

CAST-32A Compliance Solution



How can the CAST-32A Compliance Solution help you?

Our CAST-32A Compliance Solution provides a complete solution for certifying multicore aerospace projects in accordance with CAST-32A guidance. Custom packages support different roles in the avionics supply chain, including those of Integrated Modular Avionics (IMA) System Integrators, Platform Suppliers and Application Suppliers.

Benefits

- Reduce the cost and effort of certifying your multicore aerospace project
- Streamline and automate your multicore verification using the proven **RVS** toolsuite and Rapi**Daemon** technology
- Get started quickly with our wide range of supported multicore processor architectures
- Reduce certification risk with independent verification of your project
- Produce robust certification artifacts
- Full solution with aligned packages for each part of the avionics supply chain

Use cases

System Integrator & Certification Applicant

- End-to-end process to address all CAST-32A objectives
- Align your platform and application suppliers to harmonize CAST-32A certification activities and artifacts with multi-vendor licensing
- Verify that interference effects are understood and bounded, i.e. interference channels are mitigated
- Measure worst-case execution time on-target
- Robustness and sensitivity analysis
- Produce evidence to support DO-178C (CAST-32A) certification

Platform Supplier

- Ensure that your System Integrator's requirements are met
- Characterize platform multicore interference channels
- Evaluate and select multicore hardware and RTOS
- Determine outer bounds on worst-case execution time
- Identify multicore interference mitigation strategies

Application Supplier

- Ensure that your System Integrator's requirements are met
- Software performance characterization and optimization
- Measure worst-case execution time on-target

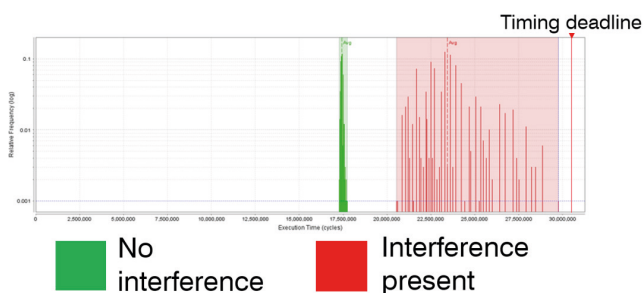


Figure 1. The CAST-32A Compliance package produces evidence on multicore timing behavior

How does it work?

The CAST-32A Compliance Solution is a combination of software tools, documentation, tests, and expert services that support compliance with CAST-32A objectives. We provide custom packages to support CAST-32A compliance with DO-178C artifacts for each part of the avionics supply chain, including platform and application providers. The CAST-32A Compliance Solution comprises:

- Engineering services to:
 - Analyze interference channels on the hardware and characterize interference effects
 - Integrate **RVS** into a multicore environment
 - Select and port Rapi**Daemons** for your target
 - Analyze software worst-case execution times in the context of multicore interference
 - Address all CAST-32A objectives
 - Train your team how to generate evidence on multicore timing behavior through the automated environment we set up
- **RVS** toolsuite to automate collection of timing evidence
- Rapi**Daemons** to support the analysis of interference effects on the multicore system
- Certification evidence

When delivering our CAST-32A Compliance Solution, we follow a V-model framework (Figure 2) to produce a clearly structured flow of verification artifacts that satisfy DO-178C traceability requirements and meet CAST-32A guidelines, ensuring a cost-effective and methodical verification process.

The stages may be iteratively refined – for example to redefine assumptions made about the platform under analysis after testing identifies hidden interference channels. This V-model applies to each level of the supply chain, focused on the particular requirements of each role. For more information on how this works, see our *Multicore Timing Analysis for DO-178C* White paper.

A solution for every part of the supply chain

Our CAST-32A Compliance Solution supports every part of the avionics supply chain.

System Integrators and Certification Applicants

The typical solution to support System Integrators and Certification Applicants includes the following:

- Processes and tools to align your platform and application suppliers
- Licenses for **RVS** tools that can automate key stages in the multicore timing analysis process (Rapi**Test**, Rapi**Time** and Rapi**Task**)
- Templates to augment your DO-178C planning documents (PSAC, SVP etc.) for CAST-32A objectives

