

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

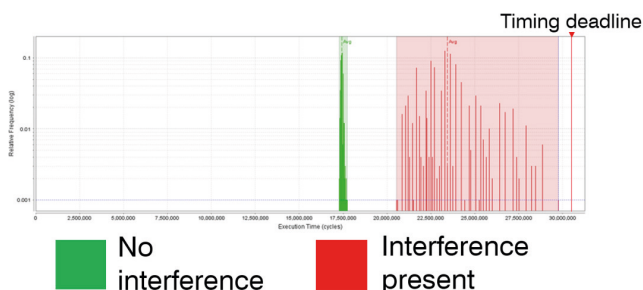


Figure 1. The CAST-32A Compliance Solution produces evidence on multicore timing behavior

Use cases

System Integrator & Certification Applicant

- End-to-end process to help 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

How does it work?

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

- Documents and tests
 - Reports describing results to demonstrate that interference channels on a multicore platform have been identified and that the impact of interference has been characterized on software running on the platform
 - Processes to describe how to use the CAST-32A Compliance Solution to address CAST-32A guidelines
 - Multicore tests to analyze the potential impact of interference on software timing behavior, and to analyze the worst-case execution time of multicore software when interference channels are stressed
 - Template DO-178C compliance documents including checklists
- Software tools
 - **RVS** toolsuite to automate the collection of timing evidence
 - **RapiDaemons** to support the analysis of interference effects on the multicore system

- Engineering services to:
 - Analyze interference channels on the hardware and characterize interference effects
 - Integrate **RVS** into a multicore environment
 - Develop, select and port **RapiDaemons** for your platform
 - Analyze software worst-case execution times in the context of multicore interference
 - Train your team how to generate evidence on multicore timing behavior through the automated environment we set up
 - Help address all CAST-32A objectives
- Certification support
 - Tool Qualification Kits for **RVS** and **RapiDaemons**
 - Qualified Target Integration Service for **RVS**
 - **RapiDaemon** Qualification Service
- Support and maintenance for:
 - **RVS** tools
 - **RapiDaemons**
 - **RVS** and **RapiDaemons** qualification kits
 - CAST-32A solution documents and tests

Our CAST-32A Compliance Solution uses 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.

