

Work Package 8

Test & Integration Plan

Outline

- Concentrating on Performance Requirements
- Hard Real-Time Core
 - Mapping GreenFlash Requirements to Tests
 - System Tests
 - Instrument Test Cases
 - Test Harness
- Soft Real-Time Core
 - Requirements
 - Test Approach
 - Instrument Test Cases
- Integration

Requirements Testing

- Each requirement will be initially assessed/tested in isolation
 - Inspection of source code
 - Benchmarking of RTC
 - Adaptive windowing
 - Different centroiders implemented
 - *etc.*
 - Utilisation of GUIs/tools
 - Ranking and creation of tests for requirements is ongoing
- System tests will test groups of performance requirements
 - Complete performance of the full RTC

Hard Real-Time Core

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Mapping Requirements to Tests

- Modular testing of individual requirements
- Aim to have a single test case which encompasses all GreenFlash functional performance requirements (2014 MAORY like instrument)
 - Frame rate of 800Hz
 - Pixel data rate of 200Gbit/s (out of scope → 100Gb/s)
 - MVM Performance of 1.5TMAC/s (6TB/s bandwidth MOSAIC 2014)
 - Latency <2ms
 - Jitter <100 μ s
- Test for individual ELT like instruments

Single Case

- Requirements
 - Frame rate of 800Hz
 - Pixel data rate of 200Gbit/s
 - MVM Performance of 1.5TMAC/s
 - Latency <2ms
 - Jitter <100μs
- Create test configuration to meet requirements

4 Hard RTC Tests

4.1 Base MAORY MCAO Test Case

The main operational tests are based on running an RTC for the MAORY system. In order to meet the performance requirements R9.10, R9.20 the tests will be run on an AO system running at 800Hz. The WFS will include 6 LGS with 1600x1600 pixels and 2x 500 NGS with 800x800 pixels (8x8 sub-apertures). This generates a large amount of data. The RTC will be run using real or simulated camera inputs, to satisfy the requirements.

The DM configuration for MAORY features 3 DMs, 1 of M4 and 2x 500 actuator DMs. Including the WFS specification the performance of only 0.84TMAC/s, below requirement R9.30. As such this test case cannot be used to assess R9.30.

Whilst running the MAORY test case the telemetry streams of the RTC will be inspected, comparing to R5.10 and R5.12. This telemetry data will be periodically saved, for contiguous bursts of 10s and inspected to satisfy R3.20, R5.20, R5.22, R7.40, R7.42, R8.26, R9.40 and R9.50. Whilst running the MOARY test case the status reporting interface to the RTC will be tested in line with R7.50.

R3.10, R3.20, R5.10, R5.12, R5.20, R5.22, R7.40, R7.42, R7.50, R8.26, R9.10, R9.20, R9.40, R9.50

Potentially increase DM actuators to 3x M4 to increase the MVM problem size to meet requirement

4.1.1 Test Instructions

1. Set configuration of RTC to MAORY system as previously described (R9.10, R9.20)
2. Start RTC system

GreenFlash Real-Time Requirements

	GreenFlash
Frame Rate	800
LGS	x6
Sub-aperture Geometry	74x74
Pixels	1600x1600
NGS	x3
Sub-aperture Geometry	8x8
Pixels	800x800
DM	x3
No. Controllable Modes	5316+2x500 (or 3x5316?)

