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Australian Government

Department of Defence
Defence Science and
Technology Organisation

Performance Evaluation of Airborne Mission Systems in the Acquisition Process

Kiril Uzunov
Air Operations Division

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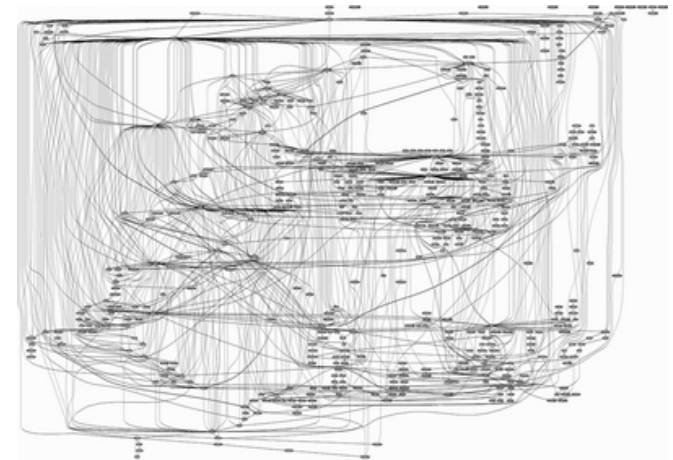
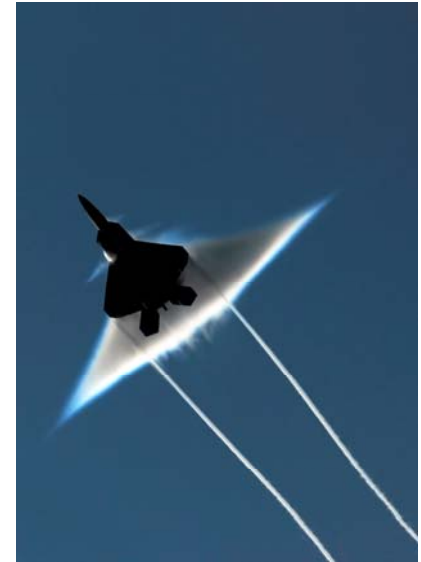
Outline

- Motivation
- Methods and tools for performance estimation
- Results and limitations



Mission System trends

- Multi-mission aircraft
 - Increasingly integrated and automated functionality
 - Increasing size, **complexity** and criticality of software intensive systems
 - Increased sensor capability
 - Long lifetime of a platform
 - New technologies – COTS and reuse
-
- Emphasis on understanding real performance



