

testing times

The IPL Software Products Newsletter

Eclipse - What's it all About?

Eclipse is more than just the latest buzz word, it's an open source community that is transforming the way tools integrate and inter-operate with one another.



Eclipse projects are focused on providing an open development platform and application frameworks for building software. The Eclipse Foundation is a not-for-profit corporation formed to advance the creation, evolution, promotion, and support of the Eclipse Platform and to cultivate both an open source community and an ecosystem of complementary products, capabilities, and services. See www.eclipse.org for more information.

Many tool vendors are adopting Eclipse as a common front-end. The chief benefit is that it offers many more opportunities for complementary tools to interface more effectively to each other, and this in turn offers a better user experience.

IPL plans to fully integrate the latest version of our testing tool, Cantata++ V5.0, into Eclipse. The current V5 prototype already integrates powerful Eclipse features with new automated test script generation functionality. One such feature is the Test Script Helper, which offers the ability to auto-generate stubs, wrappers, and expected global data items. A compilable and linkable test script is just clicks away! Another powerful feature is the integrated test and coverage results browser which makes it extremely easy to navigate through the test results.

Eclipse provides a standard set of C/C++ development tools known as CDT, based upon the GNU tool-chain, using the GCC compiler and make. There are two general classes of project available for C/C++: 'managed make' and 'standard make'. With standard make the user must supply their own makefile to build their project. With managed make, CDT generates a makefile for you. Our plans are currently focused on supporting managed make projects.

If you would like a preview of V5 under Eclipse please contact IPL.

The screenshots show the Cantata++ V5.0 interface. The top window displays a 'Welcome to Cantata++ 5.0' message and a 'TUTORIALS' section. Below this, there are sections for 'Coverage Achieved' and 'Coverage Targets'. The 'Coverage Achieved' section shows a table with columns for Statement, Decision, Boolean Operand Effectiveness (Making), and Boolean Operand Effectiveness (Assign-Cause). The 'Coverage Targets' section shows a table with columns for Coverage Type, Target, Coverage, Function, and Passed. The bottom window shows a code editor with a test script for a stack constructor, including comments and function calls. A 'Generate Template Test Script' dialog box is also visible, showing a list of functions to be stubbed or wrapped.

Sample screens and output from Cantata++ V5

Bugz Bunny

Commenting on the reasons for the success of the **NASA Mars Exploration Rover** missions, JPL's Firouz Naderi said, "Test, test, test." *Aviation Weekly and Space Technology*, January 2005

UK Tax Credit software 'accidentally deleted' one million taxpayer records, causing 360,000 people to receive underpayments and 22,000 to make underpayments. *Computing*, September 2005

Tokyo Stock Exchange closed for a day due to a 'software malfunction'. *The Guardian*, November 2005

Passengers at London's **Gatwick Airport** suffered delays at the weekend when an IT failure affected a number of check-in systems. The computer glitch, which started on Friday night, took until Sunday for airport IT staff to bring the systems back online. *Computing*, November 2005

Users of **Sky+** personal video recorders suffered a disruption of service through a software update which enhanced one feature while disabling another. This has affected, 'hundreds, maybe thousands' of households. *Private Eye*, December 2005

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Cantata

In Mission Critical Avionics

Klocwork

Working with a complex combination of new technologies



Cantata In Mission-Critical Avionics

Seven Years of Software Testing at Vibro-Meter

Vibro-Meter is one of the world's leading providers of vibration monitoring systems, as used in commercial aircraft, helicopters, and other military aerospace, industrial and marine applications. Vibro-Meter is a wholly owned subsidiary of Meggitt PLC, employing over 450 staff. Since its foundation in 1952 it has become a major supplier of complex measurement and diagnostic systems for engine health monitoring. Vibro-Meter's customers include most of the world's major aerospace corporations such as Airbus, Boeing, Embraer, UTC, General Electric and Rolls Royce.

Critical Testing Requirements

Recently, Vibro-Meter has been developing two major products; the Engine Interface and Power Monitoring (EIPM) unit for the Airbus A380 aircraft and the Engine Monitoring Unit (EMU) for the Trent 900 engine from Rolls Royce. One of the main challenges of these developments was to deliver reliable software that had been fully tested to meet the stringent safety demands of the civil avionics industry standard RTCA/DO-178B.



EMU-123 for the A380

The full name of this standard is 'Software Considerations in Airborne Systems and Equipment Certification'. It describes the techniques and methods needed to ensure the integrity and reliability of such software. Several levels exist for this standard, each of which is defined by the level of safety required. For example Level A refers to software whose failure could cause a 'Catastrophic' accident, Level B software failure could involve a 'Severe - Major' accident, and so on.

