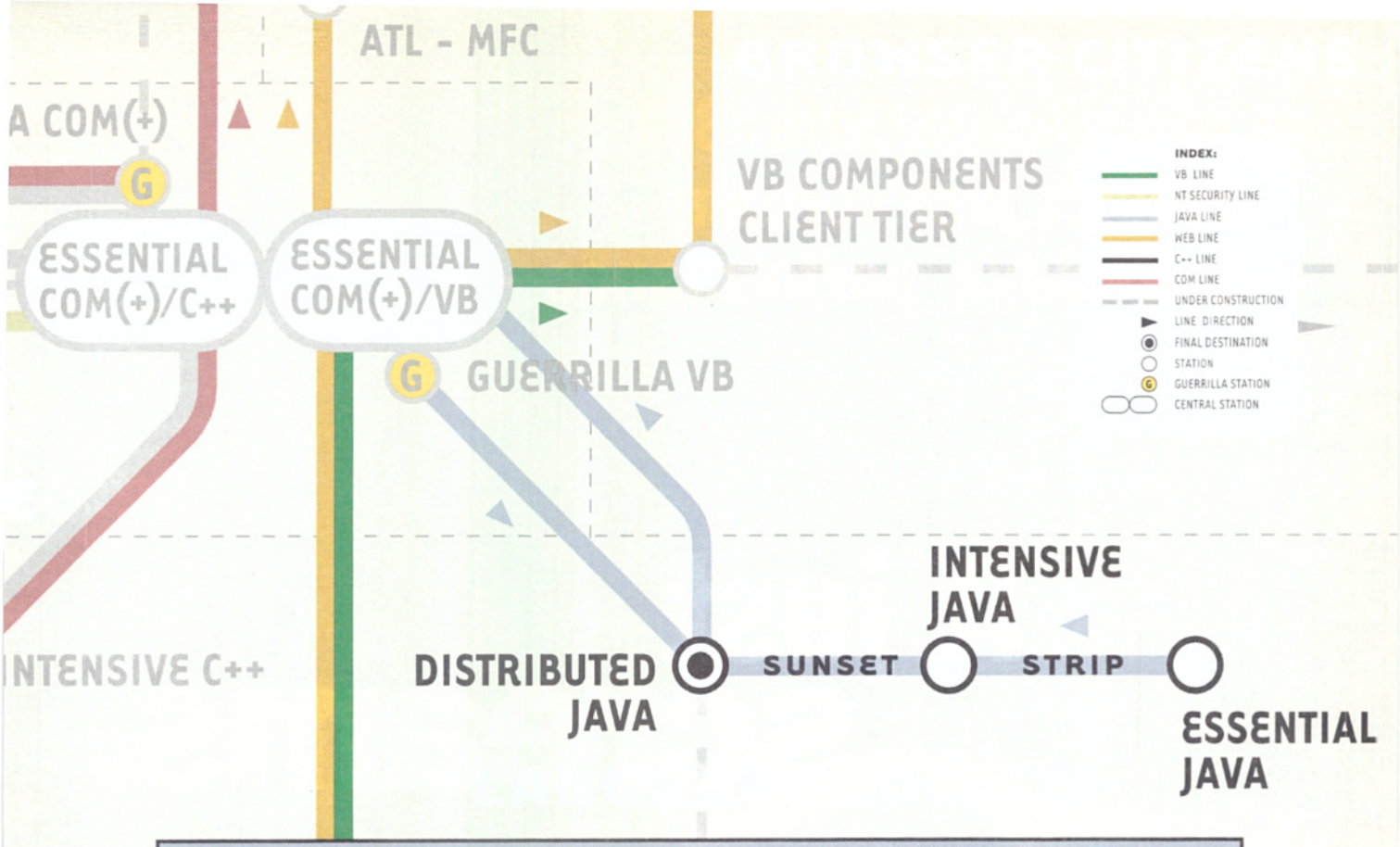

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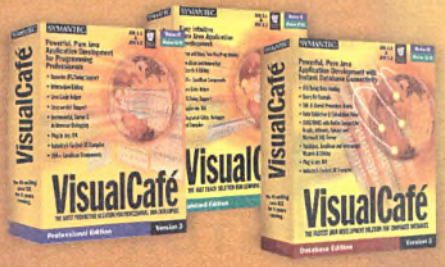

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Freeware from the East

MemProof, for leak detection, and GpProfile, for performance evaluation, are freeware Delphi tools. Mark Smith finds them well worth checking out.

In January 1998, Will Watts enthused about the numerous free and cheap resources that make Delphi programming so much fun (*Spirit of Delphi*). In that article he mentioned the RxLib library of components produced by a small team of programmers from Moscow. It seems that the former Eastern Bloc must be teeming with talented Delphi programmers, because a number of other excellent Delphi tools from Russia and its former satellites have appeared or reached maturity in the last year.

This month, I want to look at two Delphi tools that I now rate as being an indispensable part of my Delphi toolkit. MemProof 0.9 is a memory leak and error detector by Atanas Stoyanov, a Bulgarian currently working for a US company, while GpProfile 1.1.0 is a runtime-performance evaluator by Primoz Gabrijelcic from Ljubljana, Slovenia. At the time of writing, both of these tools are available free of charge, though Stoyanov has suggested that he will distribute the next major release of MemProof on a shareware basis while providing the current version as a free download. Both tools provide excellent support for multi-threaded applications and DLLs.

MemProof

MemProof detects leaks in your applications. Given enough debugging information, it can pinpoint the actual line in your source where the allocation occurs in Delphi, C++Builder, and Borland C++ 5 applications. As well as tracking memory leaks, MemProof spots invalid frees, freeing of nil pointers, and memory overwrites. It also tracks your application's use of the more common Windows resources such as fonts, palettes, the registry, and so forth. Uniquely, this includes resource allocations from the BDE and ODBC, so you can see how many tables you have open, what their names are, and where they were allocated while your program is running.

MemProof needs a lot of debugging information to work at its best. You need to turn on stack frames and debug information, turn off optimisation, include Turbo Debugger information, and use the stack frame-enabled copy of the VCL binaries. These are installed in the *\Slib* subdirectory in your Delphi installation, and you use them by adding *$(Delphi)\Slib;* to the front of the library path, an environment option rather than a project one. If you have the VCL source, you can add the VCL source path to your project's search path, which allows MemProof to include information about the VCL in its reports. Once you have done all that, you need to close Delphi and re-open it to get the SLIB option to take effect, and then do a full rebuild. Obviously, you need to reverse all of the compiler and linker options when it comes to releasing your application. This brings me back to one of my pet peeves about Delphi: if anyone in Scotts Valley is reading, can we have build profiles allowing us to have debug and release builds like C++Builder has, please?

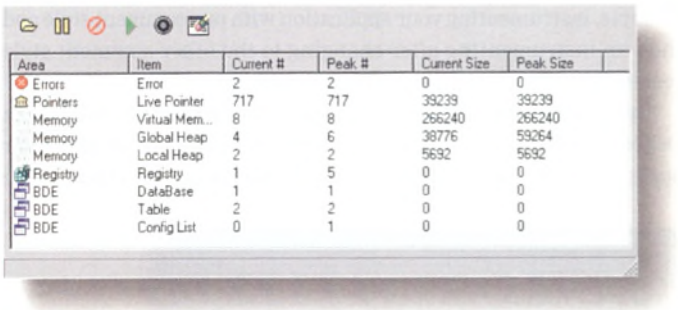
Debugging

Once you have set up and rebuilt your application you load it into MemProof and run it. The main window, shown in Figure 1, gives a real-time summary of your application's use and misuse of memory and other resources such as fonts, palettes, and threads. Figure 2 shows the Resource View, which appears when you close your application giving the details of what went wrong, and where. The three panes show what the resource loss was, where in the code it occurred, and the stack trace leading to the code. Obviously, it can only show you where the memory was allocated – you have to work out when you should have freed it, but that's what you're paid for after all.

Resource leaks are as important as memory leaks, and MemProof provides excellent reports for the most common resources divided into fourteen categories, such as BDE, Kernel, or Registry, which you can choose to trace or not. Within half of the categories, you can check for usage of specific resources, such as checking for `TTable` resources not being freed within the BDE resource tracker. If you are concerned that your program is using up a particular kind of resource, then you can debug for just that one, which is substantially quicker than tracking all resource types.

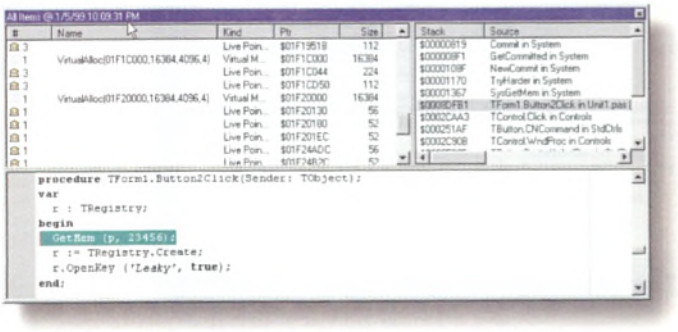
MemProof has several options to help you do a full test of your application, including the ability to stress your application by limiting the number of resources available. As a convenience, you can also specify how many Library Resource Allocations are to be ignored before MemProof starts recording. Normally, this is set to 400, which allows MemProof to ignore allocations made by the runtime library before your code starts executing.