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Acquirer's perspective

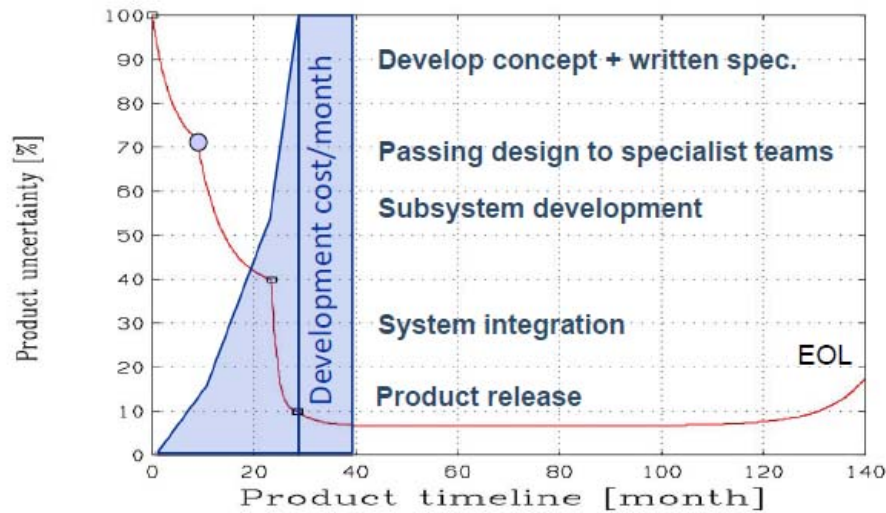
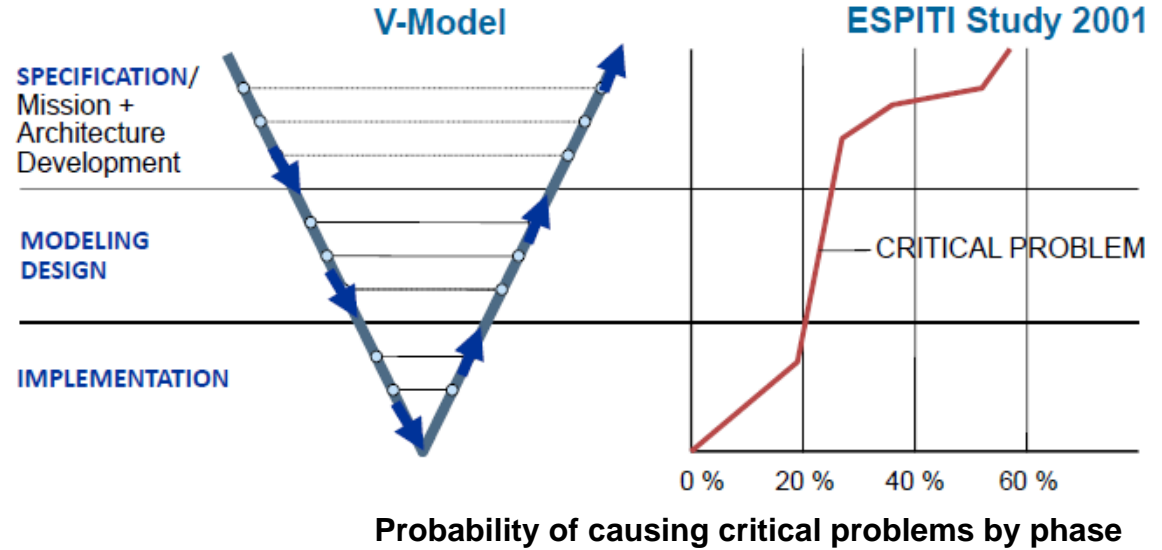
- No or restricted access to code and development environment
- Identify processes and look for adherence
- Observe issues crop up and watch for solutions and recovery
- Risk mitigation activities – research in performance estimation, modeling and benchmarking, prototype development



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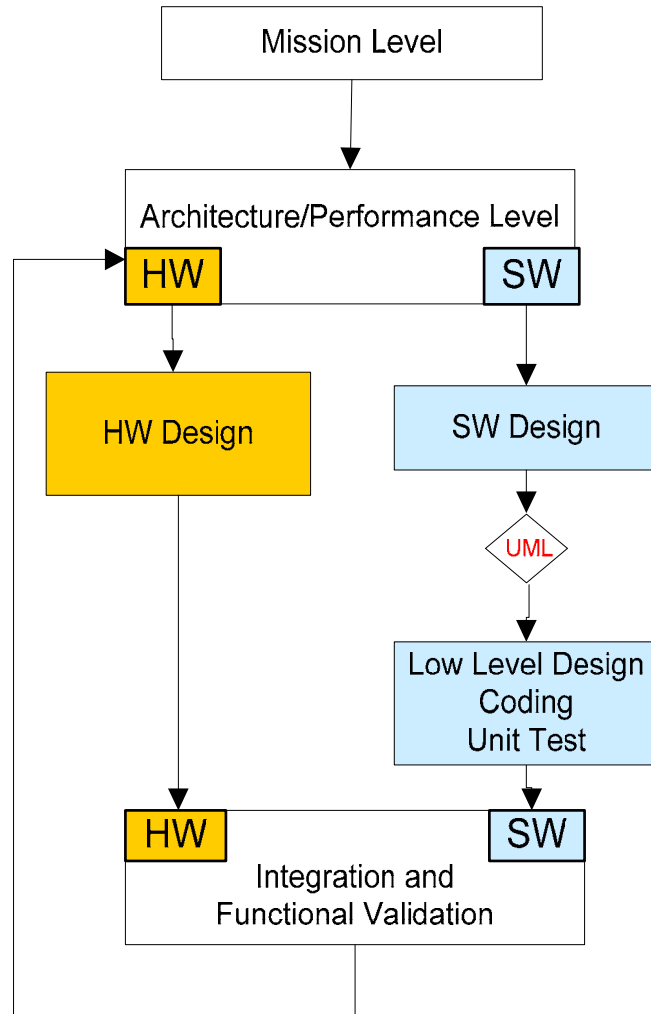
Product uncertainty