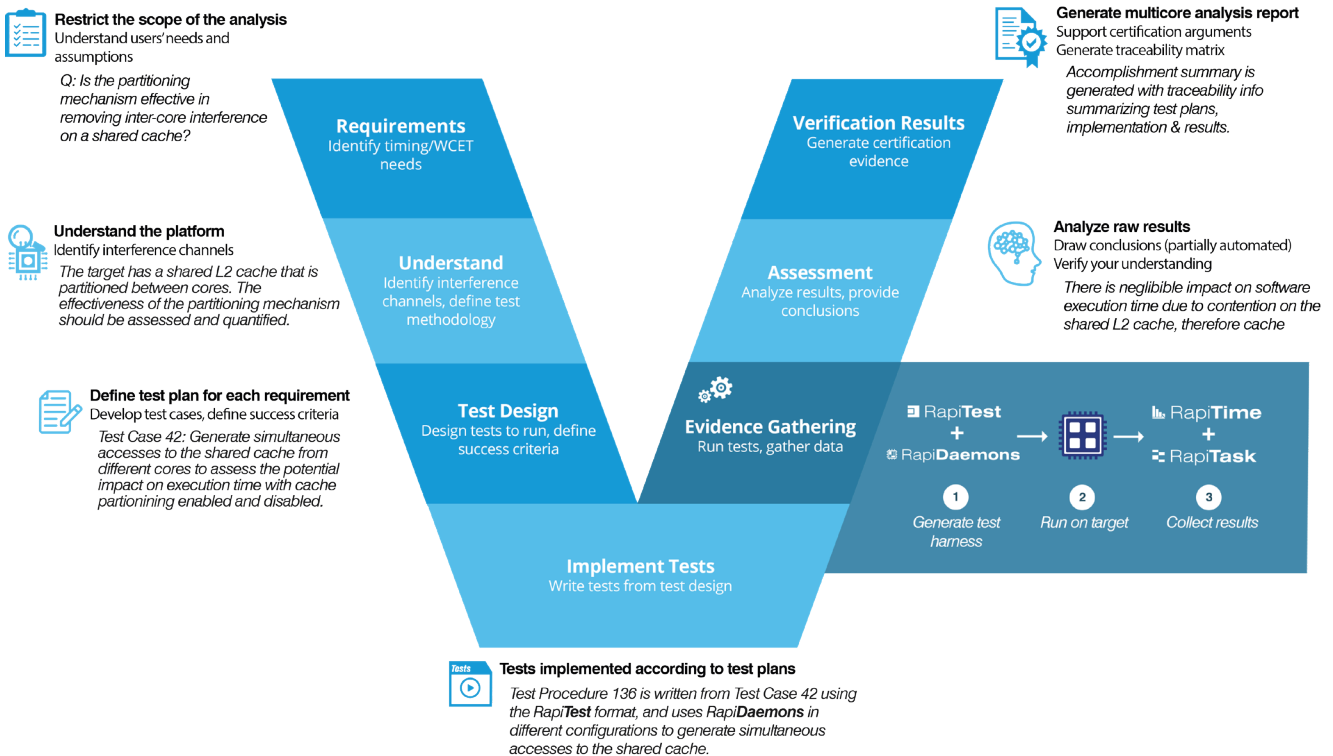


Figure 2. How we address CAST-32A multicore timing objectives

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 CAST-32A Compliance Solution allows System Integrators to perform verification activities demonstrating that a multicore Platform along with its integrated Applications is compliant with CAST-32A. When combined with the incremental assurance evidence provided by Platform Providers and Application Suppliers, this forms a complete set of CAST-32A certification evidence.

We help develop supplier frameworks and processes that can be used as acceptance criteria for CAST-32A compliance activities performed by Platform Providers and Application Suppliers on the project.

Platform Providers

The CAST-32A Compliance Solution allows Platform Providers to produce evidence demonstrating that their Platform is compliant with CAST-32A. This evidence can later be used by Application Suppliers, System Integrators and Certification Applicants to support CAST-32A compliance.

Application Suppliers

The CAST-32A Compliance Solution allows Application Suppliers to produce evidence demonstrating that their Application, running on the target Platform, is compliant with CAST-32A. This evidence can later be used by System Integrators and Certification Applicants to support CAST-32A compliance.

Documents and tests

Platform Analysis Reports

Platform Analysis Reports identify the critical configuration settings that can affect hosted software on a specific multicore platform and identify and describe the interference channels present on that platform. Together with a Platform Characterization Report, a Platform Analysis Report provides 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.

We provide Platform Analysis Reports for a range of multicore platforms. These can be customized for specific platforms through our Platform Analysis and Characterization Service.

Platform Characterization Reports

Platform Characterization Reports describe and document tests and results of tests used to stress interference channels on a specific multicore platform to quantify the potential impact of interference from each interference channel on that platform. Test development and execution is supported by the **RVS** toolchain and **RapiDaemons**. Together with a Platform Analysis Report, a Platform Characterization Report provides 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.

We provide Platform Characterization Reports for a range of multicore platforms. These can be customized for a specific platform through our Platform Analysis and Characterization Service.

Software Analysis Reports

Software Analysis Reports list requirements on software timing behavior, which are generated by reviewing and analyzing existing requirements and software architecture. Together with a Software Characterization Report, a Software Analysis Report provides 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.

We provide Software Analysis Reports for the analysis of software on a range of platforms. These can be customized for specific software on a platform through our Software Analysis and Characterization Service.

Software Characterization Reports

Software Characterization Reports describe and document tests and results of tests that quantify the worst-case execution time of software hosted on a specific multicore platform. Test development and execution is supported by the **RVS** toolchain and **RapiDaemons**. Together with a Software Characterization Report, a Software Analysis Report provides 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.

We provide Software Characterization Reports for the characterization of software on a range of platforms. These can be customized for specific software on a platform through our Software Analysis and Characterization Service.

Process documents

We provide process documents that describe in detail how to perform multicore platform and software analysis and characterization using the Rapita workflow.

This evidence can be supplied as supplementary evidence to support DO-178C certification and can be used to perform this analysis and characterization yourselves. Where you plan to do the analysis and characterization yourselves, we further support this through our Training service.