When debugging large applications, execution slows right down. I have used MemProof on a 140,000 line database application, and with all MemProof options turned on it was painfully slow on a 128 MB Pentium 400, though just about testable. Fortunately, you can leave resource tracking switched off until you reach the point in your appli-



Area	Item	Current #	Peak #	Current Size	Peak Size
Errors	Error	2	2	0	0
Pointers	Live Pointer	717	717	39239	39239
Memory	Virtual Mem...	8	8	266240	266240
Memory	Global Heap	4	6	38776	59264
Memory	Local Heap	2	2	5692	5692
Registry	Registry	1	5	0	0
BDE	DataBase	1	1	0	0
BDE	Table	2	2	0	0
BDE	Config List	0	1	0	0

Figure 1 – MemProof main screen.



```
procedure TForm1.Button2Click(Sender: TObject);
var
  r : TRegistry;
begin
  GetMem (p, 23456);
  r := TRegistry.Create;
  r.OpenKey ('Leaky', true);
end;
```

Figure 2 – MemProof Resource View.

cation that you want to check and then switch it on. This improves matters considerably, but remember to reduce the Library Resource Allocations down to zero when doing this, otherwise you won't see anything as MemProof will ignore the first 400 allocations.

One of the cool features of MemProof is the way that it can be driven from your debugged application if you begin an `OutputDebugString` message with 'MEMPROOF:' followed by the name of one of 18 commands. The commands include options to both run and stop MemProof debugging, so, eg you could call 'MEMPROOF:ResourceTracking' prior to calling the constructor of a class you want to debug, and call 'MEMPROOF:SnapshotAllResources' in its destructor, just giving you detailed debugging of what happens while there is an instance of that class active. MemProof can optionally send information about stray memory allocations to CodeSite, another debugging tool from Raize Software.

In terms of web presence and support, Atanas Stoyanov maintains a pretty comprehensive website, on which he lists the memory leaks in the Delphi 3 and 4 VCL, as well as those in Quick Reports 2.0. There are a few examples showing how to add hooks for resources not already traced, so you could write extensions for monitoring MAPI resources that are not supported by MemProof, for example. I asked Stoyanov a number of questions and all were replied to within a couple of days.

GpProfile

Once you have all the leaks out of your application, the next issue is often one of performance. GpProfile reports how frequently procedures and methods get called, and how long they take to execute. It does this by modifying your code; inserting calls to procedures that use the `QueryPerformanceCounter` windows API call to obtain an accurate measure of how long a procedure takes to execute.

Since GpProfile modifies your code, you need to make sure you have an archived copy of your source. It can remove the lines added during instrumentation, though the author makes it clear that he should not be held responsible if you lose any code. I've run GpProfile against a couple of projects of 70,000 and 100,000 lines with no problems that I didn't cause while trying to break it for this article. For example, instrumenting your application with one comment style and then un-instrumenting after changing to the other comment style results in begin/end blocks becoming mangled.

GpProfile is very easy to use. It installs itself into the Tools menu in Delphi, and that's the best place to run it from. You need to compile your application before beginning GpProfile so that Delphi provides a value

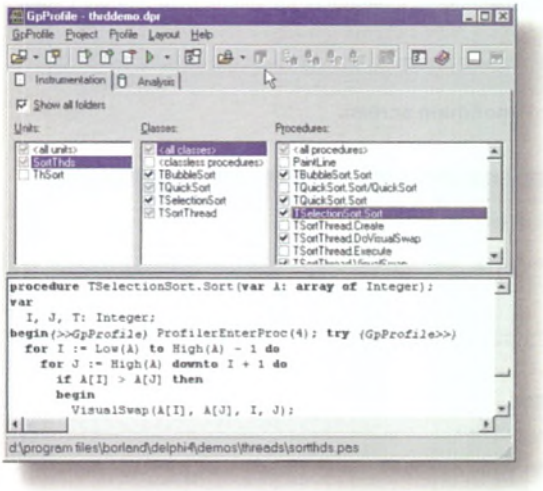


Figure 3 – GpProfile Instrumentation tab.

URLs

MemProof	http://www.nidlink.com/~astoyanov/index.htm
GpProfile	http://www.eccentrica.org/gabr/gpprofile/gpprofile.htm

for the `$EXENAME` used as a parameter for `GPPROF.EXE`. GpProfile loads up your Delphi project and parses all your code. It then presents a listing of all your units, classes, and procedures on one of two tabs, as shown in Figure 3. You can either instrument an entire application, all classes and procedures in a module, all methods of a class, or pick individual procedures and methods. Once you have selected the procedures you want to profile, you click the Instrument button and flip back to Delphi, which will tell you that some modules have changed, if you had modules you chose to profile open in the Delphi editor. I found I needed to add the `GPPROF.PAS` and `GPPROFH.PAS` modules provided with the GPPROF executable into the project. You can either do this or add their location to the library path. These modules contain the code and constants required to extract performance information from your application.

After this, just run your application from within Delphi as normal. When you close your application down, GpProfile comes to the front and shows you what your program spent its time doing on the other of the two tabs in the application window. It is tempting to choose to profile everything, but doing so means you end up profiling the user interface part of your application, which is often not what you want. Functions that interact with the user will be deemed to be slow and cloud up where your program is really spending all the important clock cycles. You can save all of your profiling settings and actual readings to disk for later use, so you can come up with some ideas about how to speed things up and then try them out days later.

As part of the instrumentation process, every piece of code you pick is modified. Generally, you shouldn't need to look at the instrumented source, since the GpProfile application does such a good job of preparing your application for profiling and then removing the inserted code afterwards.

Since you get the source for GpProfile under the terms of the GNU General Public Licence, you can in theory fix bugs yourself, though the product has advanced a lot in the two months since I started using it, which demonstrates the author's commitment. With the most recent release (1.1.0), the help file has improved considerably. There is a very useful tutorial section showing how to set up profiling and how to interpret the results. Primoz Gabrijelcic maintains a useful website that also hosts components by other Delphi experts. The source code for GpProfile is itself worth a look, since it is a good example of how to use Martin Waldenburg's TmwPasLex Delphi source code parser. Again, in preparing this review, I emailed the author with a few requests for clarification and got replies back in a timely manner.

The quality of error checking is not strained

It took me a while before I was comfortable with what MemProof was telling me about my code – what memory allocations I could safely ignore, which ones were 'sometime' tasks, and which ones I needed to fix ASAP, but after using it for a few days, I'm happy I took the time. The same goes for GpProfile. Both tools have features I haven't mentioned – the best thing you can do is download them and try them out on your application. I'm sure you won't be disappointed. ■

Mark Smith is a Delphi contractor, currently working for an investment company based in Westminster. You can contact him by emailing EXE ONLINE *msmitha@cix.co.uk, or say hello at a Borland User's Group meeting. Telephone 01980 630032 for BUG details.*

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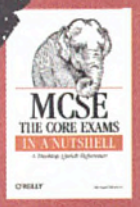

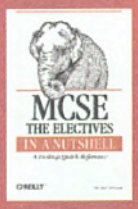

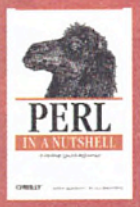

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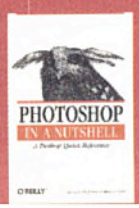

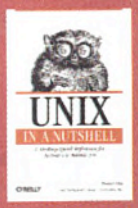

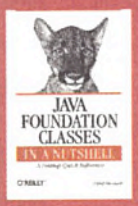

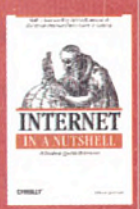

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JNI – going native

Tom Guinther shows how to employ the Java Native Interface

The Java Native Interface (JNI) is a central aspect of the Java Virtual Machine (JVM), acting as a link between Java code and native implementations. Its usefulness is often overshadowed and undermined by the worthy concept of Pure Java, and until recently a lack of compatibility with a certain well-known virtual machine. Although we spent the better part of 1998 digging up bones in the dank, dark recesses of political-skeleton closets, and trying to find a little relief from the stomach churning gyrations of world stock markets, there is one event that stands out as a clear, bipartisan victory for Java programmers. On 17 November 1998, a U.S. Federal District Court Judge issued a preliminary injunction requiring Microsoft to support JNI in the Microsoft Java Virtual Machine. On 7 December 1998, Microsoft, complying with the order, released a new version of its JVM with JNI support. All in all, the ruling and compliance has created a win-win for everyone involved, especially Java programmers.

One question that is frequently asked is why is JNI so important, especially considering that Pure Java has become the mantra of millions? The easy answer is that if a Pure Java solution works for you, then don't give JNI another thought. Why introduce unnecessary issues and headaches when a simple straightforward Java-only approach will suffice? This answer naturally leads to a second question. If JNI introduces issues and headaches, why consider using it under any circumstance?

The answer to that question is part philosophical and part practical. The philosophical part of the answer is that any real-world problem involves issues, headaches, and design and implementation dilemmas. The practical part of the answer is simply a matter of tradeoffs. In many cases, JNI can solve more problems than it introduces and in some cases it is the only viable solution. The short list of areas where JNI can be an effective tool is: removing performance bottlenecks, interfacing to existing non-Java software, and allowing access to platform-specific features not directly accessible from Pure Java code.

The performance benefits of Java versus native code are hotly debated, especially given that advances in Just-In-Time (JIT) compilers are delivering high performance Java applications that rival native C++ code (or surpass it). Still, if I had to sort 5,000 strings I would prefer to guarantee a certain performance level and would implement a JNI method to perform a Quick Sort.

The second and third benefits of JNI (integrating with non-Java code) are where JNI truly becomes the implementation of choice because you don't have many other options. When you need to interface to an existing native implementation you have three basic choices, JNI, Raw Native Interface (RNI), and J/Direct. RNI and J/Direct are both Microsoft-specific and with all probability will remain so. It is only now that we have one clear solution that will work on all major virtual machines, and that solution is of course JNI.