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Mission System development: time analysis

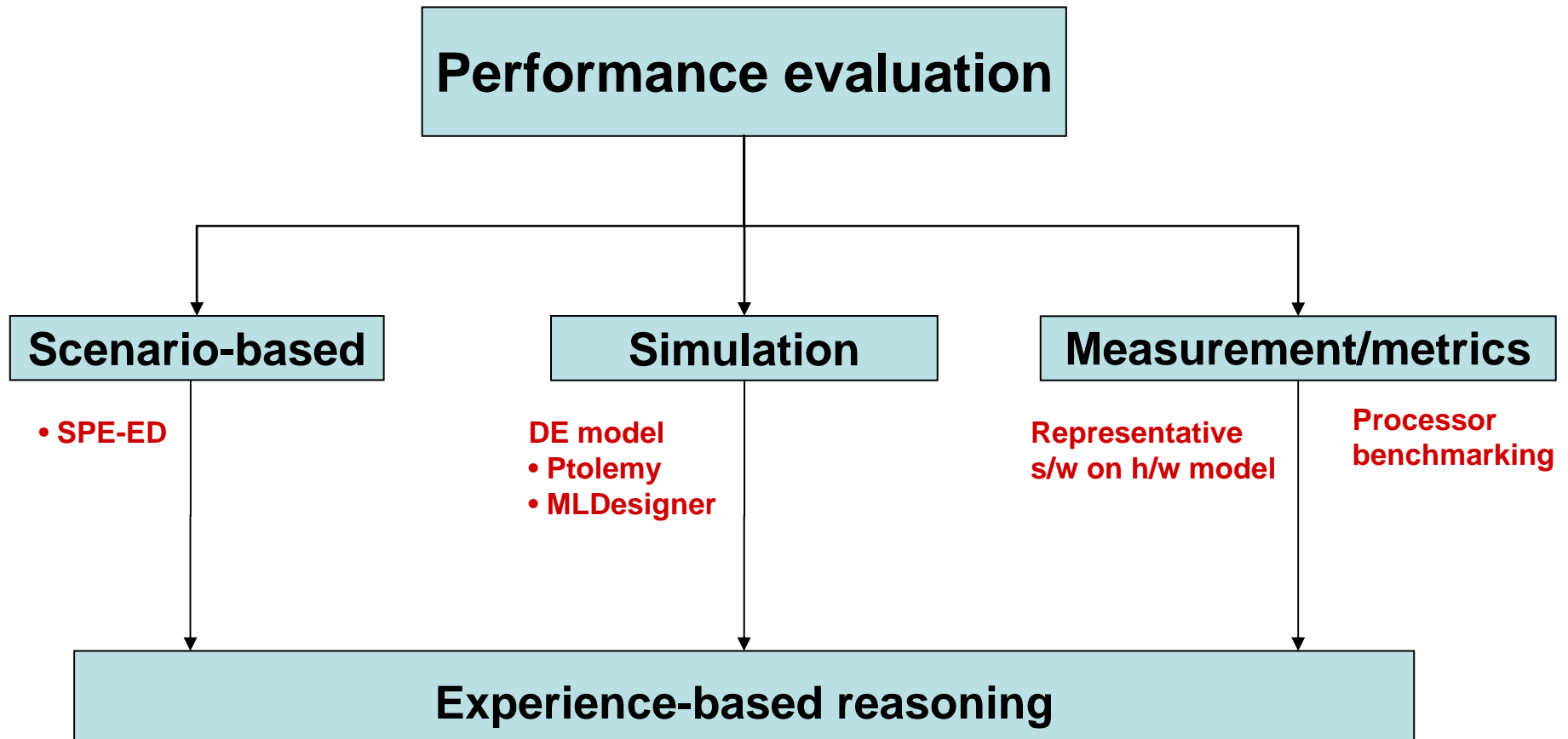


- Early architecture exploration
 - Selection of network topology, processors
 - Mapping of applications to processing nodes
