What's new at Rapita 2012-13

Overview and update

Ada Europe 2012

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Agenda

RVS Overview

RapiCover DO-178 Qualification

Upcoming Products

- Integration Guide Annexes
- RapiTime DO-178 Qualification
- RVS 3.1

EU Research Programs

- PROARTIS
- parMERASA

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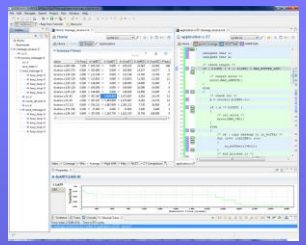
Introducing RVS

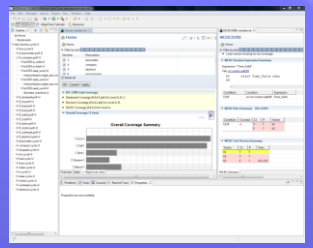
+RVS+

RapiTime



- Worst case execution time (WCET)
- Optimization identification
- Execution time verification

RapiCover



- Code coverage up to MC/DC
- Trace coverage to specific tests
- Customizable instrumentation

- Tool qualification: DO-178B/C and ISO 26262
- Supports C/C++/Ada
- No processor/compiler/RTOS limitations

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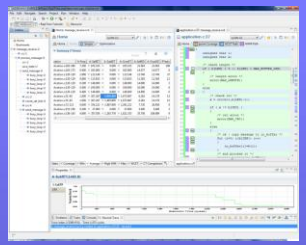

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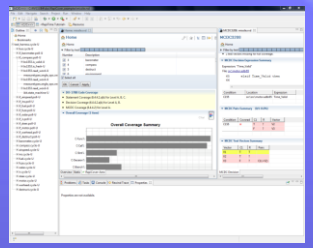

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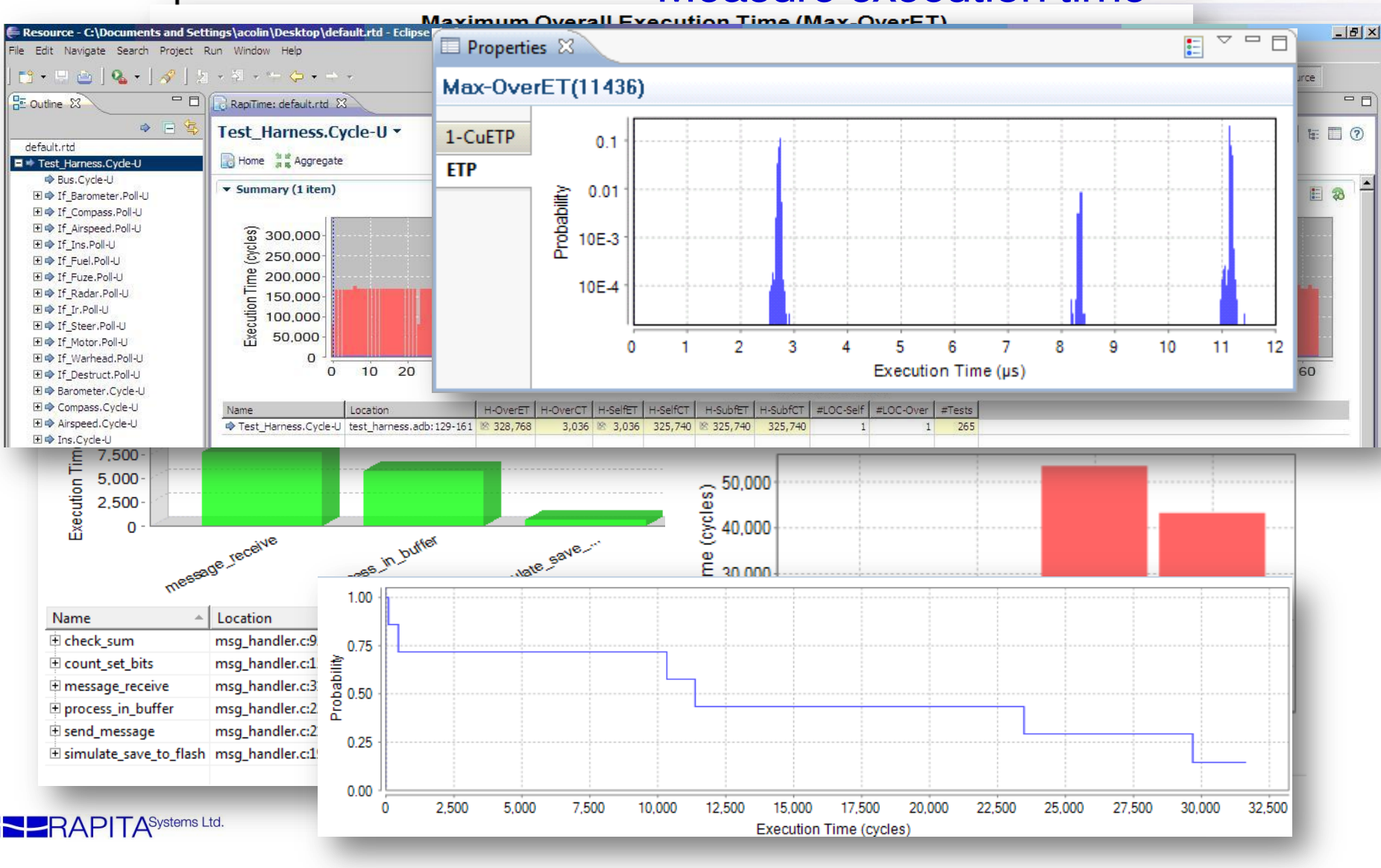
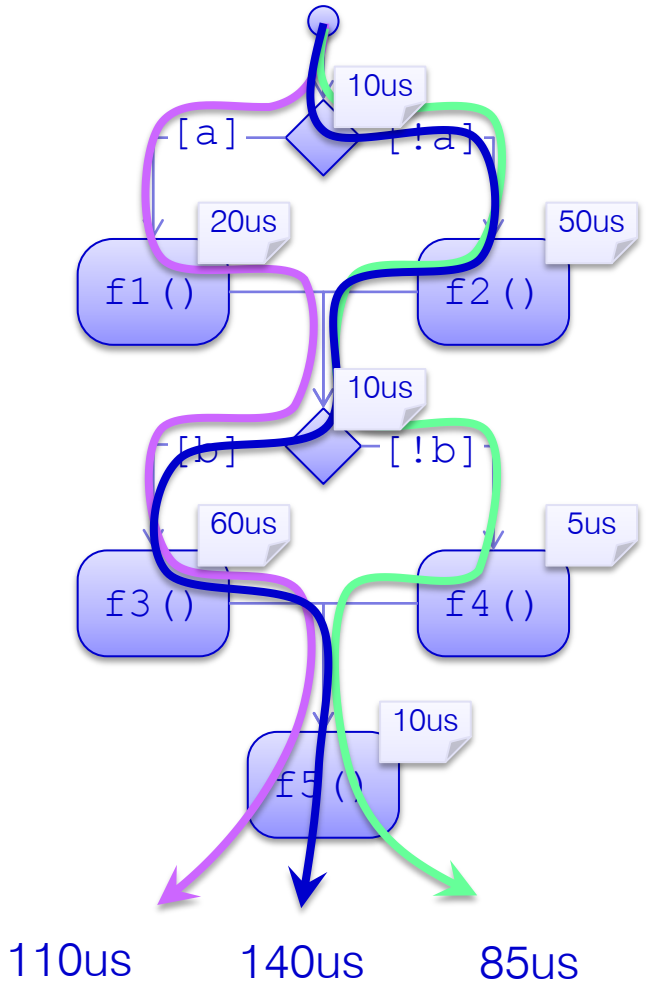
RapiTime