JNI basics

Conceptually, JNI is a bridge that spans the gulf between Java code, the JVM, and the world that exists beyond the virtual machine, often referred to as the operating system or platform. Because the JVM provides an environment independent of the underlying platform the internal representation of types and data structures can be quite alien to native code. Not to be understated, the JVM also implements its own private policies for memory, thread, and resource management. These areas play an important role in any JVM and it is crucial that native code respects and works in harmony with these policies. JNI provides a variety of methods that allow native code to interact at a simple, superficial level, or to integrate seamlessly with the inner workings of the VM itself.

Creating a JNI method in a Java class is as simple as defining a method using the `native` keyword. This informs the JVM to link the method to an external, native code implementation. The actual binary file that provides the implementation is specified (somewhat indirectly) by calling the `System.loadLibrary` method in the static initialiser that is executed when the class is loaded by the VM. The following Java class illustrates the basic principles.

```
package foopkg ;
public class foo {
   public native void fool(int i) ;
   // class static initializer
   { System.loadLibrary("foo") ; }
}
```

The `foo.fool()` routine is a native method that the JVM needs to link it to its native implementation. The class also contains a static initialiser that loads a native binary file named `foo`. Presumably, the binary file `foo` contains the implementation for `foo.fool()`. In actuality the implementation of `foo.fool()` could come from any library previously loaded by the specific class loader that loaded class `foo`. Each class loader maintains a list of libraries that have been loaded and searches through them to match the implementation for a method. There is the possibility of a name conflict, but under normal circumstances this is improbable because JNI uses a standard name mangling technique to identify methods uniquely. One binary implementation can provide support for any number of classes.

The name-mangling algorithm is relatively straightforward. It combines the literal value 'Java' with the package name (if any), the name

```
/* DO NOT EDIT THIS FILE - it is machine generated */
#include <jni.h>
/* Header for class foopkg_foo */

#ifndef _Included_foopkg_foo
#define _Included_foopkg_foo
#ifdef __cplusplus
extern "C" {
#endif
/*
 * Class:     foopkg_foo
 * Method:    fool
 * Signature: (I)V
 */
JNIEXPORT void JNICALL Java_foopkg_foo_fool__I
  (JNIEnv *, jobject, jint);

/*
 * Class:     foopkg_foo
 * Method:    fool
 * Signature: (J)V
 */
JNIEXPORT void JNICALL Java_foopkg_foo_fool__J
  (JNIEnv *, jobject, jlong);

#ifdef __cplusplus
}
#endif
#endif
```

Listing 1 – A C/C++ header file with prototypes for JNI methods.

of the class, the name of the method, and if the method is overloaded, the type signature of the methods arguments. Each component of the name is separated by underscores:

```
Java_[packagename_]ClassName_MethodName[__ArgSignature]
```

From the example class `foo`, the short name of the JNI method name for `foo.foo1()` is `Java_foopkg_foo_foo1`, and the long name is `Java_foopkg_foo_foo1__I`. The JVM looks for a native method using the short form and if a match is not found, it searches for the long form (ie a name that includes the argument signature). The format for encoding the argument signature is complicated by the fact that normal Java type signatures use special characters such as '[' and ';'. You don't need to worry about the specific details of name mangling because the `javah` tool provided by the JDK, used to convert a Java class to a useable C/C++ header file, performs this step automatically.

Once you have completed and compiled the Java class definition you'll need to run the javah tool to create a C/C++ header file that contains prototypes for each JNI method defined in the class. For class `foo`, I added an overloaded version of `foo1()` that accepts a `long` as the first parameter, and ran `javah` to produce the header file in Listing 1. The command line used to execute `javah` was:

```
javah -jni -classpath \jdk1.1.7\lib\classes.zip;.\; foopkg.foo.
```

The `-jni` switch is used to produce the function prototypes for the native methods.

Once you've generated the header file, the next step is to cut and paste the function prototypes into a C/C++ source file, add the body of each function, then compile and test. It is important to note that the native implementation needs to reside somewhere upon the system path, otherwise the JVM won't be able to find it and throws an `UnsatisfiedLinkError`. A second point to remember is that anytime you make a change to the Java class you should regenerate the header file in case there are changes that affect the native code. The best approach is to modify your project to include build procedures that ensure that these important steps happen automatically.

The native implementation

If you look closely at the native function prototypes generated by `javah`, you'll see that each method receives a pointer to an array of JNI interface pointers (`JNIEnv *`). The JNI interface pointer provides access to the methods defined by JNI. You'll use it a lot because it is the only way to access the fields and methods of Java objects.

The second parameter differs depending upon whether the routine is a class method (ie static) or non-static. Class methods don't execute in the context of an object instance, so they receive a `jclass`. This is a reference to the Java class object that defines the method. Non-static methods receive a `jobject` as the second parameter. A `jobject` is a JNI type that represents the Java object for which the native method was invoked and is equivalent to the `this` pointer. Any subsequent arguments to the native method are the JNI mappings of the original Java method arguments. All the JNI types mentioned are defined in `JNI.H`, which is included with JDK 1.1 and later.

```
package foopkg ;
public class foo {
   private int fooValue = -234 ;

   public native static int getJNIVersion() ;
   public native Class getObjectClass() ;
   public native int getFooValue() ;

   public static void main(String args[]) {
      foo aFoo = new foo() ;
      int jniVersion = foo.getJNIVersion() ;
      Class fooClass = aFoo.getObjectClass() ;
      System.out.println("The JNI version # is " +
         (jniVersion >> 16) + '.' +
         (jniVersion & 0xFFFF)) ;
      System.out.println("The class type for object aFoo is " +
         fooClass.getName()) ;
      System.out.println("The current foo value is: " +
         aFoo.getFooValue()) ;
   }

   // class static initializer
   { System.loadLibrary("foo") ; }
}
```

Listing 2 – The long way around to retrieving the value.

```
// C++ native implementation for class foopkg.foo
#include "foopkg_foo.h"

// Class: foopkg_foo, Method: getJNIVersion, Signature: ()I
JNIEXPORT jint JNICALL Java_foopkg_foo_getJNIVersion
  (JNIEnv *pEnv, jclass fooClass) {
   return pEnv->GetVersion() ;
}

// Class: foopkg_foo, Method: getObjectClass, Signature:
()Ljava/lang/Class;
JNIEXPORT jclass JNICALL Java_foopkg_foo_getObjectClass
  (JNIEnv *pEnv, jobject aFoo) {
   return pEnv->GetObjectClass(aFoo) ;
}

// Class:     foopkg_foo, Method:    getFooValue, Signature: ()I
JNIEXPORT jint JNICALL Java_foopkg_foo_getFooValue
  (JNIEnv *pEnv, jobject aFoo) {
   jclass aFooClass = pEnv->GetObjectClass(aFoo) ;
   jfieldID getValueId = pEnv->GetFieldID(aFooClass,"fooValue","I") ;
   return pEnv->GetIntField(aFoo,getValueId) ;
}
```

Listing 3 – A more involved C++ native implementation.

In order to make the sample application slightly more interesting, as well as to illustrate a few basic points, a newer version of class `foo` is in Listing 2. You'll notice that it has three native methods, one of which, `getJNIVersion()`, is static. The second method `getObjectClass()` returns a reference to a Java object representing class `foo`, and the third method, `getFooValue()`, takes the long way around to retrieving the value of the private variable `fooValue`.

The native implementation is straightforward (see Listing 3). Using the Java interface pointer (referred to as `pEnv`) is as simple as indirecting the function you want to call. One important difference between the C++ implementation and a C language implementation is that you don't need to pass the `pEnv` pointer as the first argument to each JNI method.

The implementation of `getFooValue()` illustrates the general steps required to access a field member of a Java object. It is possible to cache field and method IDs for future use. Not only is this much faster, it makes the code a lot cleaner.

Running the sample application (class `foo` defines a main function) produces the following output.

```
The JNI version # is 1.1
The class type for object aFoo is foopkg.foo
The current foo value is -234
```

The complete sample code for this column is on EXE OnLine in `foo.zip`. The foo project and workspace are for Microsoft Visual J++ 1.1 and are good illustrations of how to set up post-build steps to keep everything up to date automatically. It is fully enabled to debug either Java or the C++ native implementation.

Scratching the surface

We've barely scratched the surface of JNI so next month we'll get into the nitty gritty details of the JNI interface. Among other things, we'll take a look at exceptions, arrays, Java strings, creating Java objects, calling Java methods, synchronisation, and garbage collection. ■

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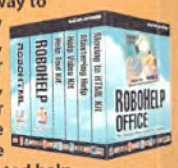

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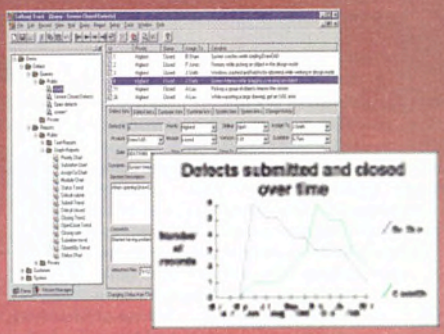

