

Testing Times

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The IPL Software Products Newsletter

No 20

Cantata++ Embedded Deployment Package

IPL is pleased to announce a new support product, which will be of special interest to Cantata++ users with multiple embedded platforms. The Embedded Deployment Package (EDP) consists of the materials and training resources required by a user to port Cantata++ to any target platform.

The benefits in having a common testing toolset across all platforms are obvious:

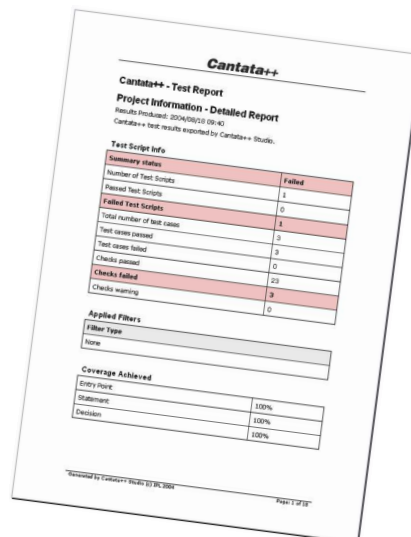
- Improved code quality from the ability to regression test on all platforms.
- Better productivity from the use of a common testing tool.
- Maximum return on the toolset and its training/familiarisation investment.

EDP includes the Cantata++ source code and the guidance necessary to port it to a target platform. Configuration for multiple targets is facilitated by a graphical user interface. The cost of the package includes the services of an IPL testing tool specialist for two days on-site, to provide expert technical support and consultancy, and assist with the first installation. The package also provides a fully auditable test validation suite, which can be used to provide standards certification evidence, as well as proving Cantata++'s functionality in the chosen embedded environments.

XML Results

With the latest version of Cantata++ (V4.0.1, now shipping) users can generate reports from Cantata++ Studio. These reports are generated in XML, allowing complete user customisation of test and code coverage results. Cantata++ Project Summary and Detailed Test reports are pre-supplied with XSLT files to produce

HTML or Microsoft Word versions of these reports, together with a simple guide to configuring your own format. These example reports are available in several languages.



Cantata++ - Test Report	
Project Information - Detailed Report	
Results Produced: 2004/06/10 09:40	
Cantata++ test results exported by Cantata++ Studio.	
Test Script Info	
Summary Status	Failed
Number of Test Scripts	1
Passed Test Scripts	0
Failed Test Scripts	1
Total Number of Test Cases	1
Test cases passed	0
Test cases failed	1
Checks passed	0
Checks failed	1
Checks warning	0
Applied Filters	
Filter Type	None
Coverage Achieved	
Entry Point	100%
Statement	100%
Decision	100%

Huygens' ultimate test approaches!

Software development is an industry where the results are not always immediately apparent. In 1993 Logica (now LogicaCMG) was contracted to write the software to control the descent of the Huygens probe into the atmosphere of Titan, one of Saturn's moons. If all goes to plan, the probe will land on Titan in mid-January 2005, and for a few brief minutes will undergo a controlled descent, while simultaneously analysing the atmospheric gases. Needless to say, the Huygens software was thoroughly tested on earth by the Logica engineers, using IPL's AdaTEST tool. We remember one Logica engineer saying

that seven years was a long time to wait to see if his code worked. Well, the time is getting nearer, so fingers crossed and best of luck!

EFA Adopts AdaTEST 95

Following extensive acceptance testing and evaluation at BAE Systems, AdaTEST 95 has been chosen as the preferred test tool for the Eurofighter Typhoon (Tranche 2) software development programme. In October 2004, AdaTEST 95 was formally accepted into the Eurofighter Typhoon system development environment.