Measure execution time



Calculating WCET…

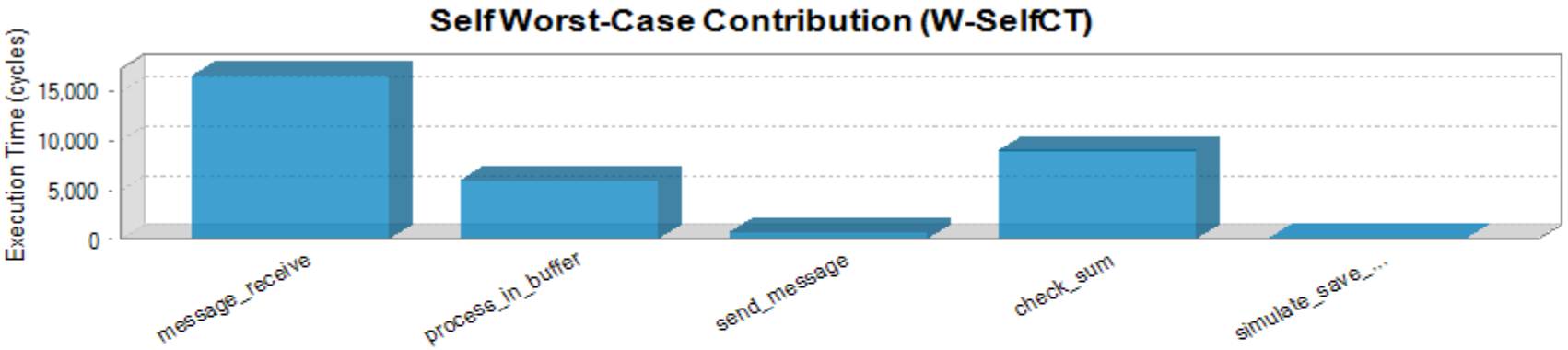
```
...
if( a )
{
    f1();
}
else
{
    f2();
}

...
if( b )
{
    f3();
}
else
{
    f4();
}

f5();
```



RapiTime

Find worst-case execution time

```
Uint8
message_receive( Uint8 const * msg )
{
    Uint8       i;
```



Name	Location	W-OverET	W-OverCT	W-SelfET	W-SelfCT	W-SubfET	W-SubfCT	W-Freq	#LOC-Self	#Tests
check_sum	msg_handler.c:92-147	2,977	8,931	2,977	8,931	0	0	3	56	10
message_receive	msg_handler.c:317-367	32,019	32,019	16,488	16,488	15,531	15,531	1	51	7
process_in_buffer	msg_handler.c:226-306	12,554	12,554	5,934	5,934	6,620	6,620	1	81	4
send_message	msg_handler.c:211-217	666	666	666	666	0	0	1	7	3
simulate_save_to_flash	msg_handler.c:193-203	2,600	0	2,600	0	0	0	0	11	1