Characterization tests

We provide test artifacts needed to analyze the potential impact of interference channels on your multicore platform and the worst-case execution time of software hosted on that platform. This includes Test Cases and Test Procedures. These artifacts let you run the multicore tests on your platform and software and describe how to interpret the results.

Characterization tests are customized for a specific platform or software through our Platform Analysis and Characterization Service and Software Analysis and Characterization Service.

Our Characterization Tests are developed for execution using **RVS** and **RapiDaemons**.

Template compliance documents

We provide template CAST-32A compliance documents, which offer a convenient blueprint that can be used to generate final compliance documents. These documents can be completed as part of our Platform Analysis and Characterization and Software Analysis and Characterization Services, or if you are performing the analysis yourself, you can use the templates as a starting point to writing your compliance documents.

We provide the following template CAST-32A compliance documents:

- Plan for Multicore Aspects of Certification (PMAC)
- Multicore Software Verification Plan (MSVP)
- Multicore Platform Characterization Results (MCPCR)
- Multicore Timing Resources Verification Results (MCTVR)
- Multicore Software Accomplishment Summary (MSAS)

You can either use these templates to create standalone DO-178C compliance documents for multicore planning and verification or they can be incorporated into your standard compliance documents (PSAC, SVP etc.). These template compliance documents also include checklists that let you easily review your progress.

Our template compliance documents cover the planning and verification activities required by 8 of the 10 CAST-32A objectives – all objectives except for MCP_Software_2 (on Data and Control Coupling) and MCP_Error_Handling_1 (on the safety net). We support planning and verification for these objectives with our Consultancy service.

Software tools

RVS toolsuite to automate gathering timing evidence

We use our software verification toolsuite – the Rapita Verification Suite – to configure and run tests on multicore platforms (**RapiTest**) and collect timing data (**RapiTime**) and scheduling data (**RapiTask**) from them (Figure 3 on the next page). 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 on the next page). 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*.

Engineering services

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

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

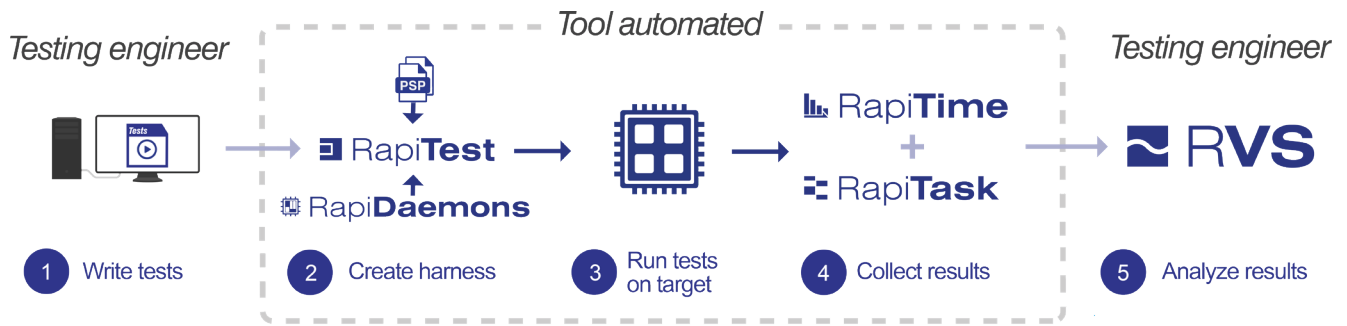


Figure 3. How RVS tools and RapiDaemons are used to gather multicore timing evidence

Platform Analysis and Characterization Service

This service provides everything needed to customize Platform Analysis Reports and Platform Characterization Reports to a specific multicore platform. This includes investigations into the critical configuration settings and interference channels that can affect hosted software behavior of the platform, the development of RapiDaemons and Characterization tests that can be used to characterize the potential impact of interference on the platform, execution of tests to produce results, and generation of a complete Platform Analysis Report and Platform Characterization Report.

The service also, together with the Software Analysis and Characterization Service, provides everything needed to complete template DO-178C compliance documents for your project.

Software Analysis and Characterization Service

This service provides everything needed to customize Software Analysis Reports and Software Characterization Reports to specific software run on a specific multicore platform. This includes deriving requirements for software hosted on the platform, the development of RapiDaemons and Characterization tests for that platform, execution of tests to produce results, and generation of a complete Software Analysis Report and Software Characterization Report.