Bugz Bunny

Computerised MoT test systems, originally due to be installed in 2003, have been delayed yet again due to 'software problems' and need for 'more testing'. *Computing, March 2004*

V22 Osprey flight trials are still being restricted by software anomalies. *Aviation Week and Space Technology, March 2004*

The Messenger Mercury orbiter launch was delayed by need for more software testing. *Aviation Week and Space Technology, April 2004*

UK airspace was closed/restricted to flights for several hours due to computer software fault. The problem was later attributed to a bug in a printer switch matrix, which had been dormant for 15 years. *NATS News, July 2004*

Bugs in the UK student loan system will leave some students facing the start of term without cash. *The Guardian, August 2004*



Inside: **AdaTEST 95** on the Saab Gripen & **Cantata++** in Motorway Control (IEC 61508)

AdaTEST 95 at Saab Aerosystems

- Testing for Success

*Contributed by Hakan Anderwall,
Saab Aerosystems*

Saab Aerosystems has been developing aircraft and aircraft subsystems for the defence market for over 60 years. Saab's products include fighter aircraft, unmanned air vehicles (UAVs), missile and helicopter systems.

One of the current projects at Saab Aerosystems is the re-implementation of the Stores Management Unit (SMU) for the JAS39 Gripen fighter aircraft. The SMU is responsible for the safe loading, release and unloading of the major weapons (bombs and missiles) carried by the aircraft. The software is being developed to the RTCA/DO-178B standard at criticality level A, using Ada 95 as the implementation language. As a result of the safety-critical nature of the software, it was decided to adopt the Ravenscar profile of the language, which has various restrictions aimed at promoting safe and reliable code.

AdaTEST 95 Customisation

To meet the stringent testing requirements, AdaTEST 95 was evaluated in early 2002, and selected for both unit and integration testing. Testing was to take place on both the host-native development platform and also on the target. The restrictions of Ravenscar meant that initial testing with coverage analysis had to be done on the host-native platform. The same tests were then repeated on the target, to ensure that the airborne code executed in exactly the same fashion as it had on the development platform. The standard AdaTEST 95 product was used for the host-native work (using the Aonix ObjectAda compiler) but for target use with the Raven version of the compiler, IPL produced a customized version of the tool. After evaluation of the product, the order was placed in May 2002 and real work started in autumn of the same year.

Low-level and integration testing

Integration tests involving complex hardware interactions were developed and run on the host, using AdaTEST's 'intelligent stubs' to simulate the behaviour of the real hardware. This included simulating timers, interrupts, communication links, and memory units. When testing the low-level,



JAS39 Gripen fighter aircraft

hardware-dependent code, tests were run directly on the target. Given the differences in the environments, it was a great advantage to be able to use the same tool in both: all the engineers involved in code testing were able to understand the testing approach, and could easily read and interpret the test results.

Productivity

One key factor in the successful use of AdaTEST 95 was the short start-up time for an inexperienced tester to become productive. The SMU team put some early effort into developing a test strategy and produced a "Test Style Guide". This had the beneficial effect of increasing consistency within the project, and also boosted productivity when new staff were introduced. IPL was very helpful in responding when technical issues were raised, and it is no exaggeration to say that most problems were responded to within one day. The project team's experience is that IPL's is the most professional technical support they have ever come across.

Sharing of stubs was used to increase productivity and minimize maintenance. However, where stubs contained significant 'functionality' they were not shared for reasons of safety and maintainability.

Automation and 'Test-on-Demand'

It was important for us to be able to develop each test suite independently, and then run from a main script which served to manage all the others. A high degree of test automation, for both host and target testing was achieved. The main feature here was the ability to analyse the results from both host and

target runs, and merge the test results, source code coverage and object coverage into a single overview which was visible to and understandable by everyone in the team.

However, since the target testing facilities were a limited resource, the automation was limited here to the ability to build the tests, but only execute when the resource was free. A 'Test-on-Demand' facility was developed, integrated with the project configuration management system, to force all available tests to be run.

Test Architecture

The test automation architecture that was developed for the SMU project has been found to work well on another project at Saab Aerosystems. The scope of the testing, safety criticality, and the host and target environments are all different, but nevertheless the principles are all perfectly reusable, and are now giving major productivity benefits to the new work. It is expected that AdaTEST 95 will continue to be used at Saab for a long time to come.