RapiTime

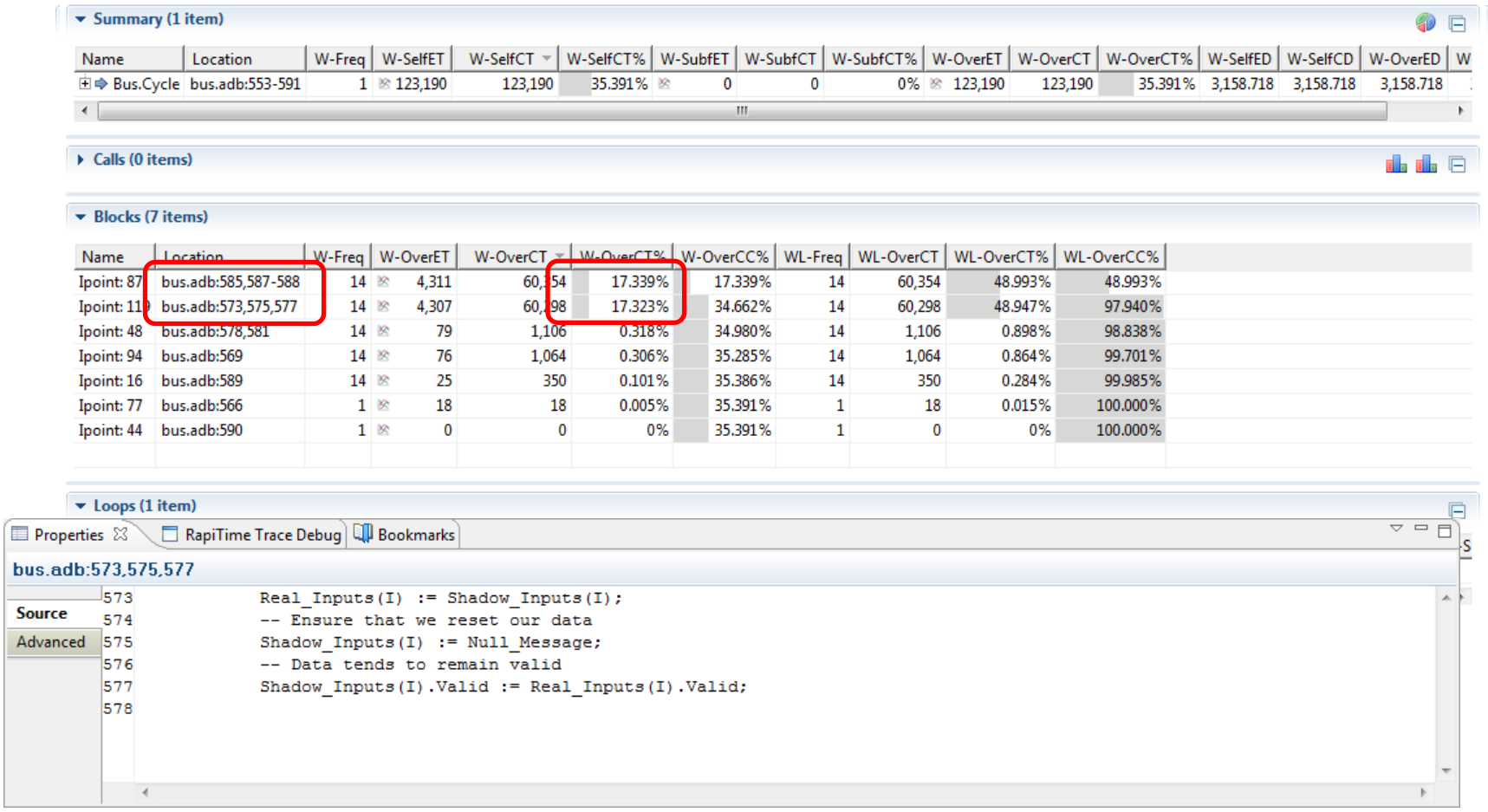
Focus optimization effort

Summary (109 items)

Name	Location	W-Freq	W-SelfET	W-SelfCT	W-SelfCT%	W-SelfCC%	W-SubfET	W-SubfCT	W-SubfCT%	W-O
Airspeed.Cycle	airspeed.adb:66-103	1	391	391	0.112%	0.112%	1,304	1,304	0.375%	
Airspeed.Extrapolate_Speed	airspeed.adb:31-60	1	226	226	0.065%	0.177%	148	148	0.043%	
BC1553.Is_Fresh	bc1553.adb:86-91	12	78	936	0.269%	0.446%	78	936	0.269%	
BC1553.Is_Valid	bc1553.adb:94-99	12	78	936	0.269%	0.715%	78	936	0.269%	
BC1553.Read_Word	bc1553.adb:104-114	30	101	3,030	0.870%	1.586%	84	2,520	0.724%	
BC1553.Write_Word	bc1553.adb:63-73	1	99	99	0.028%	1.614%	130	130	0.037%	
BIT_Machine.Change_State	bit_machine.adb:24-30	12	52	624	0.179%	1.793%	107	1,284	0.369%	
BIT_Machine.Phase	bit_machine.adb:33-36	12	0	0	0%	1.793%	0	0	0%	
BIT_Machine.Step	bit_machine.adb:55-84	12	197	2,364	0.679%	2.472%	0	0	0%	
Barometer.Cycle	barometer.adb:86-127	1	464	464	0.133%	2.606%	1,522	1,522	0.437%	
Barometer.Extrapolate_Height	barometer.adb:46-80	1	250	250	0.072%	2.678%	148	148	0.043%	
Bus.Cycle	bus.adb:553-591	1	123,190	123,190	35.391%	38.069%	0	0	0%	1.
Bus.Is_BC_Fresh	bus.adb:430-453	12	78	936	0.269%	38.338%	0	0	0%	
Bus.Is_BC_valid:159	bus.adb:455-478	12	78	936	0.269%	38.607%	0	0	0%	
Bus.Is_RT_Fresh	bus.adb:305-328	7	77	539	0.155%	38.761%	0	0	0%	
Bus.Is_RT_Valid	bus.adb:330-353	7	78	546	0.157%	38.918%	0	0	0%	
Bus.Read_BC_Word	bus.adb:481-504	30	84	2,520	0.724%	39.642%	0	0	0%	
Bus.Read_RT_Word	bus.adb:355-378	31	85	2,635	0.757%	40.399%	0	0	0%	
Bus.Write_BC_Word	bus.adb:242-270	37	95	3,515	1.010%	41.409%	0	0	0%	

