

# Testing Times

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The IPL Software Products Newsletter

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## Cantata++ V3 - Summer 2002

IPL is pleased to announce a major new release of Cantata++ later this summer.

### New multi-platform user interface

A new easy to use graphical user interface (GUI) will be available on all host platforms - for both AdaTEST 95 and Cantata++. This user interface has a range of helpful features designed to make thorough testing easier, more intuitive and more productive.

### Multi-lingual

For our many non-English speaking customers the new GUI will ultimately be available in a variety of native human languages, including German, French and Modern Chinese.

### Test Wizards

The Cantata++ GUI features a set of Test Wizards that guide users through the powerful dynamic testing features available, and cut test production time. This includes 'white-box' access to private class data, generating Stubs and Wrappers, case-by-case call sequence validation for interface testing and generation of a template test script. Rule-based checking for code coverage and static analysis requirements will also be available.

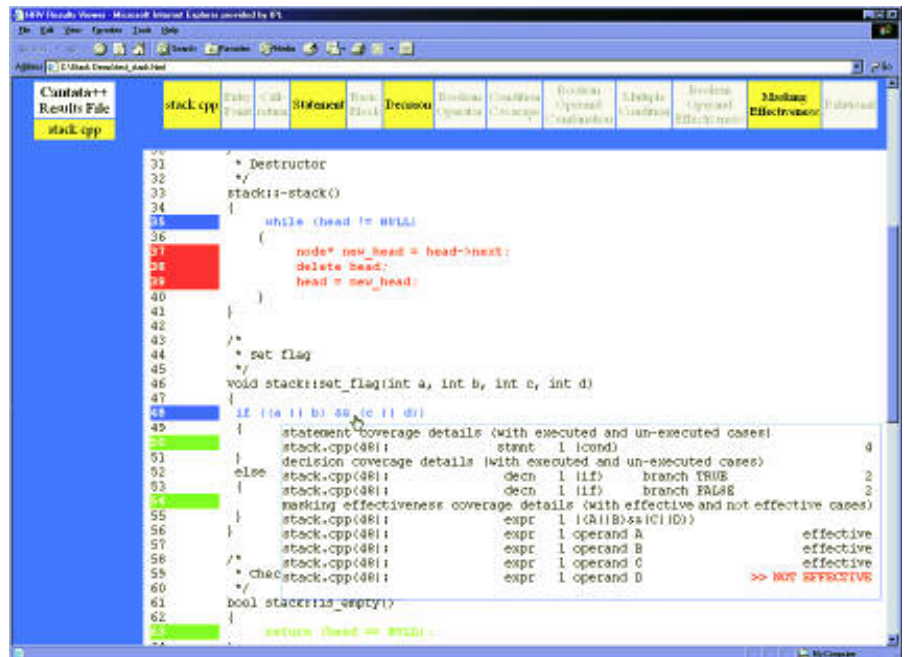
The Test Wizards also assist the user in setting the tool options necessary to allow tests to operate within the project's build mechanism.

### C and C++ testing in one tool

Cantata++ 3.0 will provide a complete testing package for C/C++. Existing Cantata tests will be fully compatible with Cantata++ 3.0, and by moving to the Cantata++ product, Cantata users will gain access to an extensive range of powerful new features, such as wrapping and context-sensitive code coverage.