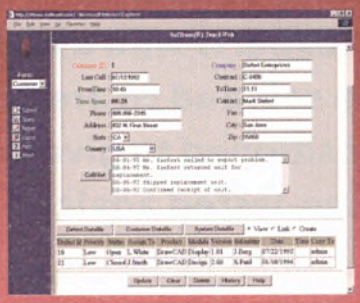

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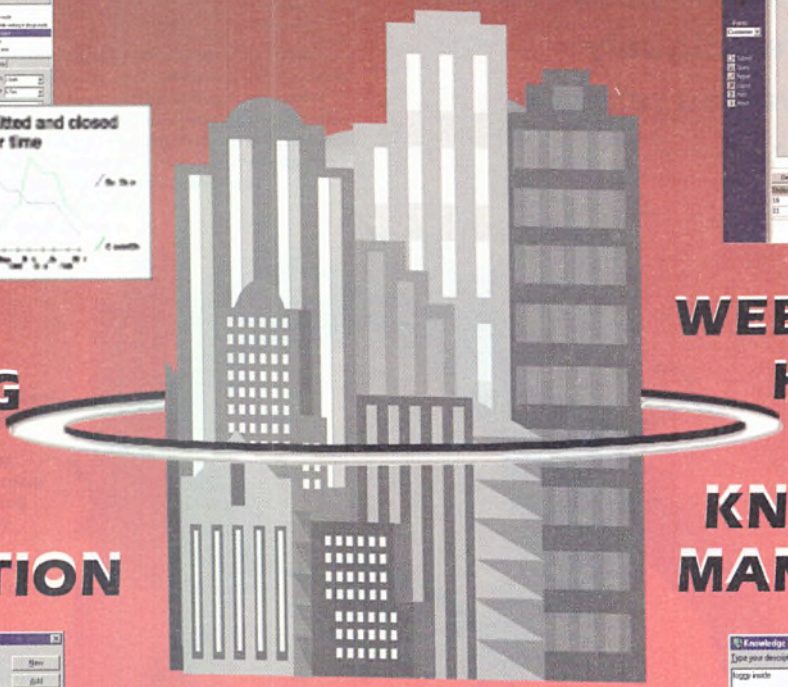

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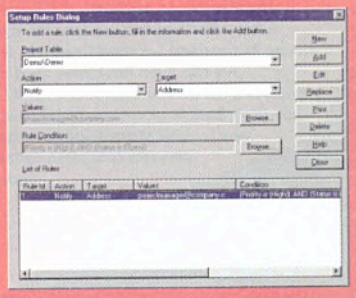

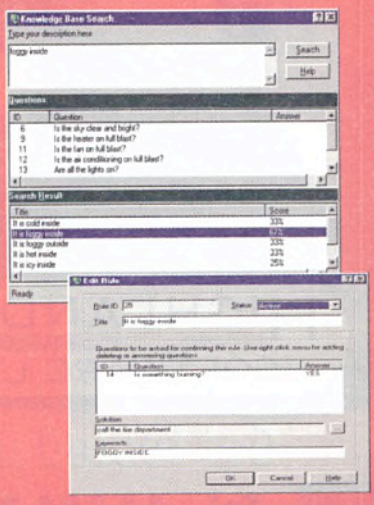

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Data Object Wizard

Jon Perkins continues his review of the new data tools in Visual Basic 6 by looking at the Data Object Wizard.

Last month I discussed the Data Environment Designer (DED), a tool that allows ADO objects to be defined graphically. Following on with this theme, I will introduce the Data Object Wizard (DOW). Whereas the DED is concerned with reducing the amount of code needed, the DOW works from the opposite principle: it actually writes the code for you.

Available only within the Enterprise edition, this tool provides two related functions. The first is to provide a Visual Basic class module that is based around a DED command object. This class module effectively acts as a data source. Once this has been defined, the wizard then allows the creation of a User Control that can be applied to a form.

Creating a data class

To explain how to use the DOW we will work through an example. Because this article follows on from last month's introduction to the DED we will again make use of the *pubs* database that is shipped with SQL Server. As a quick reminder, this database contains a simple set of book authors, titles, and publishers, and contains a rudimentary set of test data. Unfortunately, it doesn't contain a particularly well-stocked set of stored procedures. If you want to try this example yourself you will need to apply a small stored procedure creation file called `exvb0299.sql` that can be found on my website (see details at the end of this column). This file applies basic Select, Insert, Update, and Delete stored procedures (called `au_select`, `au_insert`, `au_amend`, and `au_delete` respectively) to the authors table.

To get started you should first create a new Visual Basic 6 Data Project. By default this will create a form, a Data Environment, and a Data Report. We won't be using Data Reports in this instance so it can be deleted from the project list if you prefer. Perform the following actions:

1. Double click the DataEnvironment1 item within the Project Window in order to bring up the DED. Right click on the Connection1 icon and select the Properties menu. Then, as explained in last month's article, add the necessary parameters to connect to your server, making sure that you include *pubs* as your target database.
2. Bring up the Data View window (found in the View menu). If you expand the Connection1 folder, and then the Stored Procedures folder, you should see the four additional stored procedures that were added from our `exvb0299.sql` file. Sequentially drag each of these stored procedures over to the Connection1 object in the DED. This operation highlights the difference between the two windows. The Data View window contains a snapshot (called Connection1) of the data source defined by the connection parameters, whereas the DataEnvironment window contains the working definition of our data object (also called Connection1). Incidentally, when you add the Insert, Update, and Delete stored procedures you will be asked in each case whether you actually want to execute the command. This occurs because the engine is expecting to find data returned from each procedure, which of course doesn't happen in these cases. I suggest that you choose not to run the commands, because in doing so you could actually modify the underlying data.
3. Assuming that the above steps worked okay, you can now invoke the Data Object Wizard itself, which can be found under the Add-Ins menu. After the initial introductory page you are asked whether you want either to 'create a class object to which other objects can bind data', or to create a 'user control object bound to an existing Class object'. Select the first of these options.
4. The wizard will then present you with a tree-view representation of all the DataEnvironment objects that have been created. Click on the `au_select` stored procedure; this identifies the primary means of obtaining information from the data layer (see Figure 1).
5. The next page asks which field is the primary key. Change the value of the Primary Key column for the `au_id` row from No to Yes.
6. Skip the next item – Define Lookup Table Information – for now. We'll come back to this a little later.
7. The next three pages ask which stored procedures are to be used to insert, update, and delete data. This is where we select the remaining three custom stored procedures that we added earlier.
8. The final data-gathering page asks you what name you would like to give to the class. Enter `Publishers`, and then click the Finish button.

Although we would expect to see a single class created, the first use of this wizard, within the context of a project, generates two classes. The expected class – actually called `rsclsPublishers` – contains the code for manipulating the table, including references to the various stored procedures that we supplied to the wizard. The other class – `clsDOW` – is required to exist if one or more DOW-generated classes exist, and it contains the definition for an `Enum` type called `EnumSaveMode`. This feature offers the ability to change globally the way that ADO saves the data. If the value is set to `Immediate`, then the `LockType` is set to `Optimistic` and data is saved when moving the pointer to another `RecordSet` record. The alternative value, `Batch`, sets the `LockType` to `BatchOptimistic` and determines that data is saved only when the Update method is called.

Space doesn't permit me to reproduce all of the code that is automatically written into the `rsclsPublishers` class, so I'll just mention the areas that I feel are important. Again, if you want to see all of the code and do not have the means or wish to run through the example, then

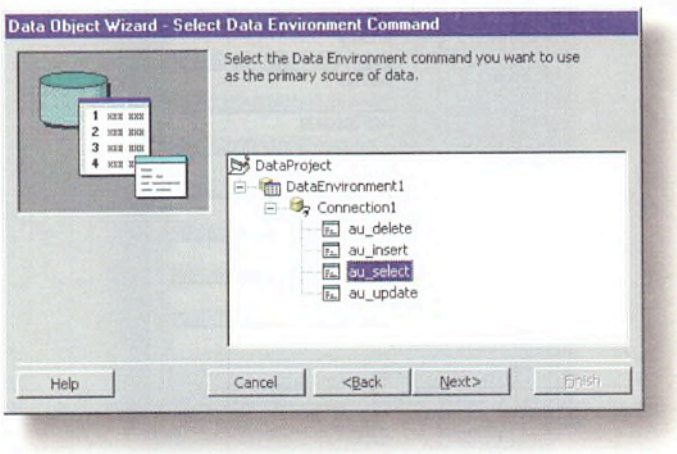

Figure 1 – Selecting the primary source of data.

this too is reproduced on my website. The class contains Get/Let properties for each of the fields specified within the `au_select` stored procedure, and the expected complement of `AddRecord`, `Delete`, `Update`, and `MoveNext/Previous`/etc methods. The class also offers four events: `ClassError` (for general application errors), `DeleteRecord` (after a record has been deleted), `rsMoveComplete` (when the `RecordSet` move operation has completed), and `rsUpdateEvent` (when the `rsUpdate` method has completed). Once this code has been generated, Visual Basic doesn't make any attempt to update it later if anything changes so you can safely modify it if you need to. For example, the few places where there is error handling within the class merely passes the problem further up the call chain. This could be a candidate for adding your own, more sophisticated handler. The only caution that I would add to this ability to change the code is to make sure that your underlying data model is stable beforehand. If the stored procedures that the class is based upon are altered, then you will probably need to rerun the wizard in order to recreate the class, thereby losing your modifications. The alternative is to alter the class code manually.

I deliberately skipped past the Define Lookup Table Information earlier so as not to cloud the main thrust of the discussion. Its purpose is to resolve foreign-key relationships to other tables. For example the *authors* table, which of course predominantly deals with American-format addresses, has a field called *state*. At runtime this field would display the two character short-form of each state, such as CA for California. If the data model were to be altered, such that a *states* table was created that included the short-form field as the primary key and the full name as the other field, then the Define Lookup Table Information facility would allow the full state name to be obtained and displayed at runtime.

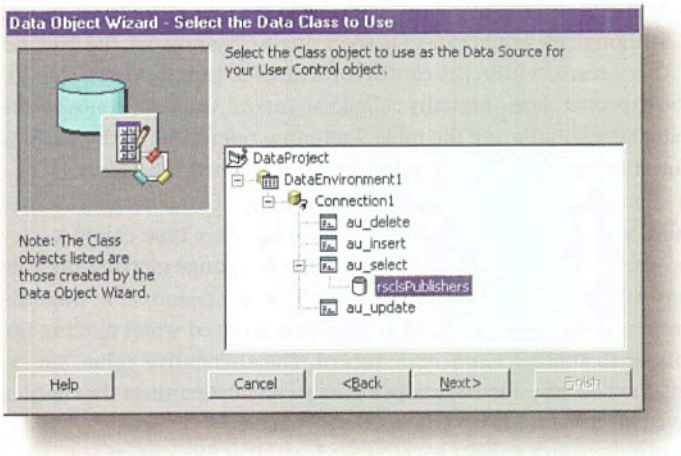

Figure 2 – Selecting the class that will act as the data source for the User Control.