Hakan Anderwall is a software test engineer at Saab Aerosystems, specialising in test automation, especially for embedded safety-critical systems. He has managed and also played a practical role in the testing of large and small projects. Hakan can be contacted at hakan.anderwall@saab.se

Since this article was written IPL have produced a new version of AdaTEST 95 which can be used with the Raven compiler to do full coverage analysis on the target. For further information on this please contact IPL.

Cantata++ for Safer Motorways - Software Testing and IEC 61508

This case study describes the use of Cantata++ on one of IPL's own projects, to produce a system to the safety standard IEC 61508. This standard has very wide scope and covers the development of all systems for safety-related roles, and in particular the development of software for programmable devices. This case study looks at how one specific highway (road transport) system development used Cantata++ for software testing in its fulfilment of IEC 61508.

Motorway Systems

The client, the Highways Agency (HA), has responsibility for managing, maintaining and improving the motorway and trunk road network in England. Several computer systems are already in place to help with the task of avoiding congestion. The current system used to control roadside equipment and monitor road conditions is called NMCS2 (National Motorway Communications System 2). An ATM (Active Traffic Management) pilot project is currently being run by the HA on one section of the motorway network. The aim of ATM is to make best use of existing road space to increase capacity and ease congestion, by controlling traffic according to actual and predicted road conditions.

In 2002 the HA invited tenders for the development of a new subsystem called the Network ATM Supervisory Subsystem (NASS), to form an additional element within the existing NMCS2 and future ATM systems. NASS takes real-time traffic flow data, combines this with historical flow data, and then predicts future flows. If congestion is predicted, NASS will evaluate a number of predefined traffic control plans to avoid or minimise the predicted congestion, selecting the optimal plan. NASS will then issue requests for the settings of roadside signals and message signs to implement predefined traffic control plans.

The NASS contract was awarded to IPL in late 2002. NASS is approximately half-way to ultimate completion, having successfully progressed through a "proof of concept" (PoC) phase. The next release of the software will interface to a simulated NMCS2 system, and by early 2006 it is



anticipated that NASS will be ready to go live.

Safety Assessment

The use of IEC 61508 was mandated by the HA as a result of consideration of the hazards involved. At the start of the NASS project, IPL engineers assessed that the safety level appropriate for the project was SIL 1. This relatively low grading reflects the fact that NASS does not directly control any hazardous equipment, but is involved in issuing requests for traffic sign and signal settings which can have safety consequences when acted upon.

Progress

IPL started work in early 2003. Having agreed the system requirements in detail for the PoC phase, software design followed a method based on the use of UML. This led to the identification of 20 software components (6 executables and 13 libraries) to make up the active NASS elements. Detailed design proceeded to specify the software packages and modules (classes). The classes, totalling 94 in number, were then implemented in C++.

For testing, not unnaturally, the IPL engineers chose to use Cantata++. This was partly because they were familiar

with it, but also because it provides all the functionality needed to test to the IEC 61508 SIL 1 standard. The basic requirement is to test every class in isolation and to demonstrate code coverage to the levels of 100% entry-point, statement and condition. Since every class had a number of external interfaces, not all of which could be stubbed, the Cantata++ 'wrapping' facility was vital in allowing such isolation testing to be completed as planned.

In addition to testing all classes as unit tests, the IPL team performed package and integration tests of most NASS components with Cantata++. Since 100% coverage had already been achieved during unit testing, integration testing could be allowed to live up to its name, namely testing the integration of the software units. The team, with the agreement of the HA, determined that 100% entry-point coverage was suitable to demonstrate the completeness of the integration tests. This is in fact consistent with the 61508 requirement to demonstrate that, "all software modules... interact correctly to perform their intended function..."

Following component testing the team carried out System Integration testing prior to the final level of testing, Factory Acceptance Tests (FAT). It was noteworthy that the system integration tests ran smoothly and revealed only a few design anomalies. These anomalies were fixed before FAT, which was run in December 2003 and finished within the five days which had been allocated in the original project plan.