Real-Time Performance Requirements

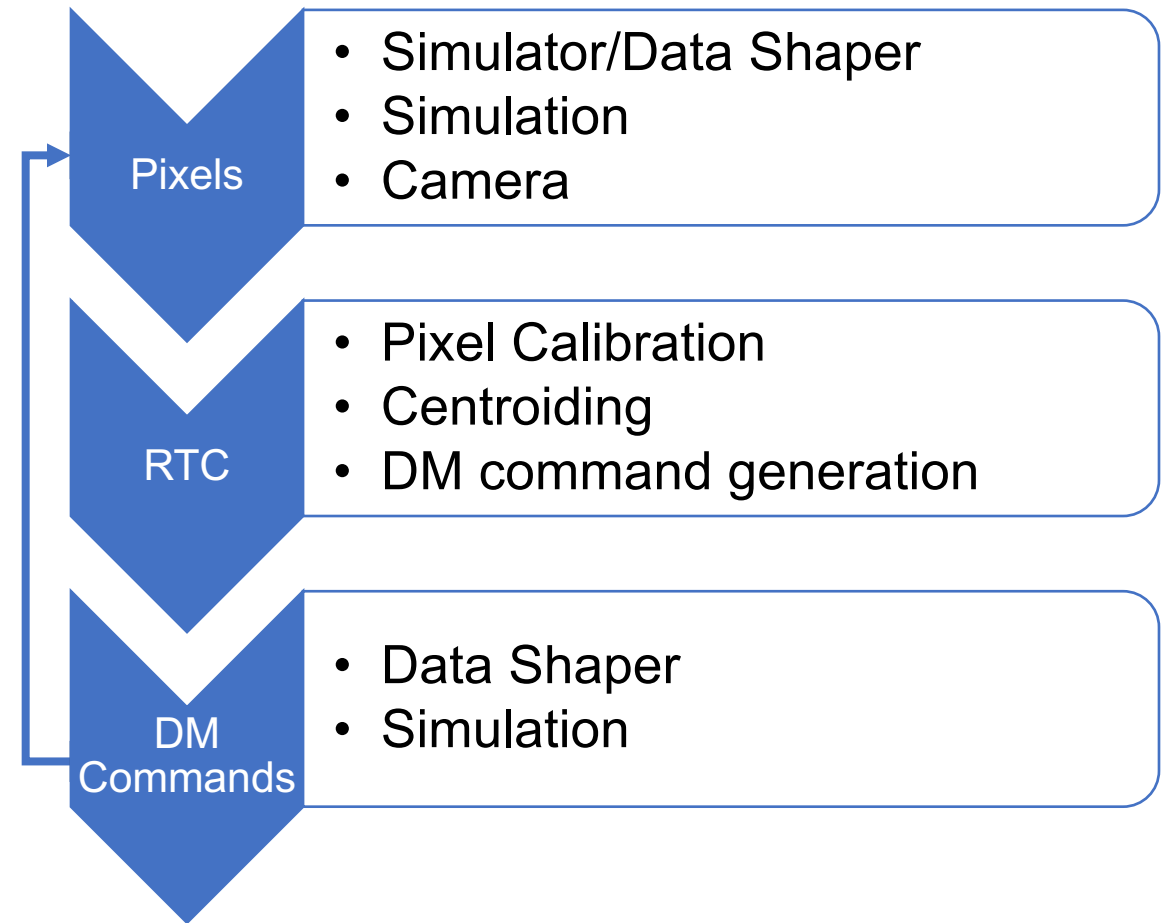
	GreenFlash	H-LTAO	H-SCAO	MAORY	MICADO	METIS	MOSAIC	HIRES
Frame Rate	800	500	1200	500	1000	500	250	1000
LGS	x6	x6		x6		x6	x4	
WFS geometry	74x74	74x74		74x74		74x74	74x74	
Pixels	1600x1600	800x800		800x800		800x800	800x800	
NGS	x3	x1	x2	x3	x1	x1?	x3	x1
WFS geometry	8x8		74x74PYR 10x10SH	8x8	96x96PYR	8x8	74x74	74x74 PYR
Pixels	800x800		240x240		240x240			220x220
DM	x3	x1	x2	x3		x1	x11	x1
No. Controllable Modes	5316+2x500	5316	5316+96	5316+?+ ?		5316	5316+ 10x(32x32)	5316

RTC Performance Requirements

	GreenFlash	H-LTAO	H-SCAO	MAORY	MICADO	METIS	MOSAIC	HIRES
Frame Rate	800	500	1200	500	1000	500	250	1000
LGS	x6	x6		x6		x6	x4	
Pixels	1600x1600	800x800		800x800		800x800	800x800	
NGS	x3	x1	x1(+1x)	x3	x1	x1?	x3	x1
Pixels	800x800	240x240	240x240		240x240			220x220
Bandwidth	200-400 Gb/s	30-50 Gb/s	1.2-2.5 Gb/s		1-2 Gb/s			
DM	x3	x1	x2	x3		x1	x11	x1
No. Controllable Modes	5316+2x500	5316	5316(+96)	5316+?+?	5316	5316	5316+ 10x(32x32)	5316
Slopes	45k	54k	15k		15k		54k	
Throughput*	0.8-1.5TMAC/s	0.5-1TMAC/s	200-400GMAC/s	?	200-400GMAC/s	See HLTAO	250-500GMAC/s	See MICADO