The service also, together with the Platform Analysis and Characterization Service, provides everything needed to complete template DO-178C compliance documents for your project.

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*.

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

Training Service

We provide training on using the Rapita CAST-32A Compliance workflow and using RVS and RapiDaemons to support this workflow.

Together with our workflow process documents, this supports you if you want to use the CAST-32A Compliance workflow to perform Platform Analysis and Characterization and/or Software Characterization yourselves.

Consulting Service

We provide consulting services on DO-178C and CAST-32A compliance including gap analysis consultancy, certification liaison support and consultancy to satisfy all CAST-32A objectives.

Certification support

Tool qualification kits

Our RVS automation tools are classified as Tool Qualification Level (TQL) 5 tools as per DO-330. Qualification support is available for RapiTest and RapiTime 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*.

RapiDaemons are classified as TQL 5 tools as per DO-330. Qualification support for RapiDaemons is available through our DO-330 Qualification kits.

Qualified Target Integration Service

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

RapiDaemon Qualification Service

Qualification evidence for Rapi**Daemons** is generated by collating results from running Rapi**Daemon** qualification tests on the target platform and using these results to instantiate template qualification documents. We provide services to run Rapi**Daemon** tests on-target, review test results, and generate and review qualification documents. For more information, see our *RapiDaemon Tool Qualification for DO-178C Product brief*.

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.

Support and maintenance

Our support and maintenance ensures that you get access to the latest updates to the CAST-32A Compliance Solution. The following Support and maintenance products are relevant to elements of the CAST-32A Compliance Solution:

- Support and maintenance for **RVS** tools used to support the CAST-32A Compliance Solution is available through our Software Support and Maintenance, as described in our *Software support and maintenance Product brief*.
- Support and maintenance for Rapi**Daemons** is available through our Rapi**Daemons** Support and Maintenance, as described in our *RapiDaemons Product brief*.

- Re-useable and Product line licenses of **RVS** and Rapi**Daemons** qualification kits are licensed with a one-time fee plus an annual subscription fee for continued rights to use our qualification kits.
- Support and maintenance for CAST-32A Compliance Solution documents and tests ensures that you get continued access to the latest updates, including new documents and tests.

Your path to compliance

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

- **Pilot phase** – we demonstrate the CAST-32A Compliance approach on a platform to be better able to scope activities for future phases. The platform and application analyzed may be your platform or a reference platform. We work with you to plan the activities in a pilot. These may include setting up a multicore integration with **RVS**, deploying Rapi**Daemons**, working through Platform Analysis and Characterization and Software Analysis and Characterization activities on a subset of the system, and reviewing your existing DO-178C planning documents for alignment with CAST-32A. We share documents to help you understand the overall CAST-32A Compliance process, including certification concerns, on a limited use license.
- **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, and may include us performing a final run for score, reviewing artifacts and traceability and 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
- A license to use CAST-32A Compliance Solution documents and tests for your project
- Platform Analysis and Characterization Service and/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 floating license* for **RapiTest**, **RapiTime**, and **RapiTask** – these licenses are enterprise and can be used for any purpose within your organization, including to support the CAST-32A Compliance Solution. The package includes a *Single configuration perpetual license* for Standard **RapiDaemons**.

See Table 1 on the next page for a full list of components included in this package.

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 floating license* for **RapiTest**, **RapiTime**, and **RapiTask** – these licenses are enterprise and can be used for any purpose within your organization, including to support the CAST-32A Compliance Solution. The package includes a *Multiple configuration perpetual license* for Standard **RapiDaemons**, Advanced **RapiDaemons** and Tuneable **RapiDaemons**.

This package includes *Re-usable* tool qualification kits for **RapiTest**, **RapiTime** and **RapiDaemons**.

See Table 1 on the next page for a full list of components included in this package.

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 floating licenses* for **RapiTest**, **RapiTime**, and **RapiTask** – these licenses are enterprise and can be used for any purpose within your organization, including to support the CAST-32A Compliance Solution. The package 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 **RapiDaemons**.

See Table 1 on the next page for a full list of components included in this package.