RapiTime

Focus optimization effort



Summary (1 item)

Name	Location	W-Freq	W-SelfET	W-SelfCT	W-SelfCT%	W-SubfET	W-SubfCT	W-SubfCT%	W-OverET	W-OverCT	W-OverCT%	W-SelfED	W-SelfCD	W-OverED	W
Bus.Cycle	bus.adb:553-591	1	123,190	123,190	35.391%	0	0	0%	123,190	123,190	35.391%	3,158.718	3,158.718	3,158.718	

Calls (0 items)

Blocks (7 items)

Name	Location	W-Freq	W-OverET	W-OverCT	W-OverCT%	W-OverCC%	WL-Freq	WL-OverCT	WL-OverCT%	WL-OverCC%
Ipoint: 87	bus.adb:585,587-588	14	4,311	60,354	17.339%	17.339%	14	60,354	48.993%	48.993%
Ipoint: 119	bus.adb:573,575,577	14	4,307	60,298	17.323%	34.662%	14	60,298	48.947%	97.940%
Ipoint: 48	bus.adb:578,581	14	79	1,106	0.318%	34.980%	14	1,106	0.898%	98.838%
Ipoint: 94	bus.adb:569	14	76	1,064	0.306%	35.285%	14	1,064	0.864%	99.701%
Ipoint: 16	bus.adb:589	14	25	350	0.101%	35.386%	14	350	0.284%	99.985%
Ipoint: 77	bus.adb:566	1	18	18	0.005%	35.391%	1	18	0.015%	100.000%
Ipoint: 44	bus.adb:590	1	0	0	0%	35.391%	1	0	0%	100.000%

Loops (1 item)

Properties | RapiTime Trace Debug | Bookmarks

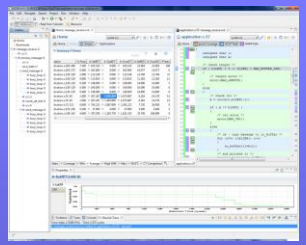
bus.adb:573,575,577

Source | Advanced

```
573            Real_Inputs(I) := Shadow_Inputs(I);
574            -- Ensure that we reset our data
575            Shadow_Inputs(I) := Null_Message;
576            -- Data tends to remain valid
577            Shadow_Inputs(I).Valid := Real_Inputs(I).Valid;
578
```

+RVS+

RapiTime



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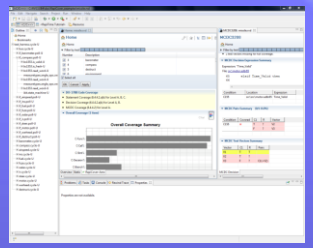
RapiCover



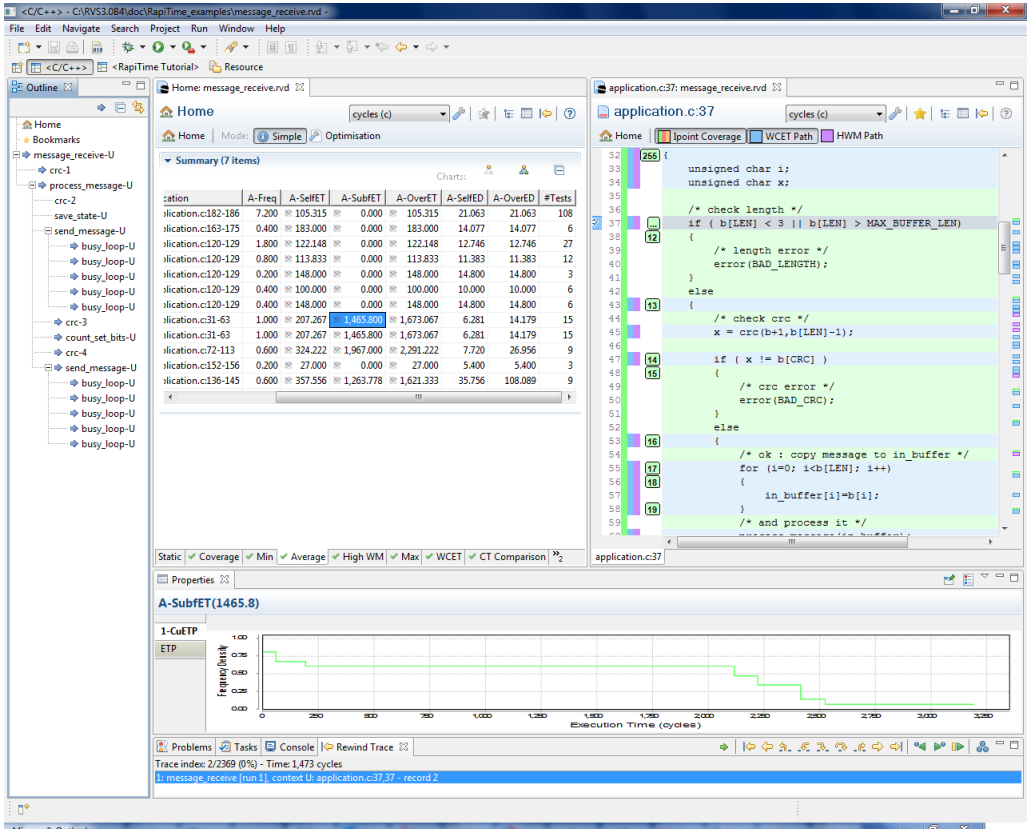
- Code coverage up to MC/DC
- Trace coverage to specific tests
- Customizable instrumentation