### Full support for C99, C++ & EC++

C compilers are starting to conform to the latest ISO standard for C, known as 'C99'. The current version of GCC



```
31  * Destructor
32  */
33  stack::~stack()
34  {
35      while (head != NULL)
36      {
37          mode* new_head = head->next;
38          delete head;
39          head = new_head;
40      }
41  }
42
43  /*
44  * set flag
45  */
46  void stack::set_flag(int a, int b, int c, int d)
47  {
48      if ((a || b) || (c || d))
49      {
50          statement coverage details (with executed and un-executed cases)
51          stack.cpp(48:1)  stmt  1  lcond)  4
52      }
53      else
54      {
55          decision coverage details (with executed and un-executed cases)
56          stack.cpp(48:1)  decn  1  lif)  branch TRUE  2
57          stack.cpp(48:1)  decn  1  lif)  branch FALSE  2
58          masking effectiveness: coverage details (with effective and not effective cases)
59          stack.cpp(48:1)  expr  1  l((A||B)&&(C||D))  effective
60          stack.cpp(48:1)  expr  1  operand A  effective
61          stack.cpp(48:1)  expr  1  operand B  effective
62          stack.cpp(48:1)  expr  1  operand C  effective
63          stack.cpp(48:1)  expr  1  operand D  NOT EFFECTIVE
64      }
65      bool stack::is_empty()
66      {
67          return (head == NULL);
68      }
69  }
```

### HTML Results Viewer

already does so. Cantata++ 3.0 fully supports the C99 language standard. The Cantata++ parser now checks code for full compliance with the ISO C++ standard. EC++ (Embedded C++), C++ optimised for the size and performance requirements of embedded systems, is becoming widely adopted in many industries. Cantata++ now completely supports many EC++ development environments.

### HTML Results Viewer

A new HTML results viewer (HRV) is also available for all Cantata, Cantata++ and AdaTEST users under maintenance. HRV automatically creates results files in HTML for every test run. Check Passes and Fails are colour highlighted for easy reference.

HRV also provides a colour coded coverage view of all source files under test, with the ability to select individual coverage metrics and view full code execution details. For an example see [www.iplbath.com/tools/hrv](http://www.iplbath.com/tools/hrv).

## Bugz Bunny

A number of 'glitches' have been reported in the press. Funny word that. It implies something that 'just happens'. Bugz says - they're just bugs, and you can eliminate them with testing!

May 2001. Osprey aircraft crash was attributed to a software anomaly. A review of the incident, in which 23 marines died, concluded that some software changes had not been tested.

May 2001. BT Wireless 'humiliated' by hold-up on the UK's first 3G mobile network on the Isle of Man. The three-month postponement is said to be due to a 'software fault' in the handsets.

June 2001. New York Stock Exchange was shut down for about 90 minutes. This was blamed on new software introduced overnight.

July 2001. An attempt to unfurl an experimental 'solar sail' in orbit failed when a software error stopped the sail separating from its launcher: it crashed.



Inside: **Cantata++** in Rail Transport  
Article on eXtreme Programming

# **Cantata++** at Alcatel Berlin

## *“It’s All About Safety”*

### **21st Century Solutions**

As part of the drive towards greater integration in Europe, the EU recognised the drawbacks of the diversity of the individual national railways and so set about a programme of harmonisation. This resulted in the European Rail Traffic Management System (ERTMS). This project encourages the European railway industry to create an interoperable European Train Control System (ETCS). Alcatel, a world force in high-speed telecommunications and transport automation, understood the importance of this evolution and has invested extensively in R&D to produce innovative ETCS solutions.

This case study features the Transport Automation group of Alcatel Berlin, which is developing a radio-based, high-speed transportation control system. This system provides enhanced safety, greater capacity and significant operating cost advantages to rail operators. Intended to deliver a system designed for 21st Century railways, the development is required to perform high-level safety-related tasks conforming to the European Committee for Electrotechnical Standardization (CENELEC). We examine how Alcatel selected and used IPL's testing tools on an ETCS project, a collaborative venture with the Siemens Transportation Systems group, and how its software testing processes have developed during the course of the project.

### **Critical Software Testing Requirements**

The main task was to develop two applications - one for radio block control on track-side written in C++, the other for the train itself to be written in C. The development environment was hosted on Solaris and the selected target architecture was an Alcatel-developed system known as TAS. For obvious reasons, the software had been assigned to the highest safety integrity level (SIL) defined by CENELEC. This SIL demands - among other quality assurance activities - the testing of the software at all levels, from module to system, including defect tracking. Alcatel was required to demonstrate



*Alcatel's Test Track Facility*

that the code had been unit tested, and also that 100% coverage of statements and 95% coverage of decisions had been achieved during testing. Test execution was to take place in the simulation environment based on the Solaris host.