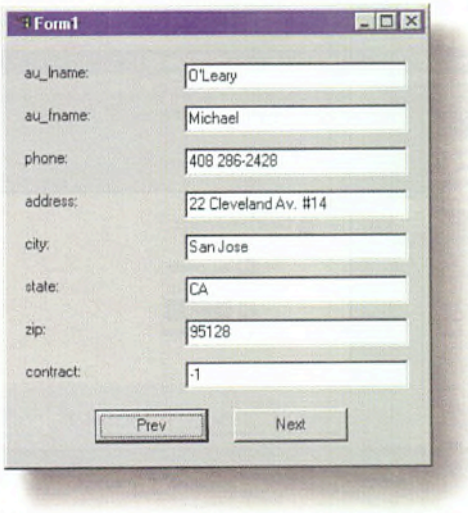

Figure 3 – A form making use of the new User Control.

Creating a User Control object

Once the definition has been completed you can return to the wizard and choose to create a User Control that uses our data class as its data source. As before, load the VB6 Data Object Wizard and then:

1. Select the second option, 'A User Control object bound to an existing Class object'.
2. You will be presented with a similar data source screen as shown in Figure 1, but this time displaying the `rsclsPublishers` class that we have just created (see Figure 2). Click on this class and proceed through the wizard.
3. You are asked to choose the underlying control that you wish to base your User Control on. This can be a single record (really a collection of text boxes by default), a data grid, a list box, or a combo box. For the purposes of this example, choose the single record option.
4. You are presented with a list of the fields that will be displayed, along with the facility to change the type of control used for each field. The default control is a text box.

Once you have submitted a name for the control and pressed the Finish button you will see that the new User Control item is displayed on the main Visual Basic toolbox. If you have several of these in a project then the ToolTip will tell you which is which. In our particular case, accepting a default control name of Publishers actually produces a User Control called `uctPublishersSingleRecord1`.

With the control now ready for use, you can drag it over to a form as usual. Figure 3 shows a basic form with an instance of the User Control, together with a couple of simple navigation buttons that I added. The Previous button, for example, simply contains the code: `uctPublishersSingleRecord1.MovePrevious`.

Usefulness?

The ability to create a User Control object that can be dragged onto a form in order to display data might seem a little redundant in light of last month's column in which I performed the same thing with the basic DED. The difference comes with the flexibility of the two approaches. The DED method involves a number of controls that are bound to a straightforward `RecordSet` object. If a simple data display were required then this would probably suffice. The DOW-based approach, however, gives you the code for both a data class and a User Control, thereby giving you the starting point for a much greater degree of customisation. Whether the quality and nature of the code is sufficient depends upon your own needs – the initial code certainly wouldn't be robust enough for many corporate applications. One key drawback would be the lack of any support in the initial code for transactions. Some companies have created their own version of this tool for use in the creation of corporate business objects that will produce code that adheres to local coding conventions and error handling methodologies. This is probably a course of action that should be debated in development departments of any size. ■

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 http://www.jonperkins.com.

The file exvb0299.sql and the module code listing can be obtained from EXE OnLine and from http://www.jonperkins.com/exe/code0299.htm

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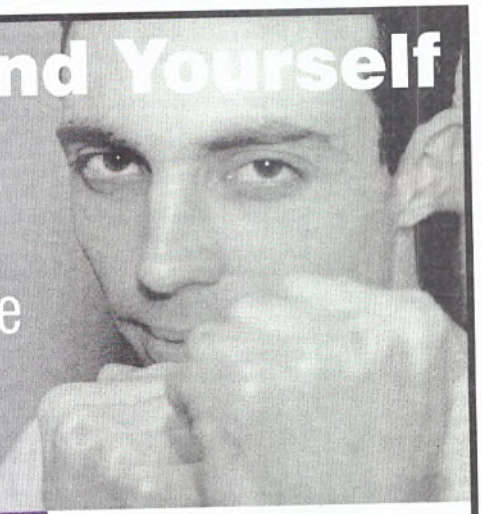

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- **Experienced developers**
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UK Technical Director: Ross Wakelin
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ISS
INTERNET SECURITY SYSTEMS

Based in the Thames Valley, ISS Group Ltd. is a subsidiary of ISS Group Inc. and is tasked with producing the worlds leading host based security management tools.

VB Developer
London **£30,000**
Leading International law firm requires a Visual Basic developer with two years experience. Successful candidates will have knowledge of SQL Server, MS Word, and Access. You will receive excellent career prospects and a competitive benefits package.
Ref: 46949/4
Email: chantal.marcusfield@haymarket.com

Delphi Developers
London **£32,000**
Developer required to join one of the fastest growing media-houses in London. Specialising in System Development for the Broadcasting Industry, they are looking for bright IT professionals to join their lively team. The atmosphere is relaxed and benefits generous. Ideal candidates will have at least 1 year of Delphi programming on Windows 95/98/NT/Oracle 8 with a good grasp of relational database fundamentals. You will also be cross trained onto web technologies and internet.
Ref: 89856/2
Email: katherine.smith@haymarket.com

C/C++ Programmer
City **to £45,000+ benefits**
Technical Consultants to join finance and banking team within this growing software house. You will be working on a variety of leading edge projects. You will need sound Unix along with either C or C++ experience. Sybase is advantageous, but training will be given for the right candidate. Casual dress code, flexitime and excellent career prospects.
Ref: 90947/1
Email: leigh.carrick.moore@haymarket.com

Development Manager
London **to £55,000 + benefits**
Experienced development manager required for a London based consultancy, you should have at least 10 years in the IT industry, with at least 5 years in an infrastructure development role. MS-WINDOWS NT and MS-EXCHANGE (a track record of rolling out this technology is essential). A minimum of 2 years experience of programming in Visual Basic with MS-Access or SQL-Server. Proven ability (minimum 2 years) in leadership and management of a small, expert team. Good verbal, presentational and written communication skills.
Ref: 90822/11
Email: leigh.carrick.moore@haymarket.com

Senior C++ Developer
City **to £45,000+benefits**
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

Software Developer
Reading **£30,000**
Our client is looking for an experienced Visual C++ programmer. A minimum of 2 years Windows 95/Windows NT experience together with a computer science degree. The successful candidate would be working on our new product range.
Ref: 95275/2
Email: katherine.smith@haymarket.com

Software Developer
Middlesex **£20-25,000+benefits**
Our client needs 2 more VB developers with SQL Server & Crystal Reports experience to join their expanding development teams - friendly, busy, target oriented division - client facing skills a must!
Ref: 95429/1
Email: debbie.suckling@haymarket.com

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C/C++/VC++

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THE BEST SOLUTION
BATH — **TO £25,000**

This high quality systems consultancy specialises in the development of embedded and real-time systems at the forefront of technology. Success has meant that young dynamic Software Engineers are sought with at least 18 months experience of the following skills: **C/C++, Visual C++, ADA, Java, OOA/OOD.** You will be expected to have excellent client/customer facing skills and will be working with successful companies on exciting projects. Suitable candidates should want to rapidly broaden their development experience with new languages and varied application environments. In addition to rapid career development they are offering high salaries and bonuses.
(Ref:ML/8416)

TAKE ON THE WORLD
BRISTOL — **TO £34,000**

As a result of continued expansion, this leader in the supply of direct marketing software and bespoke solutions to global organisations is looking for Senior Analyst programmers to get involved in all aspects of their development life cycle. A minimum of 4 years **C** or 2 years **C++** development on a **Windows NT** or **Unix** platform is essential with any knowledge of **ODBC** and **COM/DCOM** an advantage. Based in their central Bristol software R & D offices, the right candidates will enjoy a full compliment of benefits and the opportunity to travel if desired. (Ref:WH/1851)

DEMAND TO BE HEARD
WORCESTERSHIRE — **TO £48,000**

Our client has been awarded Best Business to Business e-commerce Solution to name but one of it's prestigious accolades. Setting the standards in the speech recognition industry our client uses leading edge technology within a fast moving, dynamic environment. A vacancy for a Software Engineer/Senior Developer has been created for the right candidate with approximately 2 years **MS Visual C++** with **MFC** within a **Windows 32 bit** environment. You will receive excellent training, exposure to the latest technology, occasional travel to the states, a salary second to none and good career prospects. This is an opportunity not to be missed. (Ref:WH/8197)

UNIX - TRAIN TO OO, C++
SOMERSET — **TO £35,000 +RELOC +BENS**

Our client's huge success hinges on maintaining their position at the cutting edge of modern technology. Urgent vacancies exist within a number of specialist divisions involved in various stages of the project lifecycle. You must have at least one year's experience within a **Unix** and **C** development environment but also desirable is one or more of the following: **Windows NT, OO, C++.** Extensive training, however, is offered in each area. Benefits include more than satisfactory relocation expenses for both home-owners and non-home owners, along with an extensive benefits package.
(Ref:ML/6677)

UNRIVALLED BENEFITS
BRISTOL — **£20-44,000 +BENS**

Be a part of history and join one of the world's leading providers of advanced digital communications solutions. Whether you are a graduate with 12 month's experience or a well seasoned Software Engineer, this is an opportunity to use your **Unix/C** and or **C++** skills within a state of the art technical environment. You will be involved primarily in developing real-time software for our clients next generation mobile systems. On offer is a fantastic benefits package which includes: pension scheme, private health insurance, flexible working hours and 25 day holiday.
(Ref:ML/7510)