Test Harness

- RTC independent of incoming/outgoing data
- Timing external to the RTC
- Profiling tools to inspect internal RTC timing
 - External FPGA timing
 - x86 prototypes cannot yet use multiple CPU clocks (may have a trick)
 - GPU prototype use master GPU clocks



Soft Real-Time Core

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Soft Real-Time Core Requirements

- GreenFlash Requirements
 - Consume real-time telemetry data from the hard-RT pipeline in real time
 - Perform matrix inversion to compute control matrices in 5 minutes
 - Compute phase covariance within 1 minute
 - Compute reference slopes at 0.5-10Hz

Test Approach

- Soft Real-Time Core should take slopes from telemetry and generate control matrices within required time

GreenFlash	Non-GreenFlash
Pseudo Open-Loop Slopes?	M4 Position Monitoring
Parameter Estimation	Projection Matrices
Covariance Matrix Generation	Pupil Position
Matrix Inversion	LGS/NGS Centroid Gains
Reference Slope Updates	PSF Reconstruction

- For GreenFlash case and individual ELT instruments
 - Resolution of parameters
 - Matrix sizes

Test Approach

- Benchmark algorithms internal to RTC
 - Use profiling and internal timing data
 - Test each step in isolation
- Benchmark full supervisor pipeline
 - Use profiling and internal timing data
- Demonstrate utilising telemetry and updating hard RTC parameters on small-scale systems *e.g.* SCAO

Reconstructor Performance Requirements

	GreenFlash	H-LTAO	H-SCAO	MAORY	MICADO	METIS	MOSAIC	HIRES
Frame Rate	800	500	1200	500	1000	500	250	1000
Parameter Update Rate	1 min							
Covariance Matrix size	~45kx45k	~54kx54k		~66kx66k		~54kx54k [*]	~77kx77k	
No. Matrices	1	2	0	1-?*	0	2*	10	0
Resolution		10 layers					34 layers*	
Reconstruct or	~45kx6.3k	~54kx5.3k	~11kx5.4k	~66kx6.3k	~11kx5.4k	~66kx5.3k	~77kx15.5k	~66kx5.3k
Recon Update Rate	5 mins	1 hour		30 mins*		1 hour	5 mins*	

