Proving and improving worst-case execution times on the Alenia Aermacchi M-346

*"With Rapi**Time**, we discovered the possibility to reduce by 10% the time spent by a Computer Software Configuration Item"*

Alenia Aermacchi has built over 7,000 aircraft and supplied 2,000 trainers to more than 40 countries worldwide.

Summary

Challenge

■ To measure and improve the overall execution time of the flight control system on the Alenia Aermacchi M-346 Master

Solution

■ Use Rapi**Time** to measure worst-case execution times, identify worst-case hotspots and optimize the appropriate code

Benefits

■ WCET determined with a high level of confidence and reduced effort

■ Rapid identification of software bottlenecks, leading to 10% reduction in WCET

A military transonic trainer aircraft designed for training combat pilots for front line fighter aircraft, the Alenia Aermacchi M-346 Master is powered by a digital flight control system.

An important part of the development of this system's software is the efficient capture and use of worst-case execution time data.

Challenge

In developing the flight control software, the challenge for Alenia Aermacchi was to simultaneously reduce the costs and improve the quality of worst-case execution time measurements.

Recognizing that manually determining execution times is expensive and time consuming, Alenia Aermacchi selected Rapi**Time** (part of Rapita Verification Suite, RVS) because it was the only commercially available tool that could deliver WCET measurements, given the existing hardware/software architecture.

Alenia Aermacchi planned to use Rapi**Time** to:

■ reduce the effort required to carry out timing analysis on the flight control software;

■ optimize code which powers the flight control system and reduce worst-case execution times; and

■ compare the benefits of using Rapi**Time** with established manual approaches.

Solution

Measuring worst-case execution times

Rapi**Time** was first used to measure the execution time of short sub-paths between decision points in the code. This measurement is combined with static path analysis information to compute worst-case execution times and execution time variations.

Highlighting worst-case hotspots

Conventional code profiling techniques identify the lines of code that execute the most on average. By contrast, Rapi**Time** identified worst-case hotspots in Ada sub-programs and even specific lines of source code from the point of view of their contribution to the overall worst-case execution time.

Once identified, hotspots were:

- stripped of code contributing heavily to worstcase execution times;
- provided with rewritten code.

Benefits

According to Alenia Aermacchi engineers working on measuring and improving the overall execution time of the M-346 flight control system,

> *"The main advantage [of using RapiTime] is the possibility to identify the software bottlenecks that can be subject to optimization.*
>
> *Without RapiTime, the mandatory code optimization would have been done without the knowledge of where to concentrate the efforts.*
>
> *With RapiTime, we discovered the possibility to reduce by 10% the time spent by a Computer Software Configuration Item".*

Next steps

Alenia Aermacchi are now exploring a number of options after using Rapi**Time**, including:

- Possible use of worst-case execution time information to aid DO-178B qualification;
- Selecting Rapi**Cover** to help meet code coverage measurement requirements.

To learn how Rapi**Time** can help reduce the cost and effort of execution time analysis, see our product page at www.rapitasystems.com/products/rapitime.

To enquire about what Rapita can do for you, contact us at info@rapitasystems.com.