The Future

The NASS project has completed the PoC phase, with the production of about 20 KLoC of thoroughly tested C++ code. The second "demonstrator" phase is well advanced and will lead to a doubling in the volume of code. However, success in such a project does not just mean the creation of a given amount of software. Rather, it means the production of code which is well-tested, to an agreed and suitable safety standard. So far all the evidence points to Cantata++ fulfilling its role perfectly.

Readers interested in finding out more on how IPL tools can help satisfy IEC 61508 at all SIL levels, are referred to our paper: www.iplbath.com/pdf/p0811.pdf.

Customer Quotes

"I'm happy to say that Cantata++ seems to fulfil our demands on a test tool. The user interface is straightforward and intuitive so the learning period until you can do some 'meaningful' work is quite short."

Delaval

"I evaluated Cantata++; it is a very great tool."

Intel

"...I would like to thank you and IPL in general on behalf of the NATS/ACID team for your prompt and valued assistance in this matter. Testing is a critical part of our project and Cantata++ has proved to be a valuable asset in this regard."

NATS

"[AdaTEST 95] is a powerful tool!"

ACT Europe

"I am impressed - [having] used Cantata++ from the IDE for code coverage analyses..."

Grintek Communication Systems

News In Brief

In the last 8 months:

- AdaTEST 95 has been ported to the GNAT Pro ERC32/Ravenscar compliant environment.
- Cantata++ Version 4.0.1 is now available and shipping.
- Cantata++ has been ported to the WinCE target environment
- Cantata++ has been ported to Diab/PPC environment running with the Lauterbach emulator.
- A new paper is available outlining the way that the OMG Testing Profile Specification matches the capabilities of Cantata++ and AdaTEST95.
- Cantata++ has been integrated with TNI Reqtify. This integration provides an effective solution to demonstrate traceability between requirements, test scenarios and test results.
- IPL has joined the ACT academic partnership to promote the teaching of Ada in universities and similar organisations.

New Customers

Over recent months we have been pleased to accept business from the following new customers:

- Aeronautical Defence Agency (India)
- Alaris Medical Systems (UK)
- Aselsan (Turkey)
- BAE Systems (Australia)
- Baumuller (Germany)
- Bombardier (Germany)
- BSI (Germany)
- Communication Telemetry and Telecontrol Institute (China)
- Delaval (Sweden)
- ESW (Germany)
- Feiyan Electronics Technology (China)
- Fiat Central Research (Italy)
- Goodrich Engine Control Systems (UK)
- Japan Aviation Electronics Industries (Japan)
- JiDian Engineering Institute (China)
- LPSC (France)
- Matsushita Electric Industrial Co. Ltd (Japan)
- Mermec (Italy)
- Nanjing University of Aeronautics and Astronautics (China)
- Philips Software Centre (India)
- QinetiQ (UK)
- Siemens Medical Systems (Germany)
- Siemens VDO (Germany)
- Sirio Panel (Italy)
- Shanghai Weixing Engineering Institute (China)
- Tian Da (China)
- Volvo (Sweden)
- Xiang Yu Space Technology Corporation (China)

Meet Us

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

April 5-7 2005: RTS Embedded Systems, Paris, France

April 2005, STC, Salt Lake City UT, USA

May 2005, STAR East, Orlando FL, USA

New Support Staff

Ben Braine and Chris Sharpe, have been added to the technical support team working with a newly promoted Technical Support Manager, Richard Miskin.

IPL Expands

Growing demand for IPL testing tools has led to an expansion of our sales and support capacity.

Sales

IPL will be directly responsible for sales and support to the eastern time zone of North America. Steve Howard and Ian Gilchrist will be the main contacts. A new toll-free number, 888-370-TEST, is available for all clients in North America.

Adam Mackay has joined an expanded sales team, and Neil Langmead is likely to be spending substantially more time in Germany in the near future.

New Agents

IPL has again expanded its network of local agents: Salesteam srl based in Milan, cover Italy, Nohau Elektronik based in Vaanta cover Finland, and Channel Technologies Pte Ltd based in Singapore cover Singapore, Malaysia, Indonesia, Taiwan, and Vietnam. For contact details see the IPL Partners page www.iplbath.com/tools/partners.

Training

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

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

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

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