### **Reliability**

Alcatel and Siemens first began searching for possible software tools in 1998. Their overriding requirement was reliability - both from the tool and its supplier. With a range of possible tools being considered, Alcatel approached IPL and discussed their requirements in detail. Patrick Roßbach, involved in the tool evaluation, explains: "The advice we obtained from IPL was first class. Throughout our dealings with IPL, they were professional, flexible and expert in their field. We immediately identified that IPL were people we could work with."

IPL's testing tools met the given admission requirements very well but then had to undergo an in-depth technical evaluation on Solaris in conjunction with the GNU compilers.

### **Easy integration**

As Egbert Voigt, the leader of the development team, explains: "Our understanding of software engineering

and the demands of CENELEC expect that our development environment had to be supported by comprehensive configuration management, requirements management and traceability, use of CASE tools from analysis down to code generation and multi-level testing". Therefore, an important part of the evaluation was to see how compatible the IPL tools were in such a multi-tool environment. "It was essential to use flexible tools that could 'slot-in' easily to this structure", he concluded.

Cantata++ had to prove its adaptability by being integrated into a hierarchical 'make' structure for regression testing, by integration with the CASE tool for test case design and by allowing the publication of test results via a web-based Information Management System.

### **Training Expertise**

A major problem facing Alcatel was finding a robust testing tool that could cope with the demands of testing object-oriented software using features such as templates, polymorphism, reuse, and abstract base classes. As part of the technical evaluation, Jürgen Sievers attended IPL's training courses in Munich. He remarks, "The courses

explained exactly the problems we had envisaged when considering testing object-oriented software; the Cantata++ solutions to these problems were truly remarkable." Following a successful evaluation of the tools and with the very promising experiences during the co-operation with IPL's technical support engineers, Patrick Roßbach was in a position to recommend that IPL's tools were the best choice for the project.



ETCS Test Vehicle

### Successful process development

Selecting a tool is only ever the first step of a tool procurement strategy. The integration of Cantata++ into the development tool chain had already taken place during the evaluation phase. The experience Alcatel had gained during this integration was valuable in specifying and refining its development process and associated quality system. Finally, the prospective users had to be trained. As Patrick Roßbach comments: "One of the decisive reasons that Cantata++ became a success story in our project was the participation of all developers on IPL's training programmes. During the courses, not only was the tool's handling taught but, more importantly, the general principles and aims of the module testing process were clearly explained."

Patrick concluded, "Looking back, Alcatel is very pleased with the choice of the IPL tools. Technical, organisational or formal problems and unexpected challenges arose along the way, as is usual in business projects. These could not always be solved easily, but IPL's professional support and help always saw us through".

Egbert Voigt remarks: "Cantata++ does not confuse the user with overkill features, but it offers all necessary solutions for straightforward module testing that the developers will get into quickly. When switching to a new platform release, Cantata++ was a great relief for us. The regression test ability allows us to verify the success of the migration of our application. During integration testing the non-recurring wrapper mechanism of Cantata++ turns out to be a helpful solution for having a

look at the internal module interfaces. This gives safety about internal events, assists to efficiently detect and narrow down bugs and allows us to easily provoke unusual internal states for testing application's non-standard behaviour."

### Coverage improves motivation

Using Cantata++ not only led to a higher quality of software, but also a greater pride and motivation among team members. Cantata++ coverage analysis used in conjunction with the Cantata++ test harness proved that the software had been well tested. One team member remarked: "Measuring the coverage reached during module testing seems to give some developers a new experience about the progress of their work. Usually during development activities it is difficult to estimate the maturity of work. Recognising the rising coverage gives direct feedback about the effect of module testing and motivation to complete."