- DO-178B Qualification Kit
- Target Integration Service

RapiCover

Coverage levels

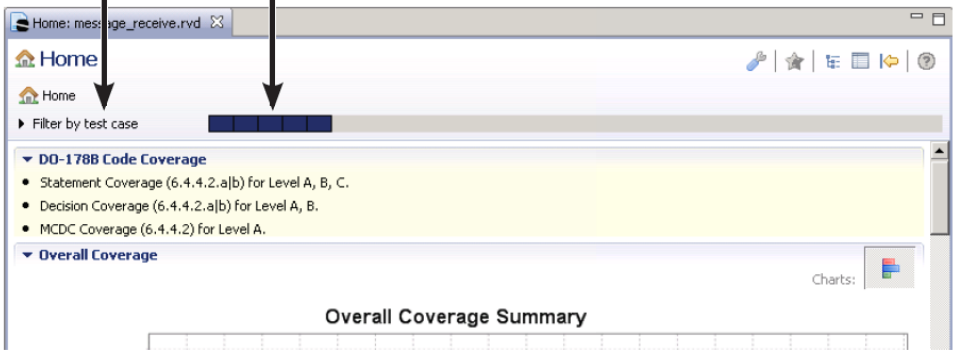
- Function
- Call
- Statement
- Decision
- Modified Condition/Decision



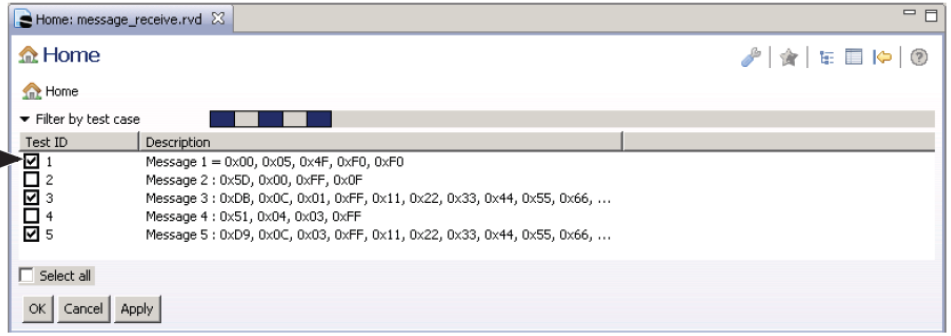
Reporting results by test case

Filter button

Filter summary



Filter checkboxes



Dealing with resource limitations

Trace vs map

```
201, 203,
203, 203,
201, 205,
207
```

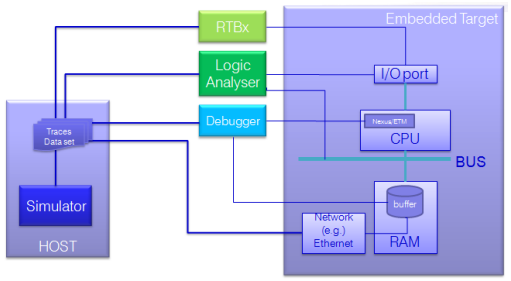
201	✓
202	
203	✓
204	✓
205	✓
206	
207	✓

Customize level of coverage

Multiple instrumentation strategies

	Profile modifier						
Profile	b	e	l	m	q	t	x
None	-	-	-	-	-	-	-
COV_CALLS	-	●	-	●	-	-	●
COV_DECISIONS	-	●	-	●	-	-	●
COV_FUNCTIONS	-	●	-	●	-	-	●
COV_MCDC_F	●	◇	-	●	-	-	◇
COV_MCDC_MAP	●	◇	-	●	-	-	◇
COV_MCDC_TF	●	◇	-	●	-	-	◇
COV_MCDC_VAL	●	◇	-	●	-	-	◇
COV_STATEMENTS	-	●	-	●	-	-	●

Data collection alternatives



Agenda

RVS Overview

⇨ **RapiCover DO-178 Qualification**

Upcoming Products

- Integration Guide Annexes
- RapiTime DO-178 Qualification
- RVS 3.1

Research Activities

Certification objectives: RapiCover

Objective			Applicability				Output	
ID	Description	Ref.	A	B	C	D	Description	Ref.
A-7, 5	Test coverage of software structure (modified condition/decision) is achieved.	6.4.4.2	●				Software Verification Results	11.14
A-7, 6	Test coverage of software structure (decision coverage) is achieved.	6.4.4.2a 6.4.4.2b	●	●			Software Verification Results	11.14
A-7, 7	Test coverage of software structure (statement coverage) is achieved.	6.4.4.2a 6.4.4.2b	●	●	❍		Software Verification Results	11.14

