
Flight Control System Execution Timing Analyzed Cheaper, Faster with RapiTime



Challenge

When an industry-leading avionics supplier set out to develop the Flight Control System for a new class of aircraft, its key objectives were to improve product quality while simultaneously driving down development costs. In critical applications such as flight control systems, the timing behavior of the system is as important as functional behavior. Therefore, establishing the system's execution timing cannot be an afterthought. Early detection and resolution of potential timing problems brings benefits both in terms of reduced development costs, but also in improved quality.

The supplier's previous approach to ensuring execution timing relied upon effort-intensive manual processes. Large quantities of tests were required to obtain time measurements. Painstaking effort was then required to map the measurements back onto the underlying architecture. The high cost of collecting this information made it undesirable to repeat measurements throughout the process.

Solution

The avionics supplier considered several alternative approaches for automating the process of measur-

ing software execution timing before selecting RapiTime from Rapita Systems. RapiTime is a tool suite that analyses the timing behavior of embedded software by combining a static model of the code structure with dynamic results in the form of detailed measurements of on-target timing behavior. In addition to recording the distribution of execution times (including minimum, maximum and average) and code coverage, RapiTime adds the ability to predictively model untested paths (which it creates by composing previously tested path components).

The Challenge

To improve early detection and resolution of timing problems on a flight control system while reducing development effort

The Solution

RapiTime on-target profiling automates execution time measurement and highlights potential problem areas

The Benefits

- **Identifying the causes of timing problems with less than 10% of the effort of previous approaches**
 - **Showing specific fixes are free of side-effects**
 - **Providing convincing evidence that timing requirements have been met.**
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"It was the combination of static and dynamic analysis that attracted us" commented Wayne King, Engineering Fellow "We were concerned that an approach that relied only on static analysis was dependent upon getting the model of the hardware

exactly right. RapiTime's ability to measure code executed on the target hardware removes that risk from the outset."

RapiTime distils huge amounts of information into digestible, human-readable tables and charts. This enables better optimization, debugging and more detailed confirmation of execution timing than ever before. RapiTime places particular emphasis on analysis of the worst-case execution time (WCET), the key factor in determining responsiveness of real-time systems.

Benefits

"The biggest benefit that RapiTime brought to our development process was just how quickly we could get comprehensive timing measurements from our tests." said King "Not only did we reduce our effort requirements for the testing, but we could use our results in ways that were infeasible before. It is now significantly faster for us to identify a timing issue, update the software to resolve the issue, test the updated software and verify that it's fixed."

"RapiTime has also helped us to identify some very specific performance bottlenecks with the underlying hardware that were causing very real difficulty to identify."

About RapiTime

RapiTime from Rapita Systems Ltd., is an automated performance measurement and timing analysis tool, which provides a solution to the problem of obtaining detailed execution time information about complex systems implemented in C or Ada.

RapiTime can automatically instrument the code at various levels of abstraction from function or sub-program boundaries, down to the sub-paths between individual decision points. The instrumented software is then executed on the embedded target, and subject to extensive testing. During testing, when each instrumentation point is executed, its

identifier and a timestamp are captured in a trace of the software's execution.

RapiTime processes the trace data obtained during testing and combines it with structural information derived from analysis of the source code. The result is a broad collection of detailed timing information about the system. For information about RapiTime and the timing information it can provide, see the RapiTime Brochure and the RapiTime Whitepaper available from www.rapitasystems.com.

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