Custom packages

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

Table 1. Components included in standard CAST-32A Compliance Solution packages

Component type	Component	Items included in package type		
		Single configuration	Multiple configuration	Product line
Supported configurations	Number of configurations supported	1	3	3
Documents and tests	Platform and Software Analysis and Characterization Reports	Included	Included	Included
	Process documents	Included	Included	Included
	Characterization tests	Included	Included	Included
	Template DO-178C compliance documents	Included	Included	Included
RVS licenses	Rapi Test license(s)	1 Annual floating*	1 Perpetual floating*	3 Perpetual floating*
	Rapi Time license(s)	1 Annual floating*	1 Perpetual floating*	3 Perpetual floating*
	Rapi Task license(s)	1 Annual floating*	1 Perpetual floating*	3 Perpetual floating*
RapiDaemons	Standard Rapi Daemons	Single configuration license	Multiple configuration license	Product line license
	Advanced Rapi Daemons	Not included	Multiple configuration license	Product line license
	Tuneable Rapi Daemons	Not included	Multiple configuration license	Product line license
	Discovery Rapi Daemon tool	Not included	Not included	Product line license
	Surrogate Rapi Daemon tool	Not included	Not included	Product line license
Engineering services	Target Integration Service for RVS integration	Included	Included	Included
	Target Integration Service for Rapi Daemon porting and configuration	For included Rapi Daemons	For included Rapi Daemons	For included Rapi Daemons
	Platform Analysis and Characterization Service	Included	Included	Included
	Software Analysis and Characterization Service	Included	Included	Included
	Training	Optional	Optional	Optional
	Consultancy	Optional	Optional	Optional
Qualification support	Rapi Time qualification kit license	Not included	Re-usable	Product line
	Rapi Test qualification kit license	Not included	Re-usable	Product line
	Rapi Daemons qualification kit license	Not included	Re-useable	Product line
	Qualified Target Integration Service	Not included	Included	Included
	Rapi Daemon Qualification Service	Not included	Included	Included
Support and maintenance	RVS tools	Duration of project	Duration of project	Duration of project
	Rapi Daemons	Duration of project	Duration of project	Duration of project
	RVS tool and Rapi Daemon qualification kits	Not included	Duration of project	Duration of project
	CAST-32A Compliance Solution documents and tests	Duration of project	Duration of project	Duration of project

* **RVS** licenses are enterprise licenses and can be used for any purpose within your organization, including to support the CAST-32A Compliance Solution

Table 2. Meeting CAST-32A objectives across the customer and vendor ecosystem

Objective	Description	Customer role	RTOS/HW vendor role	Rapita role
MCP_Planning_1	System description	Document in PSAC/PHAC	Early architecture evaluation	Early platform evaluation
MCP_Planning_2	List of MCP shared resources, active HW dynamic features	Document in PSAC/PHAC, how to verify in SVP	RTOS + HW information	Platform characterization
MCP_Resource_Usage_1	Configuration settings	Incorporation of recommendations in PSAC, add HLR	Recommendations of mitigation strategies	Analysis and recommendations
MCP_Resource_Usage_2	Mitigations for inadvertently altered CCS	Document in PSAC/PHAC, verify and analyze	N/A	Architecture analysis, review, test
MCP_Resource_Usage_3	List of interference channels and verification methods	Review results, incorporate in PSAC, identify in HLRs, V&V methods in SVP	RTOS + HW information	Platform characterization
MCP_Resource_Usage_4	In a worst-case scenario, it has been verified that the software's resource demands do not exceed those available	Review results, incorporate in PSAC, identify in HLRs, V&V methods in SVP	RTOS information	Software characterization analysis and methods, verify and analyze
MCP_Software_1	WCET analysis of all SW components	Support in running tests, review results	RTOS information	WCET analysis and results; we provide evidence on the execution time behavior of your code that takes multicore interference into account
MCP_Software_2	Data Coupling/Control Coupling analysis by requirements-based testing	Customer to define and perform	N/A	Tools and services
MCP_Error_Handling_1	SafetyNet	Customer to define and perform	Customer or RTOS	Review, test
MCP_Accomplishment_Summary	Showing compliance	Incorporate results in SAS	Support	Support evidence; we provide multicore timing evidence that you can easily include



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