 - OS/scheduler configuration
- Later stages
 - Verification
 - Safety and certification
 - Calculating reserve capacity for growth

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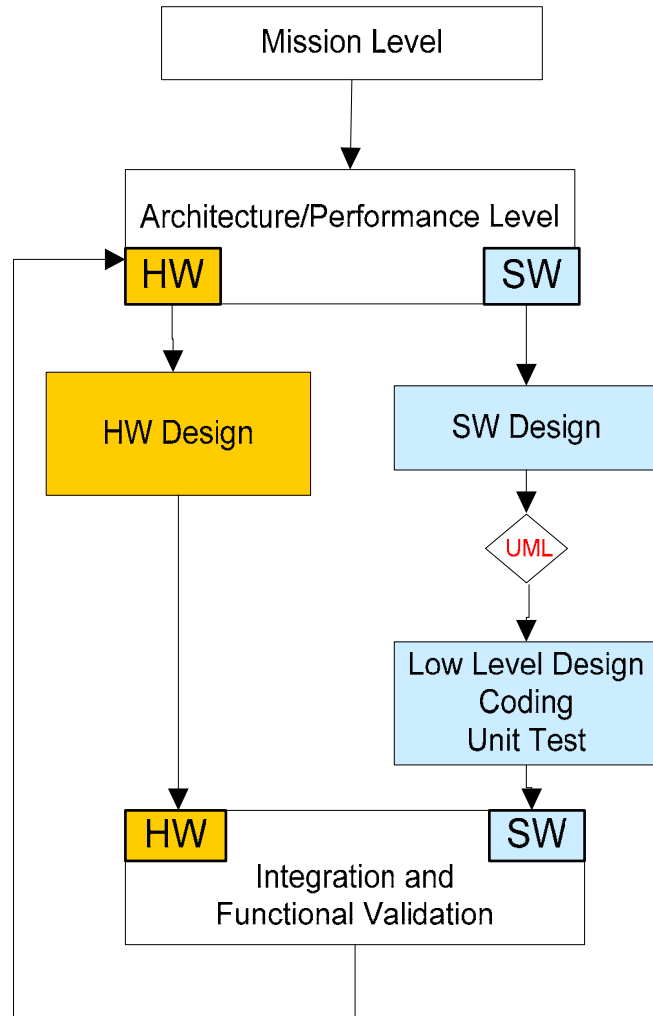
Performance evaluation techniques



