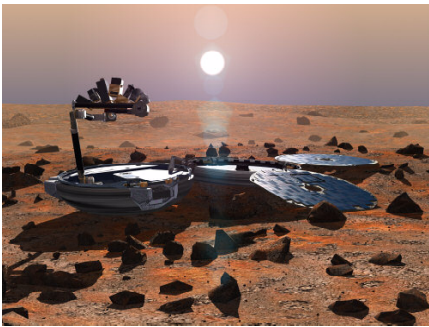


AdaTEST

There's No Room For Failure

Astrium is Europe's major satellite and space vehicles developer. It has operating companies located in France, Germany, UK and Spain, and is a successful participant in space work all over the world. Two current projects in the UK serve to illustrate both the breadth of Astrium's work and its commitment to producing on-board software to the demanding standards required for deployment in space.



Beagle 2 on the Surface of Mars.

*All rights reserved Beagle 2,
www.beagle2.com*

Case Study: Astrium

BACKGROUND

Funded by the Canadian Space Agency, RADARSAT-2 is planned to launch in 2004; it will carry advanced radar equipment enabling it to perform detailed topographic mapping of the Earth's surface. The Synthetic Aperture Radar Sensor Electronics it will use is being supplied by Astrium Ltd, based on equipment and systems originally developed for Europe's Envisat.

A different kind of spacecraft altogether, Beagle 2, is a UK-led Mars lander, intended to carry out a range of experiments to investigate whether life has ever (or still does) exist on Mars. It will be launched in June 2003, as part of the larger ESA Mars Express mission. Beagle 2 is being developed by Astrium Ltd. on behalf of the Open University who are leading the academic investigations of the quest.

MAXIMISING RELIABILITY

Both projects require the production of large amounts of on-board software. The need for the highest level of software reliability is paramount in both cases, though for different reasons. In the case of the RADARSAT-2 project, the need for reliability is driven by customer requirements for high-availability of the sensing instruments. A significant proportion of the software cannot be changed once the craft is launched, so the very highest standards have to be applied. In the case of Beagle 2, the weight constraints on the craft are such that very few of the usual redundant systems can be incorporated in the design. Hence the systems, including the software, just have to work - there is no fallback.

Quite early on in the software projects' lifecycle some key decisions were taken to help maximise software reliability. One of these was to use Ada, and in particular the high-reliability 'Ravenscar profile' subset. Another decision was to conduct a detailed program of software unit testing. Dave Yetton, Software Project Manager for RADARSAT-2 says, "As a company we are 100% committed to the idea of unit testing. We have done it before and believe it is one of the best ways to gain confidence in our code."

The choice of software testing tools was fairly quickly resolved because Astrium had used AdaTEST previously on the Envisat programme and other projects. AdaTEST had a good track-record in the company and was liked and respected by Astrium's software engineers. In the case of Beagle 2, Astrium were not directly involved in writing the software, but were using two software subcontractors (Logica and Coda SciSys). Bill Edwards is Astrium's Software Manager in charge of the Beagle 2 programme, and says, "Both of these companies had previous positive experience of AdaTEST, so the choice of AdaTEST 95 was easily agreed." Delivery of the tools took place during early 2000, and work began.

TESTING PRODUCTIVITY

The Astrium engineer most closely involved with RADARSAT-2 software development work was Dan Marshman. He says that the ease with which his engineers learnt to use AdaTEST 95 was a crucial factor in making the team productive quickly. "In a matter of days, a programmer could be testing code with AdaTEST 95 from a standing start. The product needs little or no training and is quite intuitive to learn, even for beginners." The total volume of RADARSAT-2 code that needed testing was around 20 KLoC with about 225 separate unit tests to be created and run.

Given that the Ravenscar target environment was a new quantity for Astrium, it was important to ensure that tests would also run on the target. This was facilitated by AdaTEST 95's target features - scripts can be run unchanged in the target environment. It became the project standard that all 'critical' code would be tested in this way, while less critical code would be unit tested only on the host.

The total size of Beagle 2 code was about 950 Kbytes with about 80 Objects. The original intention had been to test only on the host but it very quickly became apparent that a lot of the code could only be run on the target. Since the initial AdaTEST 95 delivery did not permit coverage on the target (due to the Ravenscar restrictions of the compiler) a minor crisis threatened to develop. However, says Bill Edwards, "IPL rose to the occasion and offered to look into the problem based upon an idea provided by the compiler supplier. They quickly implemented a very capable working solution, which most importantly for us did not eat into our limited budget and has proved as reliable as the rest of the AdaTEST 95 product."

NEW WAYS OF TESTING

The RADARSAT-2 project was keen to explore new ways of testing which would build on the previous experiences of AdaTEST. Dan Marshman describes some of the innovations they introduced. "The first improvement we made was to use shared stubs. In this way we avoided many of the recompilation issues introduced previously as code changed. The vital enabling technology was our configuration management system which allowed AdaTEST 95 scripts and stubs to be kept in tight step with each other."

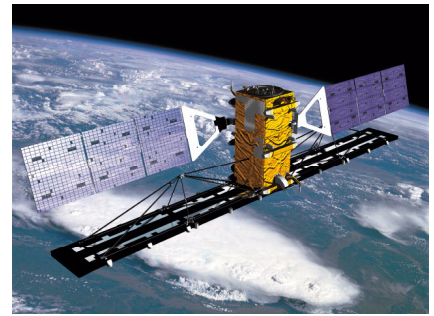
A second major issue was that they were making extensive use of OO design and programming techniques. The approach to testing that the team adopted was based closely on the hierarchical integration testing methods recommended by OO specialists. This involves fully testing code for base class implementations and then testing only the added or changed functionality for derived classes. "This worked well for us," says Dan Marshman, "even though we had up to five levels of derived classes." As work progressed they also learnt another useful OO testing trick, namely that of coding tests as child units of the units being tested. This conveniently allowed white-box access to class private components, and is a useful addition to the more well-known test points technique for accessing package body data. They did learn however that Ada protected objects do not fit comfortably into a deep class hierarchy, so some new techniques had to be evolved to deal with these situations.

CONCLUSIONS

Both the RADARSAT-2 and Beagle 2 projects are nearing the end of software production. Bill Edwards has only praise for the contribution of AdaTEST 95. "It gave no problems in use for the entire duration of the project and we could carry out coverage testing on the target with the updated version, even though the compiler supported the Ravenscar Profile." Dan Marshman concurs, "It was productive from day 1. AdaTEST 95 has been fantastic for us. It is easy to use, reliable, and gives us exactly what we want, both from our own point of view as developers, and also looking at the need to give our customers results data which they can understand and depend on."

Dave Yetton has the final word. "My projects have used the IPL testing tools for quite a number of years. Over that period we've come to respect the products, and also IPL's willingness to support them and provide us, the customer, with an exceptional level of assistance. I fully expect that we will be using more of IPL's tools in future work."

IPL would like to thank Astrium for permission to report on their experiences with AdaTEST 95, and take this opportunity to wish them well with ongoing and future programs.



RADARSAT-2
© Canadian Space Agency,
www.space.gc.ca

FURTHER INFORMATION



Software Products Group
IPL Information Processing Ltd
Eveleigh House
Grove Street
Bath
BA1 5LR
United Kingdom

Telephone: +44(0) 1225 475000
Facsimile: +44 (0) 1225 444400
Email: tools@iplbath.com
<http://www.iplbath.com/tools>



Copyright © IPL 2003.
All trademarks acknowledged

The text for all IPL product case studies is agreed and approved by the customers.



Certificate Number FM 01589