The DO-178B standard mandates the use of dynamic testing at both unit and integration levels. Test coverage analysis and verification of coding standards also need to be undertaken. In 1999, Vibro-Meter's engineers started putting together a development tool chain to support future projects. A high priority for the engineers was to find tools that would support the testing techniques required by this stringent standard. Due to previous successful experience with Cantata's sister tool for the Ada language, AdaTEST, Vibro-Meter rapidly identified Cantata as the strongest candidate. This was because of the close mapping of Cantata's specification to the requirements of DO178B.

Evaluation

Following a detailed technical evaluation, it quickly became clear to Vibro-Meter that Cantata was the right choice for a DO-178B development. Cantata was not only fully effective for this standard, particularly in terms of supporting all forms of coverage analysis required, but was also complete in terms of automation, usability and integration within Vibro-Meter's own environment. An initial order for Cantata was placed in 2000, and a training session for 20 engineers followed soon after.

A380 – Program EIPM

Vibro-Meter has been supplying equipment to Airbus since 1970, the first project being for the A300 aeroplane. Since then the company has designed and supplied engine monitoring and interface units for all Airbus aircraft programmes. The function of the A380 EIPM system is to supply and monitor power to engine-mounted systems (Electronic Engine Control, Engine Monitoring Unit, Igniters, etc) and to provide Electronic Engine Control parameters to the aircraft systems. Mr Carl Burton, Director of the Electronic Department, and Mr Philippe Lomazzi, Head of Software Development, were in charge of this project. The software was produced entirely in C by Vibro-Meter using a team of six software engineers. The processing unit was based on a Motorola/Freescale chip and the software development environment was the GreenHills Multi IDE. The software integrity level assigned

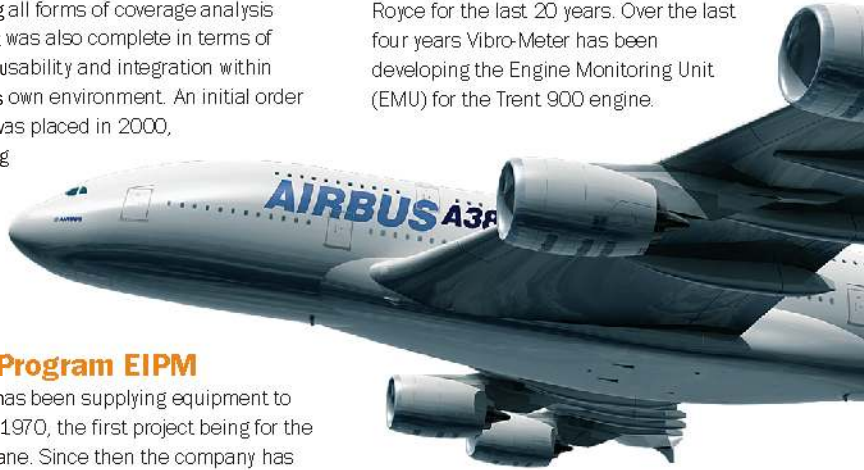
"Cantata can be used, after purchase of the related libraries, for different targets without problem."

was Level B. Cantata was used to perform the unit tests and provide evidence of 100% coverage at statement and decision levels. Vibro-Meter was required to perform the unit tests and coverage analysis both on a target simulator as well as on the real target. For these purposes IPL engineers customised Cantata for the Vibro-Meter environment, which was then supplied and installed without any significant difficulty. "Cantata can be used, after purchase of the related libraries, for different targets without problem. We have done this for both our A380 EMU and EIPM systems." says Philippe Lomazzi. This requirement was facilitated by Cantata's target features as the test script can be run unchanged in the target environment.

The first component of the EIPM was successfully delivered to Airbus in December 2003.

Trent 900 – Rolls Royce

Vibro-Meter has been working for Rolls Royce for the last 20 years. Over the last four years Vibro-Meter has been developing the Engine Monitoring Unit (EMU) for the Trent 900 engine.



The EMU monitors several advanced parameters such as engine vibrations, pressure, temperature and implements advanced algorithms for engine maintenance purposes. It also acquires engine vibrations for an on-board engine balancing process. The software integrity level assigned was Level C.

For this project, Vibro-Meter decided to use the TI TMS320C33 and Freescale PowerPC chips. The Green Hills Multi IDE and the TI Code Composer environments were used and the application was coded in C. Cantata was used in order to comply fully with the DO-178B standard and Vibro-Meter's engineers particularly praised the easy use of the tool and its technical solutions to enable straightforward module testing.

Conclusion

Both projects have been a real success and Cantata has proved itself in a mission critical environment. Vibro-Meter's confidence in IPL for the last seven years has been justified by the tool's successful deployment on both programs. Mr Philippe Lomazzi has the final word: "The systematic use of Cantata has enabled us to have the shortest unit tests phase possible with great efficiency in term of cost."

IPL would like to thank Vibro-Meter SA for permission to report on their experiences with Cantata, and take this opportunity to wish them well with ongoing and future programs.