- Branch coverage also reported
  - Improves discovery of test effectiveness problems

Qualification as a verification tool (TQL5)

Qualification Service

Qualification Kit

Qualification Data

	Developer	User
TOR	Normal	-
TOVR	Full	-
TCI	Full	-
TQP	-	Outline*
TAS	-	Outline*
LCP	Access	-

	Developer	User
TCPR	Full	-
TVK	Support	-

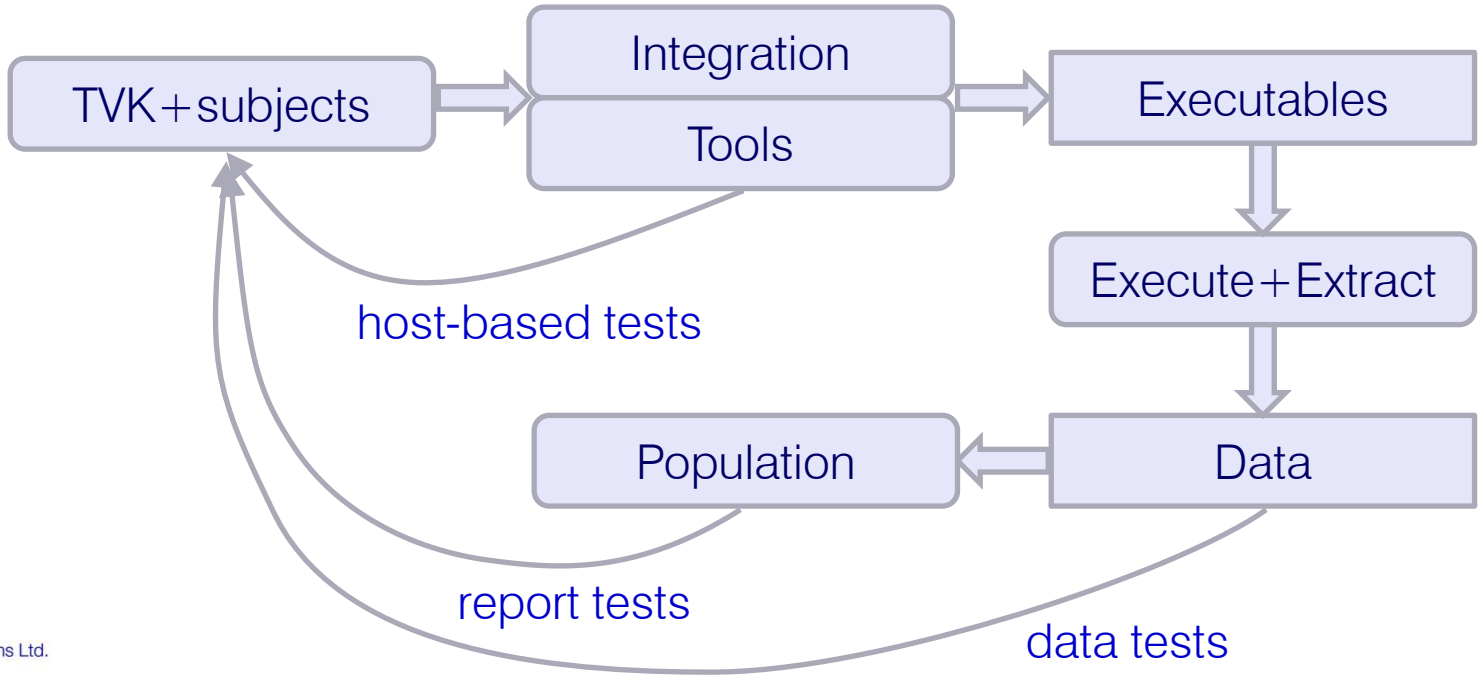
	Developer	User
TVK	integration	-
TOVR	-	Data
TAS	-	Data

* Outline is complete but marks user data customisation points

Verification Kit

RapiCover TVK

- Test runner
  - Invokes commandline tools directly
  - Invokes behaviour in your integration
- A selection of subject programs
- A framework for filter testing
- A single report summarising the test result



Kit vs. Service

Qualification Kit gives you high-level tests

- Test cases and procedures explain customisation process
- Limited support to get tests installed, selected and executed
- Support for investigating tests that fail

Qualification Service gives you on-site engineering effort

- Analysis of coverage measurement against recommended workflow
  - e.g. use of build ID system
- Confidence in tool configuration
- Dedicated analysis of target data filtering
- Dedicated analysis of demultiplexing
- Dedicated analysis of your instrumentation library
- Analysis of instrumentation options, tool commandlines
- Generation of test data for verification records