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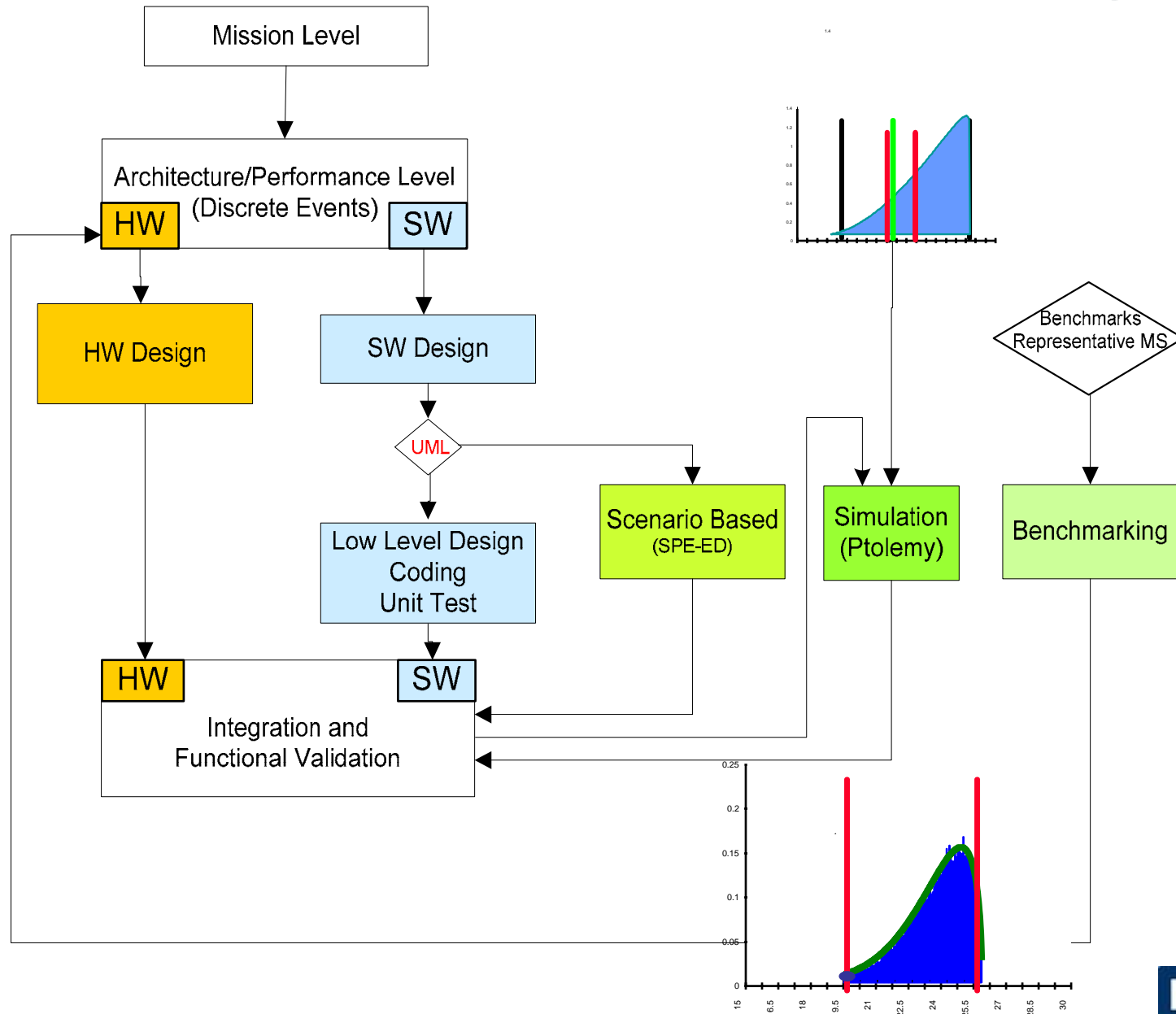
MS performance modelling flow



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MS performance modelling flow



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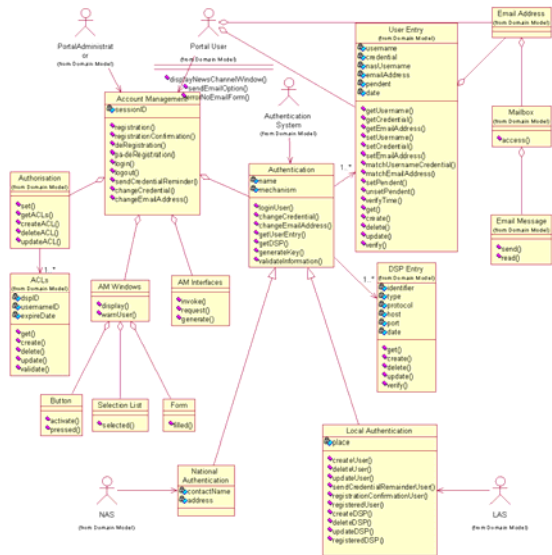
Scenario based