A full description of the use of Cantata for DO-178B can be found on IPL's website at www.ipl.com/products/library

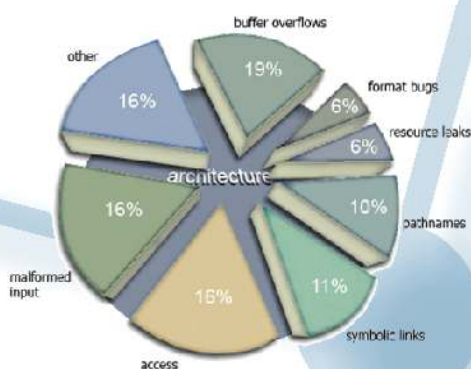
The Development and Maturity of Static Analysis

Source Code Static Analysis is a proven method of finding as much as 30% of all software defects in a given project¹. Adopting a "time zero" approach, the aim of static analysis is to find the problems as soon as they enter the code base, rather than allow them into the system where they are more difficult to find and therefore more expensive to fix. With this approach, the programmer is released to spend more time coding and adding new features to an application and less time debugging and testing. It also means that the traditional test phases of a project run through much more smoothly as many of the basic errors such as memory leaks, buffer overruns, use of uninitialised data, NULL pointer dereferences etc are caught before the code is tested dynamically. The test team can thus focus on checking the functionality of the code against its intended specification, rather than spend time solving programming errors.

Static analysis tools have been around in some form or another for almost the complete history of programming. Early forms of static analysis tools used simple pattern matching to enforce coding styles and find simple errors. Using this technique a programmer could search for a list of functions that were known to be dangerous and should be avoided. In the early stages the tools were difficult to use and limited in ability to find real bugs.

The next step in the evolution came by looking at code metrics, such as lines of code, ratio of code lines to comment lines, and cyclomatic complexity. Using these statistics, the developer could gain a greater understanding of the complexity and quality of the code. Cyclomatic complexity is one of the most widely used software metrics. It directly measures the number of decision outcomes in a program's source code. There is a correlation between the cyclomatic complexity, and how many dynamic test cases will be required to achieve full decision coverage. The metric can therefore be

useful in estimating test effort for a given module. Also, the more paths that can be taken, the more complex the code is, and the more likely that human error will have crept into the code. Other newer metrics such as coupling, and file churn can help to assess the impact and risk of changing a module, by measuring how coupled (dependent) the module is on the rest of the system.



Common Vulnerabilities and Exposures [Evans & Larochelle, IEEE Software, Jan 2002.]

The next stage was the development of more sophisticated searching algorithms to find defects in the interaction between multiple function calls. Examples include using an alloc without a matching free, and failing to close an open network connection. Semantic analysis was added, allowing tools to assess the basic structure and relationships of functions within an application. The additional contextual information helps the tool to understand errors which may exist on a particular code path in the application. The more advanced static tools, such as Klocwork K7, use abstract syntax trees to perform a run-time simulation of the code to predict what will happen to the code in real life. The most recent development has been the ability to create custom rules which help tailor the static analyzer to look for errors specific to an operating environment, application and coding standards.

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Klocwork - a case study

Mentor Graphics (www.mentor.com), founded in 1981 in Wilsonville, Oregon, is a leading supplier of electronic design automation (EDA) solutions.

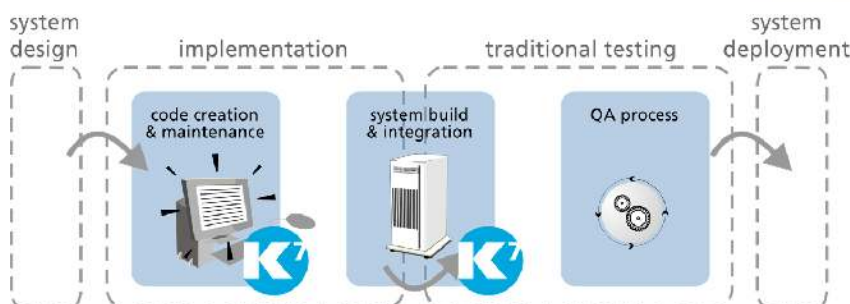
According to Kevin Pendleton, Director of Quality and Support Systems for the Systems Design Division at Mentor Graphics, "Mentor's code base is a complex combination of new technology, older technology, and acquired technology. We have different legacies for these technologies in terms of the languages we support, build environments, compilers, and so forth. Our challenge is to pull these different technologies together in order to provide integrated solutions for customers at every level of the PCB market, from entry-level shrink-wrap solutions through solutions for global, enterprise customers."