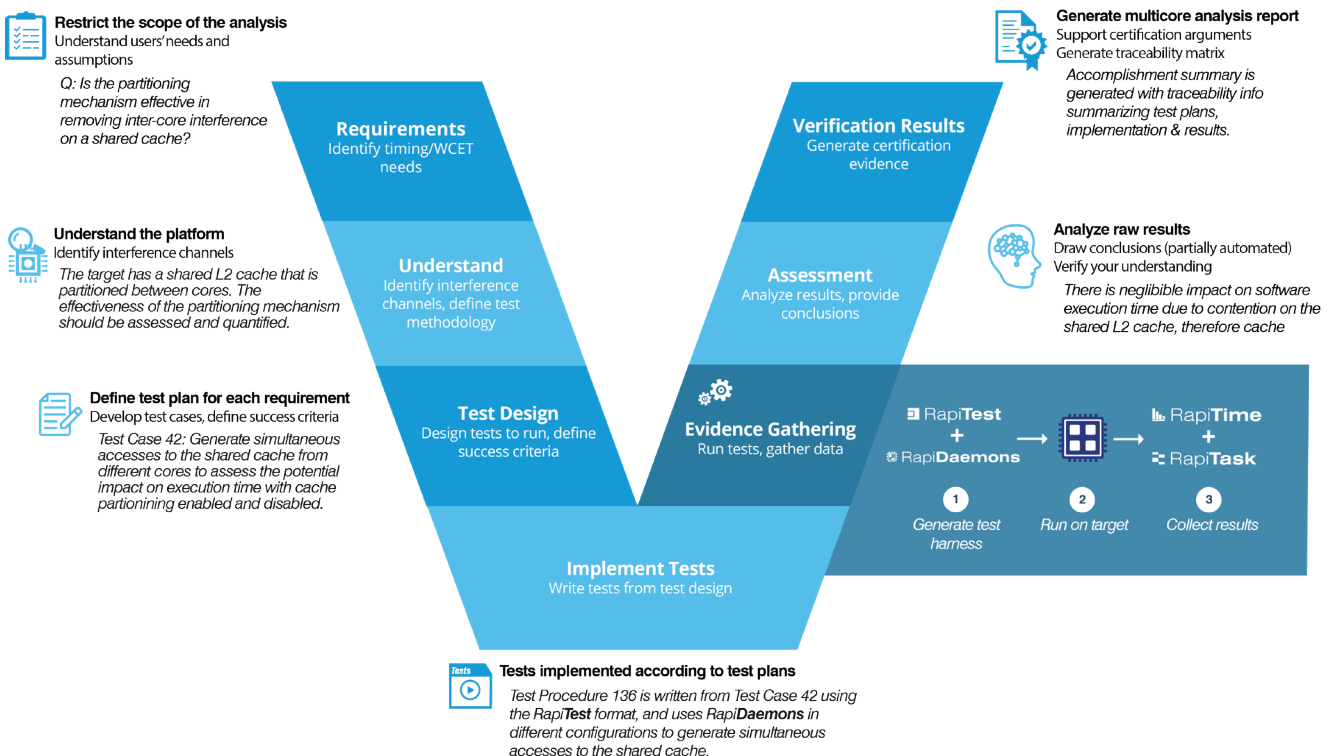


Figure 2. How we address CAST-32A multicore timing objectives

Platform Providers

The typical solution to support Platform Providers includes the following:

- A *Platform Analysis and Characterization Service* to identify interference channels present in the multicore platform and ensure that the platform meets the requirements of the System Integrator
- Licenses for **RVS** tools that can automate key stages in the multicore timing analysis process (**RapiTest**, **RapiTime** and **RapiTask**)
- A *Target Integration Service* to integrate the **RVS** tools above with the multicore platform
- Licenses for **RapiDaemons** needed to generate multicore interference
- A *Target Integration Service* to port **RapiDaemons** so they work on the target hardware and RTOS

Application Suppliers

The typical solution to support Application Suppliers includes the following:

- A *Software Analysis and Characterization Service* to demonstrate that the tested application's timing behavior is robust with respect to interference caused by interference channels on the multicore platform, and that the application meets the requirements of the System Integrator
- Licenses for **RVS** tools that can automate key stages in the multicore timing analysis process (**RapiTest**, **RapiTime** and **RapiTask**)
- Licenses for **RapiDaemons** needed to generate multicore interference

Components of the solution

RVS toolsuite to automate gathering timing evidence

We use our software verification toolsuite – Rapita Verification Suite – to apply tests to multicore hardware (**RapiTest**) and collect timing data (**RapiTime**) and scheduling data (**RapiTask**) from them (Figure 3). Using these tools, we automate various stages of the multicore timing analysis process. In some situations, we may also use our **RTBx** datalogger to collect trace data from your multicore platform during testing.

See our related *Product briefs* for more information on these tools.