* Best estimates

Integration

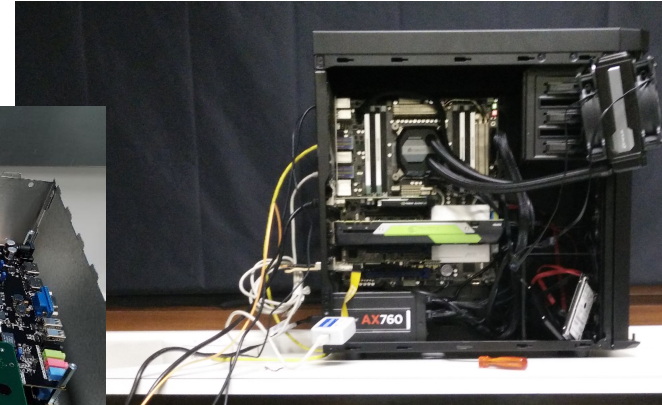
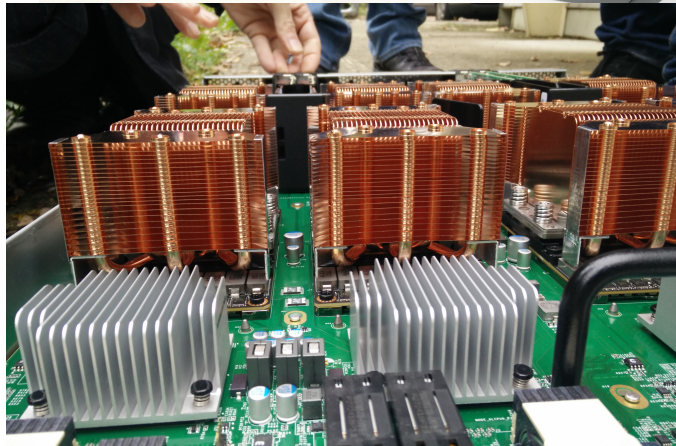
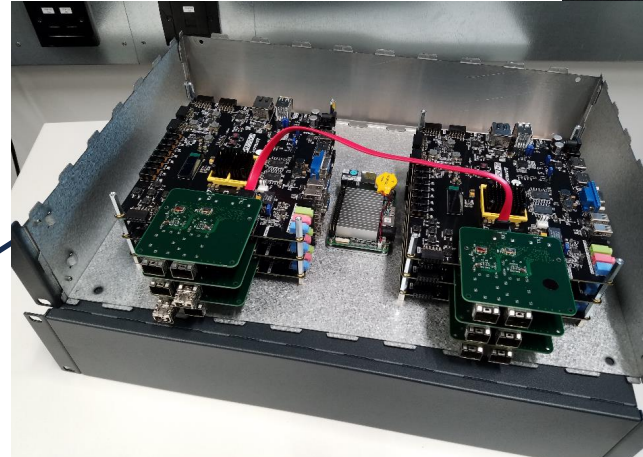
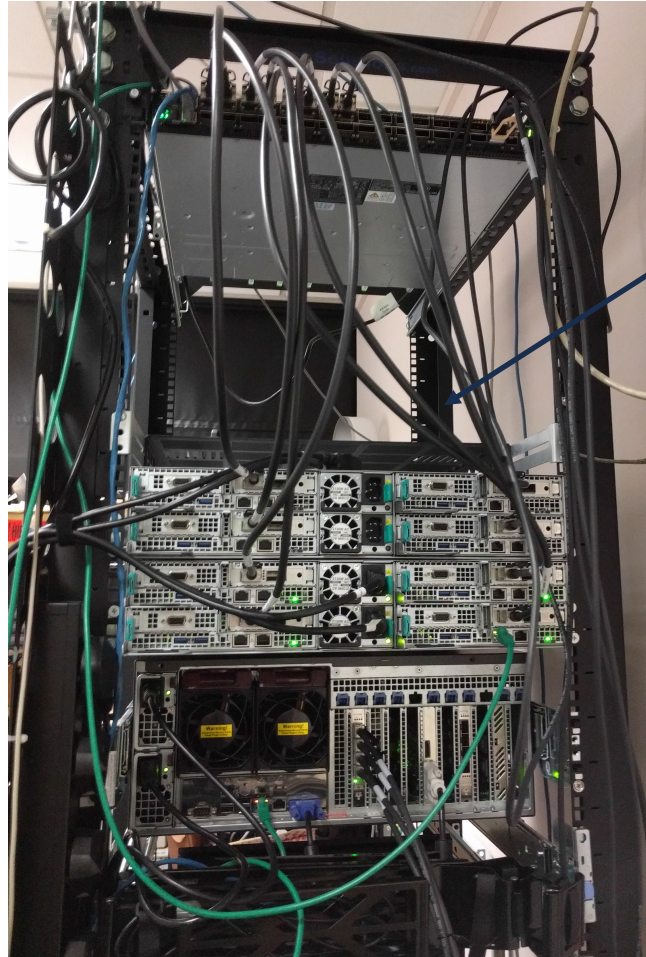
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Integration Plan

- Multiple prototypes in multiple locations
 - GPU
 - MIC
 - FPGA
 - All potentially meet requirements
- All will be constructed and tested against common test plan
 - Comparison of results in final report
- Individually integrated by respective institutions

Integration Plan



06/04/2018



Summary

- Hard Real-Time Core
 - Mapping GreenFlash Requirements to Tests
 - System Tests
 - Instrument Test Cases
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END