Mentor Graphics began to investigate Klocwork at the end of 2003. A quick overnight analysis of a small subset of Mentor's source code turned up legitimate defects in relatively mature code, and they were easily addressed because Klocwork points the developer directly to the line of code with the problem. A subsequent six-month pilot project focused on both defect identification and architectural analysis. "We saw an immediate return on our investment. Klocwork identified about 1,000 issues, and we were able to address 500 of them in our next release. All of them were found directly by the tool, without any QA team effort required," says Pendleton.

Mentor Graphics is integrating Klocwork into its build processes on Linux, Unix, and Windows and into the engineering desktop so that every time an engineer checks in code, a Klocwork analysis will run. This way, programmers can address any issues before their code enters the build process. Most of Mentor Graphics' source code is C and C++, but the company is doing more and more with Java — another reason why Klocwork's solution is a good long-term fit.

Mentor Graphics is also leveraging Klocwork's reporting capabilities to design a comprehensive dashboard with reports and metrics to help assess the ROI of future projects and to enable management and development team members to monitor the quality, health, and status of projects under way. "We've had good results so far," says Pendleton. "When we kicked this project off, one of the things I was concerned about was how we could measure ROI and progress over time. How many problems did we prevent from hitting the field? ROI was very quickly realized — within one release cycle. Based on our results so far, the tool is paying for itself."

Klocwork K7- a process wide static analysis solution



K7 integrates with IDE's to provide real time static testing capabilities, eliminating defects before they enter the code. K7 integrates with build environments to static test all system components as source code.

¹ Building Software with Quality and Speed, Srivibhavan Balaram, R&D Director, Hewlett Packard, Systems Technology & Software Division, Bangalore

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The best static analysis solutions today now have integrated defect detection at all levels, from developer desktop, through to system level. With added checks on security and the architecture, examining code bases for clusters, API issues and spaghetti code, it is estimated that the 30% defect detection figure could rise to as much as 40%. Architects can now use static analysis tools to perform "what if" scenario testing, refactor complex areas of spaghetti code, and devise rules

to protect the project from architectural erosion. The result is a suite of tools which can rapidly scan coding bases for defects in many different categories. This has resulted in **greater developer productivity, providing more secure and reliable code and providing excellent return on investment** compared to traditional testing techniques alone.

To see such tools in action, please contact IPL on tools@ipl.com.

IPL Adds Memory Monitoring Tool

Working in conjunction with OC Systems, IPL has created a new tool called **MemProbes**. The purpose of this is to detect memory problems in C and C++ software such as memory leaks and buffer overruns. **MemProbes** is best used at system test level, but can also be at lower levels, such as integration tests. The elimination of these memory problems complements the use of Cantata++ in the process of producing quality, reliable software and will be of particular interest to developers of long-running applications.

News in Brief

- IPL has extended the agreement for marketing of the **Klocwork** tool to include **France, Belgium and The Netherlands**. Stephane Rougerie has been added to the Klocwork team at IPL to help with this activity. This is in addition to the already agreed territories of the **UK and German-Speaking countries**.
- Internally, IPL Products has reorganised. Shaun Davey, previously in charge, is now IPL Sales and Marketing Director. **Ian Gilchrist** becomes Software Products Manager, and **Richard Keeble** becomes Products Support Manager.

New Customers

Over recent months we have been pleased to accept business from the following new customers (in alphabetic order):

Beijing Aerospace Standard Research Institute
Diagnostic Grifols
EDAG Engineering
InfoTech Enterprises
Jidian Engineering Research Institute
Konica Minolta
Korean Aerospace Industries
North Institute Beijing
NTE
Qinetiq
Simulation Systems
Valeo

New Support Engineers

The latest additions to the Cantata++ and AdaTEST 95 technical support team are Tom Longridge and Jenny Wright.



Alcatel

IPL is pleased to announce a corporate agreement with Alcatel for the supply of Cantata++ and AdaTEST 95 on a global basis. This agreement follows several years' successful use of IPL's products by various Alcatel business units around the World and is in line with Alcatel's policy to standardise on proven software technologies. Alcatel's business spans a range of high technology products, including telecoms, transport and space systems. The need for reliability of the software in these products is paramount; hence the adoption of IPL's testing tools.

Meet Us

Here are some of the events at which you can meet us:

May 24

Boards and Solutions, Reading, UK

August 29-31

TAIC PART, Windsor, UK

October 11-12

Embedded Systems Show, Birmingham, UK

Gilchrist & Downing



Testing Ted

Ports

In the past 6 months the following new ports have been completed:

- Cantata++** to several of the TI TMS320 chips including C2808, C2812, C6415 and C6203, also to the Renesas M32, H8S and HCS1.2 chips.
- AdaTEST 95** to AIX/Power Ada, and also to PPC/Gnat/VxWorks6.

Training

We continue to regularly run our one-day courses on:

- Cantata++ for C++
- Cantata++ for C
- AdaTEST 95

For further details see: www.ipl.com/tools/training

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