APPLY NOW!
DORSET — **TO £33,000**

Our client is a rapidly expanding Telecoms solutions provider with an impressive client base throughout the UK. Phenomenal success has meant they are now looking to recruit for a number of new positions from Graduate Software Engineer through to Senior Software Engineer with the following skills: **C/C++** or **Visual C++** and **Windows (V95/NT).** You will work on a variety of exciting projects using the latest technologies. In return you can expect to receive a competitive salary, health and life insurance and 20 days holiday. (Ref:ML/8797)

WEB NOTES

0117 988 0000 • Peter Shawyer

JAVA/CORBA/E-COMMERCE CONSULTANTS
BATH/WILTSHIRE — **£20-50,000**

This exciting, progressive software house urgently seek several developers for front-end and back-end **Web/Intranet** development projects. Whether you are a junior programmer or a project leader, if you have at least one year's experience in any of **HTML, JavaScript, Java, ASP, Perl/CGI** you can gain skills in the development tools you do not already know along with **COM/DCOM** & **CORBA.** Excellent scope for career progression, superb salaries, bonuses and flexible working arrangements make this the opportunity all aspiring **Web** developers cannot afford to miss. (Ref:PS/9497)

NOTABLY HOMELY
WILTSHIRE — **TO £30,000**

Two **CLP** level developers are sought to specialise in **Notes**-based **Intranet** development projects for this **Lotus** business partner. If you have at least 1 year's **Notes** applications development experience, you can enhance those skills, gain exposure to **Internet** development technologies and earn a lucrative salary plus bonus; all of this plus the option to work in the comfort of your own home, spending just 2-3 days per month in the office, if you so wish. (Ref:PS/9200)

JAVAMOBILE
BRISTOL — **£20-30,000**

This well-reputed provider of hi-tec solutions to the finance, telecoms and government sectors, urgently require **Java** developers at all levels. If you have a minimum of one years' **Java** programming experience, you can get involved in cutting-edge **Internet/Intranet** delivery projects, gain x-training to **Corba** and **Oracle** and earn an excellent package in a high-profile role with possibilities of UK and international travel. (Ref:PS/8581)

BOUNDLESS POSSIBILITIES
GLOUCESTERSHIRE — **£28-35,000**

This extremely successful provider of **Web**-centric solutions to a variety of sectors urgently require several Web professionals. Whether you are a developer with knowledge of **ATL, HTML, VB, Java, COM, C/C++** (any blend thereof) or an experienced web designer with a creative outlook and good general multimedia skills, you can become part of the South West's major IT success story. The scope for career progression, the marketability you will gain through both the training and prestige of working here, along with the irresistible package, make this an awesome opportunity.
(Ref:PS/9588)

LOTUS NOTES - GAIN DOMINO
BRISTOL — **TO £30,000**

This pioneering **Notes** Consultancy now need to recruit two Developers to join the burgeoning **Lotus Notes** Development team. Ideally you will have at least six months experience developing in **Domino** although X-training to **Domino** is available for those who can demonstrate a good understanding of **Notes V4.x** development. To find out more about this superb training opportunity and the fantastic package on offer, call today. (Ref:PS/9417)

REWARD YOURSELF
SOMERSET — **TO £50,000 +CAR**

This dynamic software house, a leading provider of **Intranet** and **Java** applications, urgently require **Java** and **Corba** Developers at all levels, ideally with **e-commerce**, management and strategy experience. These opportunities encompass pioneering Web-centric development projects, accredited training in **Java** and **Corba**, irresistible remuneration packages, bonuses and car. (Ref:PS/8683)

S. WEST	C++, ASP, VB, DCOM DEVELOPERS	£18-36,000
BRISTOL	INTRANET A/P, C/C++, ASP GAIN JAVA	TO £35,000
BRISTOL	JAVA A/P, WEB/E-COMMERCE	TO £33,000
BATH	WEB DESIGNER, DIRECTOR, HTML	TO £20,000
BATH	JAVA CONSULTANTS, E-COMMERCE	TO £40,000
WILTS	JAVA/CORBA, OO DEVELOPERS	£20-35,000
WILTS	INTERNET CONSULTANTS, ALL LEVELS	£20-40,000
WORCS	OO/WEB DEVELOPERS - GAIN JAVA	TO £35,000
GLOS	WEB/INTERNET SYSTEMS DESIGNERS	TO £35,000
GLOS	NOTES/DOMINO DEVELOPERS	£25-30,000
WILTS	NOTES A/P's (CLP), WORK FROM HOME	TO £36,000
DORSET	NOTES DEVELOPERS & ADMIN	£15-32,000
DORSET	HTML, DIRECTOR, PHOTOSHOP	TO £21,000
BRISTOL	WEB/MULTIMEDIA DESIGNERS	£18-25,000

VB/SQL SVR

0117 988 0000 • Peter Bennett

PROGRAMMERS TO SENIOR A/P'S
WILTSHIRE — **£22-35,000**

Specialising in **Microsoft SQL Server** database technologies our client has established itself as a leader in the development of enterprise wide software solutions. If you have 6 months experience in **Visual Basic v4/5/6, SQL Server 6.5/7** then apply now to work within this relaxed but dynamic environment. This unique opportunity will cross train you to the latest **Microsoft** technologies as and when required encouraging you towards **MCSD** status. Apply now and receive a structured career, high salary and full benefits.
(Ref:DV/9885)

DOCUMENT MGMT, WORKFLOW, IMAGING
BATH — **£21-38,000**

Our client is one of the largest and most prestigious consultancy firms in the world. 5 Senior Consultants/ Consultants are now urgently required with experience in any of the following: **Workflow Implementation, Document Management, Imaging, Data Capture, Systems Integration.** You will be involved in the full project lifecycle, utilising and building on your expertise. The successful candidate will receive an excellent salary, training as and when required and a generous benefits package.
(Ref:DV/9783)

SHARE THE WEALTH
BRISTOL — **£18-38,000**

Our client employs 2000 staff worldwide providing software and services to the securities industry. Within this dynamic environment Developers through to Senior Analyst/Programmers are now urgently required to develop their software through its full project life cycle. You will have a minimum 6 months experience in **Visual Basic v4/5/6** and **SQL Server 6.5/7.** As well as an excellent salary you will be working within a flexible, leading edge hands-on environment. (Ref:DV/9883)

SLICK VACANCY
WILTSHIRE — **TO £30,000 +BENS**

Our client is a specialist lubricants and chemicals manufacturer with operations in over 50 countries world-wide. Vacancies exist within there IS department for 4 A/P's with at least 12 months experience of 1 of the following: **Visual Basic (v5/4), Access 97** and **SQL Server 6.5/7.0.** You will be responsible for the development of cross-business applications for deployment throughout the world. On offer are excellent salaries, full benefits package and an opportunity to receive technical skills training into other leading edge technologies. (Ref:DV/9348)

WHAT A JOB!
NORTH GLOS — **TO £31,000 +BENS**

This well established and highly successful software house urgently requires a graduate with at least 2 years experience designing, developing and testing a multi-user **Visual basic 4/5** and **SQL Server 6/6.5** application. Experience of the following would be advantageous although full training will be given: **Rational Rose, Active X** controls and components, **COM/DCOM** and **SQL Server.** If you are not already at MCSD status then full training to this is mandatory. Apply now and receive a healthy salary with full benefits and in/out house training. (Ref:VB/9413)

VB/ACTIVE X DEVELOPERS X5
WILTSHIRE — **TO £30,000 +BENS**

Our client is one of the leading suppliers of IT solutions to the Emergency Services in the UK. Opportunities have been created to work on a leading edge technology project from inception through its full life cycle. The ideal candidates will have at least 12 months experience developing user interfaces for n-tier **client-server** systems using **Visual Basic 4/5** and **Active X.** On offer are excellent salaries and an extensive benefits package. (Ref:VB/8864)

COMPUTER FUTURES

SOUTH WEST

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Der übervirus

VIRUS ALERT!

If you receive an email entitled 'Badtimes', delete it immediately.

- Do not open it. Apparently this one is pretty nasty.
- It will not only erase everything on your hard drive, but it will also delete anything on disks within 20 feet of your computer.
- It demagnetizes the stripes on ALL of your credit cards.
- It reprograms your ATM access code, screws up the tracking on your VCR, and uses subspace field harmonics to scratch any CDs you attempt to play.
- It will re-calibrate your refrigerator's coolness settings so all your ice cream melts and your milk curdles.
- It will program your phone autodial to call only your mother-in-law's number.
- It will mix antifreeze into your fish tank.
- It will drink all your beer.
- It will leave dirty socks on the coffee table when you are expecting company.
- Its radioactive emissions will cause your toe jam and bellybutton fuzz (be honest, you have some) to migrate behind your ears.
- It will replace your shampoo with Nair[1] and your Nair with Rogaine[2], all while dating your current boy/girlfriend behind your back and billing their hotel rendezvous to your Visa card.
- It will cause you to run with scissors and throw things in a way that is only fun until someone loses an eye.
- It will give you Dutch Elm Disease and Tinea[3].
- It will rewrite your backup files, changing all your active verbs to passive tense and incorporating undetectable misspellings, which grossly change the interpretations of key sentences.
- If the 'Badtimes' message is opened in a Windows 95 environment, it will leave the toilet seat up and leave your hair dryer plugged in dangerously close to a full bathtub.
- It will not only remove the forbidden tags from your mattresses and pillows, but it will also refill your skimmed milk with whole milk.
- It will replace all your luncheon meat with Spam.
- It will molecularly rearrange your cologne or perfume, causing it to smell like dill pickles.
- It is insidious and subtle.
- It is dangerous and terrifying to behold.
- It is also a rather interesting shade of mauve.
- These are just a few signs of infection.