### Conclusion

Alcatel knew what they needed to test their high-integrity software. They wanted a 'state of the art' testing solution, backed up by excellent technical support and training. Cantata++ has proved itself in a mission critical environment and Alcatel's confidence in IPL was justified by the tool's successful deployment on the ETCS program.

*IPL would like to thank Alcatel for permission to report on their experiences with Cantata++ and take this opportunity to wish them well with their ongoing ETCS program.*

## Cantata++ - useful in the eXtreme !

*By IPL Consultant, Steven Foster*

Many clients have indicated that they are considering using Cantata++ to test C++ in an eXtreme Programming (XP) context. This article explores some of the benefits that Cantata++ can bring to an XP project.

Kent Beck developed the XP technique while working with Smalltalk at Tektronix. Its aim is to facilitate cost-effective development of quality software when requirements are vague or continually changing. It does this by embracing change as part of the development process. Development occurs in short well-defined iterations. Code is refactored (redesigned and simplified) at every opportunity. The system is defined solely by the test

scripts and code, and by brief customer derived story cards that describe aspects of system functionality.

Testing is a cornerstone of the XP methodology. Programmers implementing any new functionality work in pairs at a single computer and will usually write a unit test first, followed by the minimum code that will allow the test to pass. This process is repeated until all the functionality is implemented. Problems that arise when new functionality is added are fixed immediately. The unit tests establish that the individual classes behave as expected. Once the new unit tests and existing unit tests all pass, the second level of tests, known as functional tests, will be run. These are specified by the customer and give confidence that the new code meets customer requirements.

Cantata++ provides a reliable framework in which to run unit and functional tests in an object-oriented (OO) development paradigm and provides objective measurement of the effectiveness of the testing strategy. These features are particularly relevant to the XP methodology:

- Test scripts are written in the development (C/C++) language giving flexibility and a low learning overhead
- Test execution is easy to automate and gives an unambiguous pass/fail.
- Unit tests can be independent - one test failing will not cause others to do so
- OO coverage metrics quantify confidence in the thoroughness of testing OO code and highlight where additional test cases are required or where redundant code can be refactored
- OO complexity metrics highlight code that is difficult to maintain and assess testability.
- Cantata++'s unique wrapping technology gives full control over the interface between the object under test and external software.

C++ gives an opportunity to write maintainable code but has pitfalls for the unwary. Strong static typing along with #include dependencies can result in code that is costly to maintain and test. Cantata++ static analysis provides most of the well-known OO complexity metrics such as Robert Martin's object-oriented dependency metrics and Chidamber and Kemerer's MOOSE metric set. These metrics can indicate early in the development process if code is becoming unmaintainable or too expensive to test.

***Hence, Cantata++ fully supports XP, making this methodology viable for producing high-reliability software.***

## New Customers

In the last few months we have been grateful to receive the custom of the following new companies (in alphabetical order):

Agilent, AK Aerotek, Alcatel Mobile Communications, Alstom Transport, Amedis Pharmaceuticals, Austrian Research Centre, China North Industry Group, Datel Defence, Disetronic Medical Systems, East China Institute of Computer Research, Grintek, Hindustan Aeronautics Ltd, Innomedic, Instrumentarium Corp, Intecs Group, Kongsberg Seatex, L&T InfoTech, Markem Technology, Mevis Technology, MilSOFT, Philips Digital Networks, Raytheon Systems, Satyam Computer Services, Smiths Industries, Taiji Computer Corporation, TeleSpazio, Thales Avionics UK, Vikram Sarabhai Space Centre, Yomi Solutions.

## Customer Quotes

As usual we are including a few of the comments made by our users in recent months. Thank you to our customers for their positive feedback.

*"It's easy to be positive when working with such a superior tool as AdaTEST 95. I've worked with a few testing tools in my time, both commercial and free, and yours is by far the best."*  
ConsultIT/Kongsberg, March 2002.