RapiDaemons

RapiDaemons are small applications that run on multicore hardware and generate intentional contention on specific resources within the system (Figure 3). Each **RapiDaemon** targets a specific resource, for example caches, interconnects, memory and other on-chip or off-chip shared resources. This lets you identify and quantify the effects of multicore interference by running different **RapiDaemons** in different configurations.

We provide different types of **RapiDaemons** and **RapiDaemon** tools, which support multicore timing analysis in different ways. These include:

- Standard **Daemons**
- Advanced **Daemons**
- Tuneable **RapiDaemons**
- Discovery **RapiDaemon** tool
- Surrogate **RapiDaemon** tool

For more information on **RapiDaemons**, see our *RapiDaemons Product brief*.

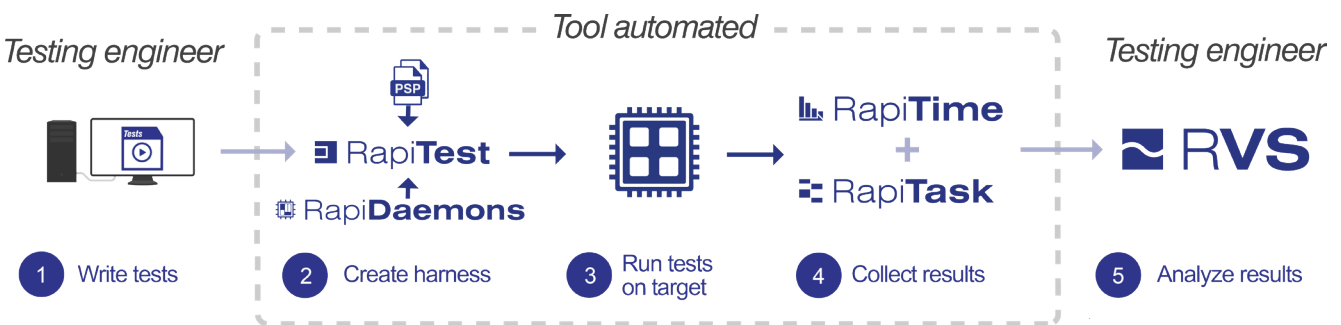


Figure 3. How **RVS** tools and **RapiDaemons** are used to gather multicore timing evidence

Engineering services

Our CAST-32A Compliance Solution utilizes a range of services, including:

- Target Integration Service
- Qualified Target Integration Service
- Platform Analysis and Characterization Service
- Software Analysis and Characterization Service
- Consulting and Training Services

Target Integration Service

To integrate **RVS** tools to be used within a multicore environment, we provide a Target Integration Service. This is described in our *Target Integration Service Product brief*.

Rapi**Daemons** must be ported for the multicore platform they are used for. This is also provided through our *Target Integration Service*.

Qualified Target Integration Service

To use evidence produced by **RVS** tools for certification, the integration of **RVS** must be qualified to produce evidence demonstrating that **RVS** has been correctly installed and is working appropriately with the system. We support this through our *Qualified Target Integration Service*, which is described in our *Tool Qualification for DO-178C Product briefs*.

Platform Analysis and Characterization Service

This service provides CAST-32A evidence that Platform Providers can use to demonstrate that their platform is certifiable for DO-178C following CAST-32A guidance and ensure that requirements from the System Integrator are met.

Our expert engineers analyze a multicore system to identify its interference channels, working with chip manufacturers, board developers, and RTOS vendors to analyze the CPU and peripherals (as managed by the RTOS) in depth. We review CPU and board documentation to produce a detailed and complete list of interference channels that must be characterized and quantified for a given combination of critical configuration settings.

We then use the **RVS** toolchain and Rapi**Daemons** to quantify and characterize the platform's hardware and RTOS. We deliver artifacts that systems engineers can use to justify hardware configuration settings used and architectural decisions made to avoid and/or mitigate multicore interference effects.

Software Analysis and Characterization Service

This service provides CAST-32A evidence that Application Providers can use to demonstrate that their application is certifiable for DO-178C following CAST-32A guidance and that requirements from the System Integrator are met.

Our expert engineers create and run tests using **RVS** tools and Rapi**Daemons** to investigate the effects of interference on software applications and determine software worst-case execution times.

We deliver artifacts that systems engineers can use to address the CAST-32A objectives related to worst-case execution time calculation

Consulting and Training Services

We provide consulting services and custom training on DO-178C and CAST-32A compliance including gap analysis consultancy, and custom training on the processes and tools we use to investigate the effects of multicore interference.