Performance estimation using SPE-ED

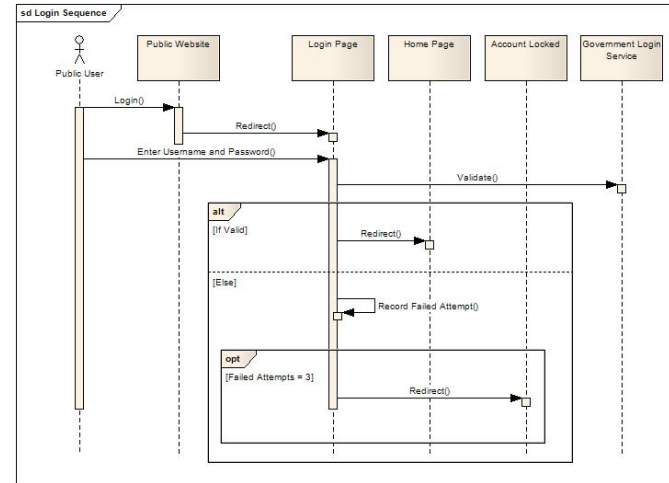
1a Scope and Scenario



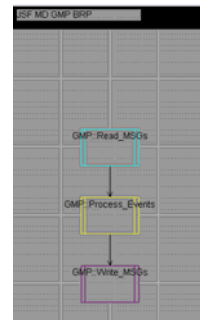
1b UML model



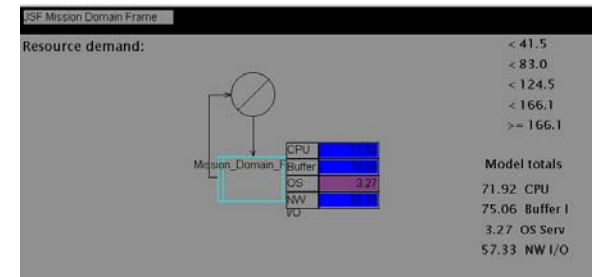
2 UML Sequence diagram



3 Execution graph



4 SPE-ED model



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WCET based calculator

Timing validation

Needs WCET for each task

- Code level
 - end-to-end measurement
 - static analysis
 - hybrid analysis

- System level
 - end-to-end measurement
 - schedulability analysis (timing validation)