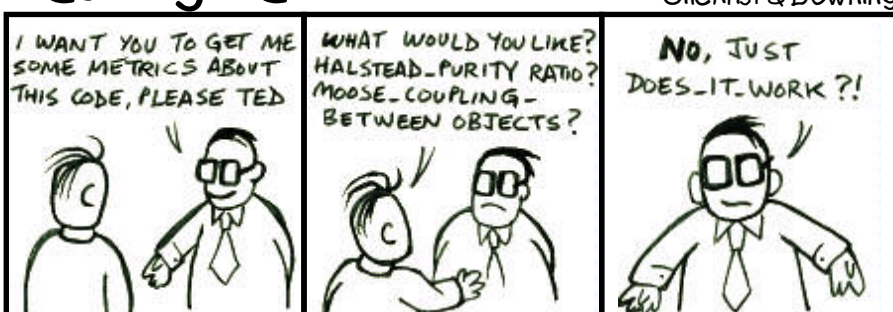
*"I can confirm that the IPL tools Cantata++ and AdaTest are first class tools for testing purposes and should be on our list of recommended tools."*  
Logica, April 2002.

*"First of all I feel I must say thank you for a great tool! It also feels stable unlike many other tools. I just have to love a supplier like you guys. We're talking ultra-smooth... ;-)"*  
ABB Robotics, May 2001.

*"I would like to thank \*you\*, for being about the easiest and most professional company to deal with. Rest assured that I will sing IPL's praises at every opportunity!"*

Thales ATM, June 2001.

## Testing Ted



Gilchrist & Downing

## New Support Engineers

Chris Priest and Adam Mackay have recently joined the Technical Support Team. They will be specialising in AdaTEST and Cantata/Cantata++ respectively; continuing the tradition of top class support.



Chris Priest and Adam Mackay

## Green Hills Partner

IPL is pleased to announce that we have recently joined the Green Hills partner program. This will allow us to provide an even closer integration between Cantata++ and AdaTEST, and the Green Hills MULTI IDE.

## New Articles

We have written a paper in response to the recent FDA 'General Principles of Software Validation', which should be of interest to medical equipment developers and manufacturers. This and a new paper on 'Target Testing and EC++' are available at the website at [www.iplbath.com/tools/papers](http://www.iplbath.com/tools/papers).

New Technical Notes (available to customers):

AdaTEST 95: coverage techniques for system testing; how to handle elaboration code; testing private types.

Cantata++: enforcement of C++ coding rules; testing DLLs; inheritance context coverage; using Cantata++ with I-Logix Rhapsody.

## Monthly News

Don't forget that a monthly news update appears on our website at [www.iplbath.com/tools/news](http://www.iplbath.com/tools/news).

## Product Ports

Here are some of the new product ports which have been performed in the past few months:

AdaTEST 95: Rational Apex 3.2, ObjectAda 7.1, GNAT 3.14, Green Hills 3.1, ERC32, Coldfire (GHS/GMART), i960 (ICC).

Cantata: Tornado2, ERC32 (gcc/egcs), PPC (GHS), PPC/WinCE, Hitachi H8, 8051 (Keil).

Cantata++: Solaris x86, Linux 2.4 Kernel, StrongARM (GHS), V850 (GHS).

For current platform availability see the website or contact your supplier.

## Meet Us

Here are some of the events where you can meet us:

- QBIT Tools Fair, 19 September 2002, London.
- Embedded Systems Club, 29 October 2002, Swindon.
- EuroSTAR 2002, 12-14 November, Edinburgh.

## Korean Agent

IPL is pleased to announce that Genesis Technologies Corporation will act as IPL's local agent in South Korea. For contact details of all IPL's distributors and sales agents see our web site at [www.iplbath.com/tools/partners](http://www.iplbath.com/tools/partners).

## Training

See our web site for information on IPL products' training courses: [www.iplbath.com/tools/training](http://www.iplbath.com/tools/training).

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