DO-178C and CAST-32A certification

Certification evidence

Our CAST-32A Compliance Solution produces evidence to satisfy all CAST-32A objectives.

Our **RVS** automation tools are classified as Tool Qualification Level (TQL) 5 tools as per DO-330. Qualification support is available for Rapi**Test** and Rapi**Time** through our DO-330 Qualification kits, which have been used for certification in many DAL A aerospace projects certifying against DO-178C. For more information, see our Tool qualification for DO-178C Product briefs.

Evidence to satisfy certification requirements for the use of Rapi**Daemons** is produced during the tooling qualification process.

We support you in extending your PSAC to address CAST-32A objectives and producing a SAS including all evidence and traceability of artifacts used in our process that are needed to support certification.

Incremental certification

Our CAST-32A Compliance Solution supports an incremental approach to certification. In this approach, which is often used for the certification of Integrated Modular Avionics (IMA) as specified in DO-297, a certification argument is created incrementally in the following way:

- Evidence is produced for the multicore platform, highlighting which interference channels are present in the system. This evidence is submitted to a certification authority to achieve acceptance, and this does not need to be repeated when applications are added to the multicore platform.
- Evidence is independently produced for each application to be hosted on the multicore platform, showing that each application is robust with respect to interference caused by the interference channels identified for the multicore platform. This evidence is submitted to a certification authority to achieve acceptance for each application.

- Hosted applications are integrated into the multicore platform.
- When the certification applicant makes a final certification application, they claim credit from the acceptance claimed previous and do not need to recertify any part of the system.

This approach also supports the addition of new applications to the system without the need to re-generate artifacts for existing applications.

In this case, acceptance must only be requested for the new applications added to the system as per DO-297.

Your path to compliance

The path to CAST-32A certification can be split into 3 distinct phases:

- **Pilot phase** – we set up an environment where evidence for multicore timing behavior can be automatically generated on a *subset* of your system. We perform a preliminary platform analysis to identify potential interference channels in a subset of your system. We characterize your hardware and software for multicore interference effects, or we deliver training that lets you do this yourself. We provide recommended text for your PSAC and SVP to cover CAST-32A objectives.
- **Implementation phase** – we set up an environment where evidence for multicore timing behavior can be automatically generated on your complete system. We perform a platform analysis to identify potential interference channels in your system. We characterize your hardware and software for multicore interference effects, or we deliver training that lets you do this yourself.
- **Certification phase** – we expand on the work done in the Implementation phase to prepare the project for certification. This includes deploying tool qualification kits and qualified target integration services, reviewing artifacts and traceability generated in the Implementation phase, and, if desired, assisting you in producing your SAS and liaising with certification authorities.

Packages

We provide standard packages for CAST-32A Compliance, which are suitable for a range of use cases. All packages include the following:

- Integration services for the **RVS** toolsuite
- Porting and configuration services for **RapiDaemons** and **RapiDaemon** tools included in the package
- Platform Analysis and Characterization Service or Software

Analysis and Characterization Service, depending on your role in the avionics supply chain

Single configuration package

This supports exploratory testing into multicore interference and the evaluation of a single multicore configuration.

This package includes a single *Annual license* for **RapiTest**, **RapiTime**, and **RapiTask** and a *Single configuration perpetual license* for Standard **RapiDaemons**.

Multiple configuration package

This supports detailed analysis of multicore interference in a single project that is aiming for DO-178/CAST-32A certification.

This package includes a single *Perpetual license* for **RapiTest**, **RapiTime**, and **RapiTask**. It includes a *Multiple configuration perpetual license* for Standard **RapiDaemons**, Advanced **RapiDaemons** and the Discovery **RapiDaemon** tool.

This package includes *Re-usable* tool qualification kits for **RapiTest**, **RapiTime** and **RapiTask** and certification evidence for included **RapiDaemons** and **RapiDaemon** tools.

Product line package

This supports detailed analysis of multicore interference for multiple projects that share the same multicore platform and are aiming for DO-178/CAST-32A certification.

This package includes 3 *Perpetual licenses* for **RapiTest**, **RapiTime**, and **RapiTask**. It includes a *Product line perpetual license* for Standard **RapiDaemons**, Advanced **RapiDaemons**, Tuneable **RapiDaemons** and the Discovery and Surrogate **RapiDaemon** tools.

This package includes *Product line* tool qualification kits for **RapiTest**, **RapiTime** and **RapiTask** and certification evidence for included **RapiDaemons** and **RapiDaemon** tools.

Custom packages

In addition to the standard packages listed above, we can work with you to tailor these packages to meet your needs.



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