[1] A hair removal product [2] A hair regrowth product [3] Athlete's Foot (yuk)

Thanks to Jules for forwarding this one to us.

Freebie of the month

If you've been reading this particular section of the magazine avidly for the last few months, you will by now have got a pretty good idea of the kind of freebies doled out to journalists by the various companies in the software industry. Some give novelties – things that you can squeeze, things that go squeak, things that glow in the dark, or other such nonsense. Some give more practical gifts – pens, pads, bags. Some give alcohol (mmm.... alcohol). Then there are those that specialise in the kind of freebie you can wear – most often t-shirts or button-up shirts. We have even encountered the odd cagoule, jacket, and sweatshirt. But this is a new one on us.

Debugging and code analysis tools specialists NuMega Technologies (now part of Compuware, we should mention) popped round to see us last month, and they came bearing boxer shorts. Not just any boxer's shorts, of course. No. These are green. Very green. Sporting a rather delightful tartan pattern (or perhaps that should just be plaid, because we did try to look the tartan up... with no success), and generously sized to fit everyone in the office apart from the Big Giant Ed, did we mention they're very green?

Seriously, though, folks. These are good. In keeping with our ongoing Campaign for Useful Freebies, we have to declare the NuMega boxers a success. Other companies, take note. Boxer shorts – good, squeezy cameras – bad.

And furbyly...

NSA, the United States' super-secret spy agency, has been invaded by eavesdroppers. No small matter this, for NSA has long had the world's most sophisticated eavesdropping network (codenamed ECHELON). Apart from routinely monitoring all phone, fax, telex and email traffic around the world – including the UK, thanks to NSA's cosy relationship with GCHQ – the agency, based at Fort Meade in Maryland, is reputed to have the world's most advanced computer systems installed in vast underground vaults below its headquarters building. Technology there is reckoned to be at least a decade ahead of the rest of the world. Yet the mighty NSA is running scared from a $30 children's toy that caused near riots in toy stores last Christmas.

Furby, for the previously unaware, is an electronic furry doll. The twist is that Furby interacts with the user (read: child) thanks to a network of sensors which let it know when it is being touched. Furby also speaks in its own baby-language, Furbish, which kids are flocking to learn. The dolls have an infrared port built into their foreheads, which allows Furbys to communicate with one another. Should one Furby begin laughing, it will usually set off all the other Furbys in the room. So why is NSA so worried?

Simple. Aside from fluent Furbish, Furby gradually learns to speak English words (up to 100 of them) by listening to what is said to it, sampling and analyzing the waveform, then reproducing the words in its own voice. NSA is worried that if employees bring Furby onto the premises and inadvertently have conversations including classified information in front of it, the doll may later repeat what it has heard and grass up Uncle Sam.

Knowing the NSA as we do, however, we're sure it's only a matter of time before a special version of Furby, engineered to spy *for* the US rather than against it, is deployed against the children of foreign diplomats the world over. So remember: loose lips sink ships, and Furbys have ears.

Verity's Laureate bid

Ms Stob presents her formal entry for the top job.

Variation on a Village People song

(Best read while playing a video of a dance troupe of hard-hatted Microsoftees on your mental television.)

Young man, wipe that smile off your face
I said
Young man, get into that KnowledgeBase
I said
You know that there's code to be cut
There's no room on board for drifters.
You say the APIs are obtuse
I said
Young man, that's a feeble excuse
I said
You know where the answers are kept
So come on and join the party.

Bosh Bosh Bosh Bosh Bong

You've got to sub to the M-S-D-N
You've got to sub to the M-S-D-N
You get Windows NT for France and Japan
Updated in a quarterly plan!
You've got to sub to the M-S-D-N
You've got to sub to the M-S-D-N
You get the SDKs and the DDKs too
It's all there for me and for you!

Young man, I see the fear in your eyes
I said
Young man, best sub to Enterprise
I said
Young man, you'll get Visual C
With all that way-out wizardry!
So young man, don't take no stupid risk
You know
You should buy all those silver discs
Because
Those guys at Redmond are great
They just live to make your life fun!

Bosh Bosh Bosh Bosh Bong

You've got to sub to the M-S-D-N
You've got to sub to the M-S-D-N
You get Windows NT for France and Japan
Updated in a quarterly plan!
You've got to sub to the M-S-D-N
You've got to sub to the M-S-D-N
You get the SDKs and the DDKs too
It's all there for me and for you!

(Repeat and fade)

Backup is for punters

Monday's tape is out of date,
Tuesday's suffered unknown fate,
Wednesday's tape caught in the rollers,
Thursday's chewed by canine molars,
Jim took Friday you'll remember,
Saturday vanished in September.
A Sabbath backup would be a freak –
But if we can't find one, we're up the creek.

The dog's breakfast

The Boss asked
his PA, and
his PA asked
the Manager:
'Can we have a printout
of the profit that we made?'
The Manager
said: 'Certainly.
I'll go and tell
the Programmer.
It's his fault
the MIS
system is
delayed.'

The Programmer
said: 'Bloody hell!
Who demanded
Oracle?
I won't let
this pass
without
a big row!'
So they called
a big meeting –
everyone attended –
and for all I know
they're still
sitting there
now.

The demo of my rival has crashed

The demo of my rival has crashed
And I am pleased.
Dramatically and publicly it has crashed
In the presence of not only our usual contact
    at the Customer
But also their senior IT representative
From Head Office in Milton Keynes
Whose blessèd hand was on the mouse
When the application suddenly froze.
As did the smile on the face of my rival
And sweat trickled visibly down his temples
Glinting in the bright white light of the OHP
Which was projecting his stupidity four feet
    across
Onto the screen at the back of our boardroom.

The app of my enemy has bombed
And I am thrilled.
Completely and utterly it has bombed
No mere lockup or access violation
But a full ripe glorious Blue Screen of Death
On NT4 Workstation SP3.
And *mirabilis dictu* something I had not even
    dared hope for
I hear that the crash damaged The Live Data
    base itself.
(They are dumping the transaction log
In an effort to sort it out.)
So even the gnomic DBA subcontractor
Formerly a slavish ally of my enemy
Now mutters dark curses.

How little avails my rival now
His innovative use of RAD techniques and
His clever n-tier design
Which spreads the burden of process across
    three platforms.
(How well the burden of the corpse of his demo
Is spread across three platforms!)
How much more enjoyable in retrospect
His little homilies on the necessity
Of having in-depth Unix expertise
Before undertaking a complex design like this
Which (he said) I would find
Relied on concepts not present in toy operating
    systems.

So slosh in the gin and give the tonic to the
    thirsty spider plant!
Ring out wild modems!
Build a celebratory bonfire of toner cartridges!
The Germans have made a term for it
But *schadenfreude* is too small and mean a
    word
To contain my malicious ecstasy.
All the better if because of this incident
The contract is cancelled
And the company goes bust
And we get the sack
And the directors' lives are ruined
And England loses the World Cup!
For the demo of my enemy has gone West
And I am pleased. ■

Verity Stob wishes to apologise to Wendy Cope ('Variation on a Lennon and McCartney song'), Anon ('Monday's child is fair of face'), A. A. Milne ('The King's Breakfast'), and Clive James ('The book of my enemy has been remaindered') whose ideas she has here ripped off shamelessly.

25,000 Software Vendors Count On

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• Attachmate • AT&T
• Bayer Chemicals • BBC Television
• Creative Software • Deneba Software
• Digital Equipment Corp. (DEC) • Dun & Bradstreet
• Eastman-Kodak
• Epson Computers FACT Software
• Graphisoft • Hewlett-Packard (HP)
• Hitachi Software • Honeywell
• IBM • Intel • Intusoft
• Lattice • Lucent Technologies
• Magic (MSE)
• Matsushita
NEC • Nippon Telephone & Telegraph
• Paperclip • Philips
• Quark
• Reuters
• Racal Communications • Rockwell
• Samsung • Schlumberger
• Scitex Corp • Siemens-Nixdorf
• Toshiba
• Ultimate Technologies • Verifone
• Vibrant Graphics ...and more

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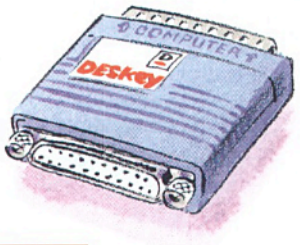

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THE SOFTWARE DEVELOPERS' MAGAZINE

EXE What are you really worth?

Is your salary right for the job you do? We're sure many of you think that you should be paid more. Here's your chance to find out how your salary compares with colleagues in similar jobs. Help us to understand the current situation by telling us about your job and we'll give you the real story.

The questionnaire is anonymous and all details will remain confidential. Just tick which job you do, fill in your rate of pay and tell us a bit about your track record, then send this form to us (postage paid). And please pass it on – photocopy this page and get your colleagues to complete it too. The more of you who respond, the more accurately we can tell you what the going rates for your skills and experience are.

For each completed questionnaire we receive, we will give £1 to the Bletchley Park Trust *(www.cranfield.ac.uk/ccc/bpark/)* or the Disaster Emergency Committee Hurricane Appeal *(www.oneworld.org/oxfam/atwork/emerg/mitchdec.htm)*. Please tick which charity you prefer us to donate to.

Just fold and secure this survey and send back to us - Freepost or by fax on 0171 970 6741.

Your job

1. Are you a contractor?
☐ *a* Yes ☐ *b* No

(Note for contractors: where the survey mentions 'your company' you should treat this as your current client/employer, not your own business.)