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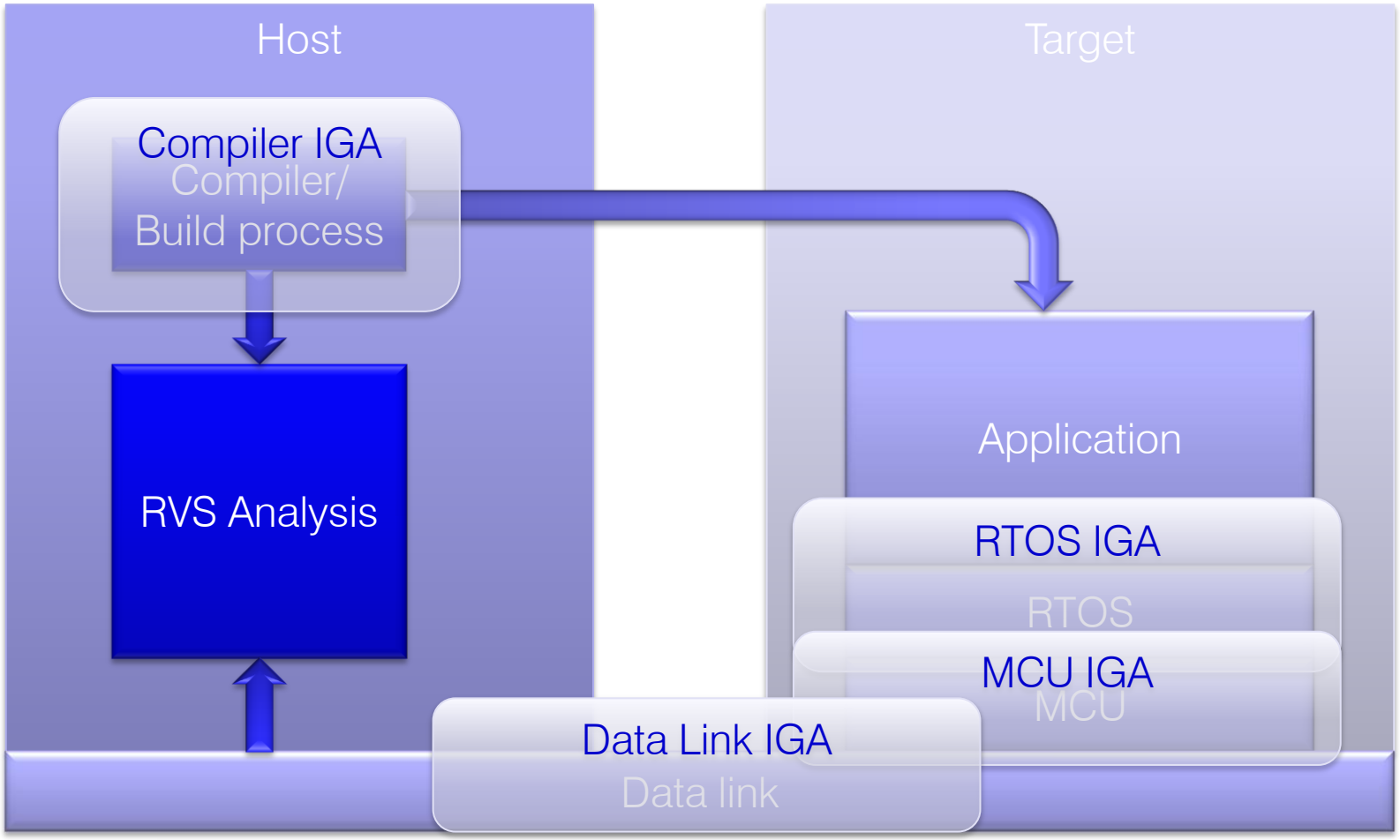
Integration Guide Annex



RapiTime DO-178 Qualification Kit

Available Q4 2012

DO-178B 6.3.4f says

- Accuracy and consistency: The objective is to determine the correctness and consistency of the Source Code, including stack usage, fixed point arithmetic overflow and resolution, resource contention, worst-case execution timing, exception handling, use of uninitialized variables or constants, unused variables or constants, and data corruption due to task or interrupt conflicts.

RapiTime builds on industry best practice with

- Lower effort
  - 90% lower according to one customer
- Improved level of detail
- Major aerospace customers already signed up to use this