1.a. If yes, how many years have you worked as a contractor?
☐ *a* Less than 1 ☐ d 4-6
☐ *b* 1-2 years ☐ *e* 6-10
☐ *c* 2-4 ☐ *f* 10+

Contractors: go to question 3

2. Are you in full-time employment?
☐ *a* Yes ☐ *b* No

2.a. If yes, how many years have you been in full-time employment?
☐ *a* Less than 1 ☐ e 6-8
☐ *b* 1-2 years ☐ *f* 8-10
☐ *c* 2-4 ☐ *g* 10-12
☐ *d* 4-6 ☐ *h* 12+

2.b. If no, are you in part-time employment?
☐ *a* Yes ☐ *b* No

2.b.1. If yes, how many years have you been in part-time employment?
☐ *a* Less than 1 ☐ e 6-8
☐ *b* 1-2 years ☐ *f* 8-10
☐ *c* 2-4 ☐ *g* 10-12
☐ *d* 4-6 ☐ *h* 12+

2.c. If no, are you self-employed?
☐ *a* Yes ☐ *b* No

2.c.1. If yes, how many years have you been self-employed?
☐ *a* Less than 1 ☐ e 6-8
☐ *b* 1-2 years ☐ *f* 8-10
☐ *c* 2-4 ☐ *g* 10-12
☐ *d* 4-6 ☐ *h* 12+

3. Which of the following best describes your company/client's main activity?
☐ *a* IT ☐ *e* Telecoms
☐ *b* Industry ☐ *f* Education
☐ *c* Finance ☐ *g* Government
☐ *d* Services ☐ *z* Other_____

4. Which of the following best describes your current job title?
☐ *a* Software developer ☐ *e* Technical director
☐ *b* Software engineer ☐ *f* Contract programmer
☐ *c* Analyst/Programmer ☐ *g* Database developer
☐ *d* Consultant ☐ *z* Other_____

5. Do you work in the software development department of your company/client?
☐ *a* Yes ☐ *b* No

6. Do you have a formally-agreed flexi-time arrangement?
☐ *a* Yes ☐ *b* No

7. Are you expected to dress formally (suit and tie), smartly (shirt and trousers), or casually (jeans and T-shirt)?
☐ *a* Formal ☐ *c* Casual
☐ *b* Smart

8. Which programming languages do you use in your job (please tick all that apply)?
☐ *a* C ☐ *j* HTML
☐ *b* C++ ☐ *k* XML
☐ *c* Visual Basic ☐ *l* 4GL
☐ *d* Delphi ☐ *m* Fortran
☐ *e* Java ☐ *n* Cobol
☐ *f* Assembler ☐ *o* SQL
☐ *g* Perl ☐ *p* Non SQL databases
☐ *h* JavaScript ☐ *z* Others_____
☐ *i* VBScript

9. Which platforms do you develop for (tick all that apply)?
☐ *a* Windows ☐ *d* Embedded
☐ *b* Unix ☐ *e* VMS
☐ *c* DOS ☐ *z* Others_____

10. Which platforms do you do development work on (please tick all that apply)?
☐ *a* Windows ☐ *d* Embedded
☐ *b* Unix ☐ *e* VMS
☐ *c* DOS ☐ *z* Others_____

11. What type of development are you primarily involved with?
☐ *a* Bespoke apps ☐ *d* Embedded apps
☐ *b* System software
☐ *c* Off-the-shelf apps ☐ *z* Other_____

12. Are the users of your software primarily in-house?
☐ *a* Yes ☐ *b* No

Money matters

(Note for contractors: for 'salary', read 'average yearly remuneration' – this is the average total amount incoming from contracts, not any salary/fee you pay yourself if you have your own company).

13. Which of the following ranges does your current salary fall into?
☐ *a* Less than £10,000 ☐ *j* £35,000-£37,999
☐ *b* £10,00-£14,999 ☐ *k* £38,000-£40,999
☐ *c* £15,000-£16,999 ☐ *l* £41,000-£49,999
☐ *d* £17,000-£19,999 ☐ *m* £50,000-£59,999
☐ *e* £20,000-£22,999 ☐ *n* £60,000-£69,999
☐ *f* £23,000-£25,999 ☐ *o* £70,000-£79,999
☐ *g* £26,000-£28,999 ☐ *p* £80,000-£89,999
☐ *h* £29,000-£31,999 ☐ *q* £90,000-£99,999
☐ *i* £32,000-£34,999 ☐ *r* £100,000+

14. Do you feel your current salary is:
☐ *a* Too high ☐ *d* Slightly low
☐ *b* Quite high ☐ *e* Very low
☐ *c* About right

15. Do you feel your current salary accurately reflects your skills and abilities?
☐ *a* Yes ☐ *b* No

16. Do you receive an annual bonus?
☐ *a* Yes ☐ *b* No

16.a. If yes, what % of your salary does this bonus represent?
☐ *a* Less than 5% ☐ *c* 10-14%
☐ *b* 5-9% ☐ *d* 15%+

17. What was your salary range 12 months ago?
☐ *a* Less than £10,000 ☐ *j* £35,000-£37,999
☐ *b* £10,00-£14,999 ☐ *k* £38,000-£40,999
☐ *c* £15,000-£16,999 ☐ *l* £41,000-£49,999
☐ *d* £17,000-£19,999 ☐ *m* £50,000-£59,999
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☐ *g* £26,000-£28,999 ☐ *p* £80,000-£89,999
☐ *h* £29,000-£31,999 ☐ *q* £90,000-£99,999
☐ *i* £32,000-£34,999 ☐ *r* £100,000+

18. Roughly what amount in salary increases do you expect to receive within the next 12 months?
☐ *a* No increase ☐ *e* £3,000-£3,999
☐ *b* £500-£999 ☐ *f* £4,000-£4,999
☐ *c* £1,000-£1,999 ☐ *g* £5,000+
☐ *d* £2,000-£2,999

19. If you changed job/client what increase in salary would you expect?
☐ *a* No increase ☐ *e* £3,000-£3,999
☐ *b* £500-£999 ☐ *f* £4,000-£4,999
☐ *c* £1,000-£1,999 ☐ *g* £5,000+
☐ *d* £2,000-£2,999

20. What range do you expect your salary to fall into in three years time?
☐ *a* Less than £10,000 ☐ *j* £35,000-£37,999
☐ *b* £10,00-£14,999 ☐ *k* £38,000-£40,999
☐ *c* £15,000-£16,999 ☐ *l* £41,000-£49,999
☐ *d* £17,000-£19,999 ☐ *m* £50,000-£59,999
☐ *e* £20,000-£22,999 ☐ *n* £60,000-£69,999
☐ *f* £23,000-£25,999 ☐ *o* £70,000-£79,999
☐ *g* £26,000-£28,999 ☐ *p* £80,000-£89,999
☐ *h* £29,000-£31,999 ☐ *q* £90,000-£99,999
☐ *i* £32,000-£34,999 ☐ *r* £100,000+

21. Is earnings potential the main reason you work within the IT industry?
☐ *a* Yes ☐ *b* No

Your track record

22. How many employees are there at your company/client in the UK?
☐ *a* Less than 5 ☐ *e* 100-499
☐ *b* 5-9 ☐ *f* 500+
☐ *c* 10-49 ☐ *g* Don't know
☐ *d* 50-99

23. What is the size of your software development team?
☐ *a* One ☐ *d* 13-20
☐ *b* 2-5 ☐ *e* 21+
☐ *c* 6-12 ☐ *f* Don't know

24. Where are you based?
☐ *a* London ☐ *h* Southern England
☐ *b* South East ☐ *i* North East
☐ *c* Midlands ☐ *j* East Anglia
☐ *d* North West ☐ *k* Wales
☐ *e* M4 corridor ☐ *l* Northern Ireland
☐ *f* South West ☐ *z* Other_____
☐ *g* Scotland

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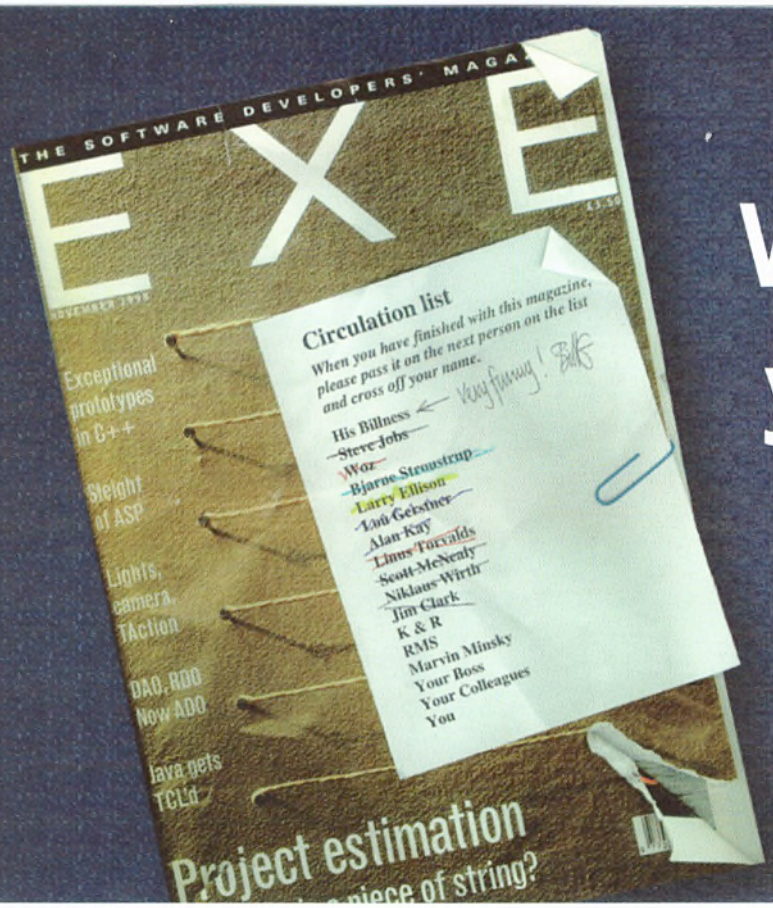

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