RVS 3.1

Available Q4 2012

Key features

- Report comparison
- “Sensitivity analysis” for timing analysis

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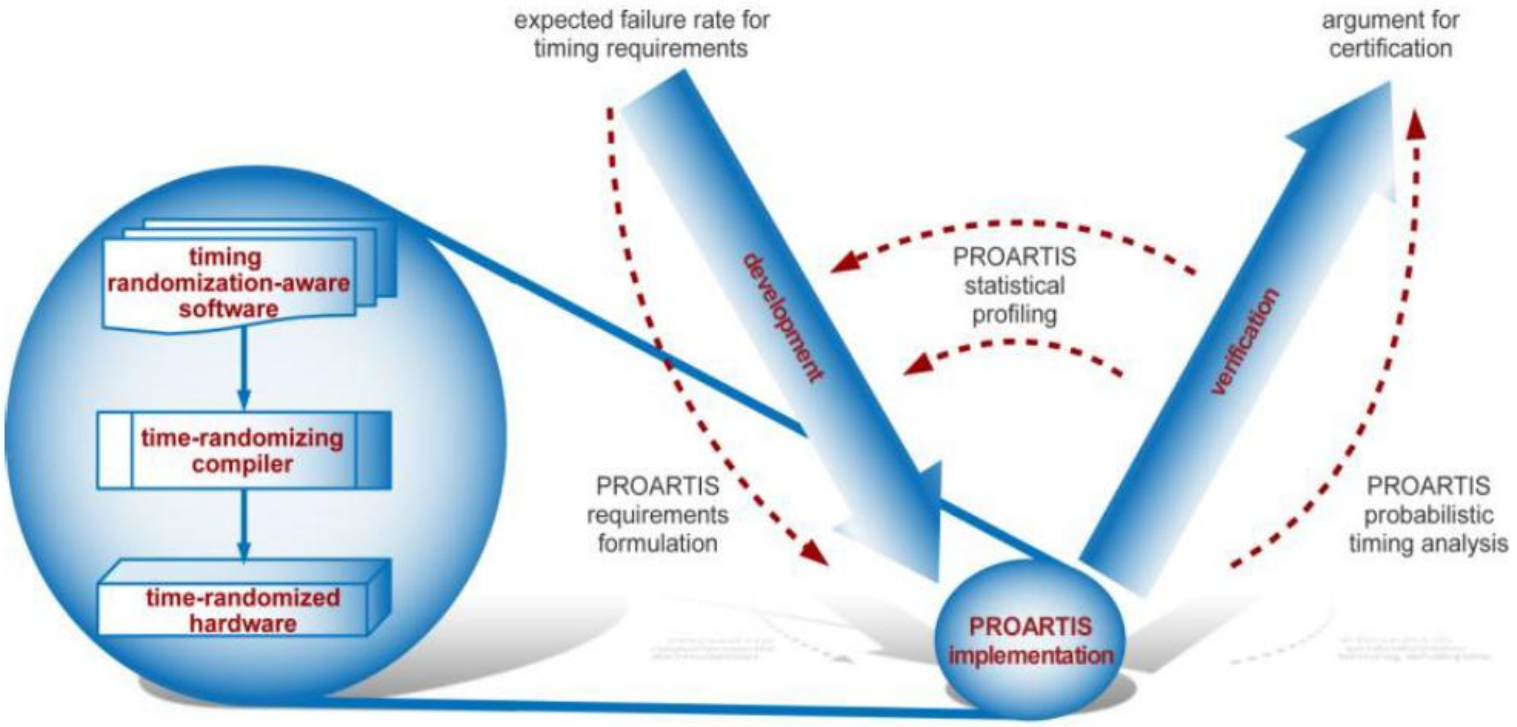
Probabilistically Analyzable Real-Time Systems

- Deliberately adding randomness to timing behavior allows new forms of software timing analysis



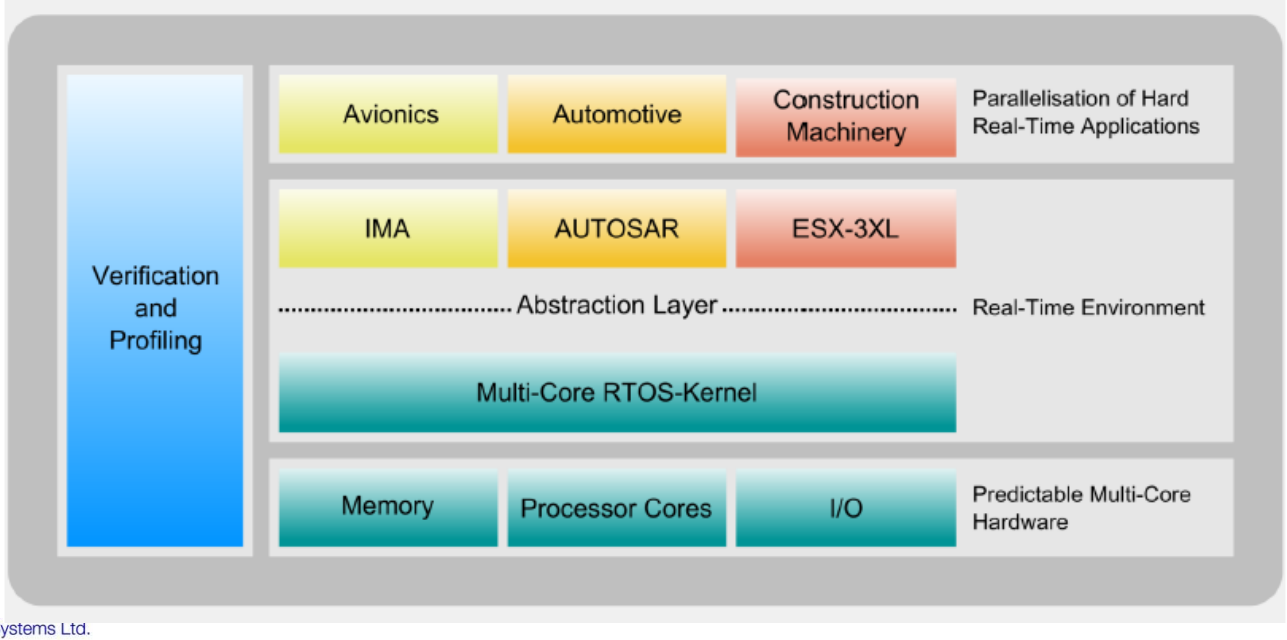
PROARTIS

parMERASA

Multicore analysis of parallelised hard real-time applications supporting analysability

New innovations:

- parallelisation techniques for safety-critical applications;
- timing analysable parallel design patterns;
- operating system virtualisation and efficient synchronisation mechanisms;
- guarantee of worst-case execution times (WCET) of parallelised applications;
- verification and profiling tools;
- timing analysable multi-core architecture with up to 64 cores.



Vacancy at Rapita Systems Ltd

Field Application Engineer (Software)

We are seeking talented candidates with a strong technical background.

You should have at least 3 years embedded programming experience and a desire to travel/meet customers.

This is an opportunity to join a growing UK-based technology company with clients in the global aerospace and automotive electronics industries.

Call +44 1904 567 747 or send a cover letter and CV to recruitment@rapitasystems.com

RAPITA Systems Ltd.