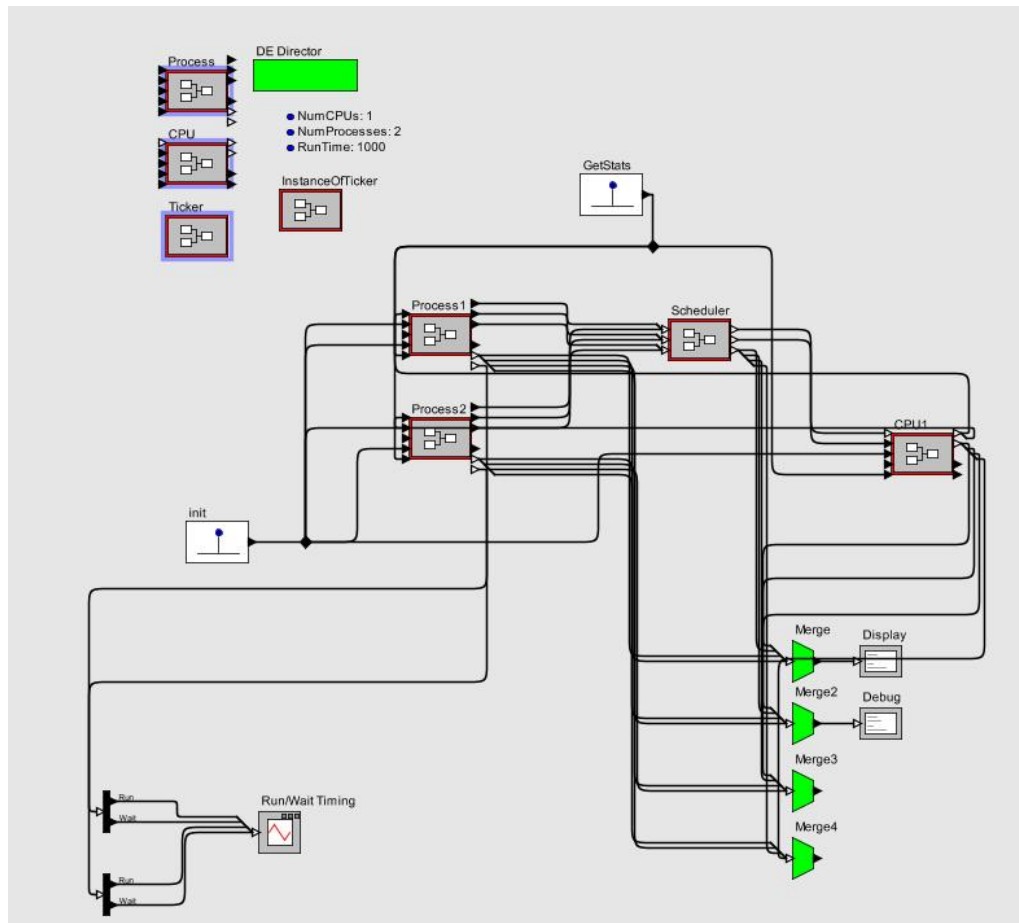


Simulation based



Ptolemy based DE model

Ptolemy terminology

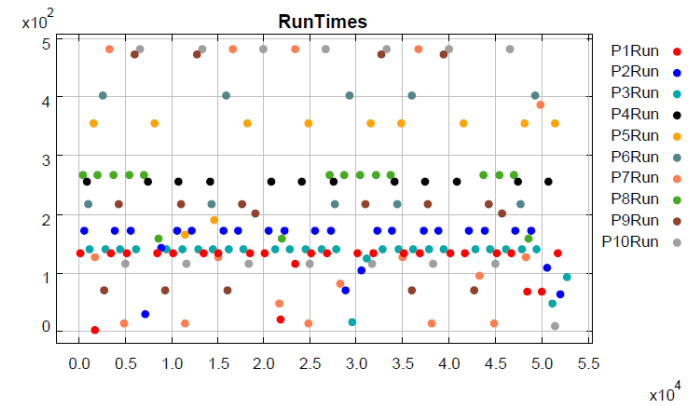
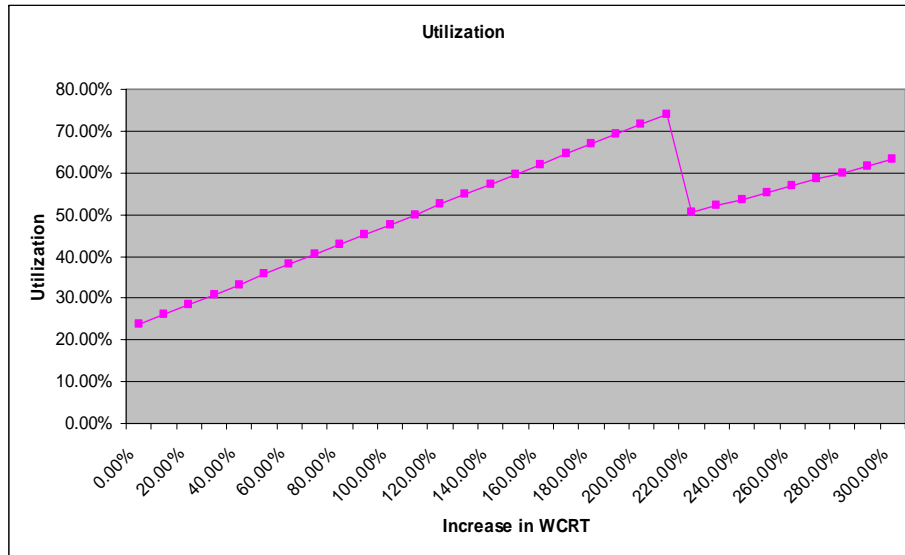


- Actors
 - Process actor
 - CPU actor
 - Scheduler
- Ports
- Events
- Parameters

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Ptolemy displays

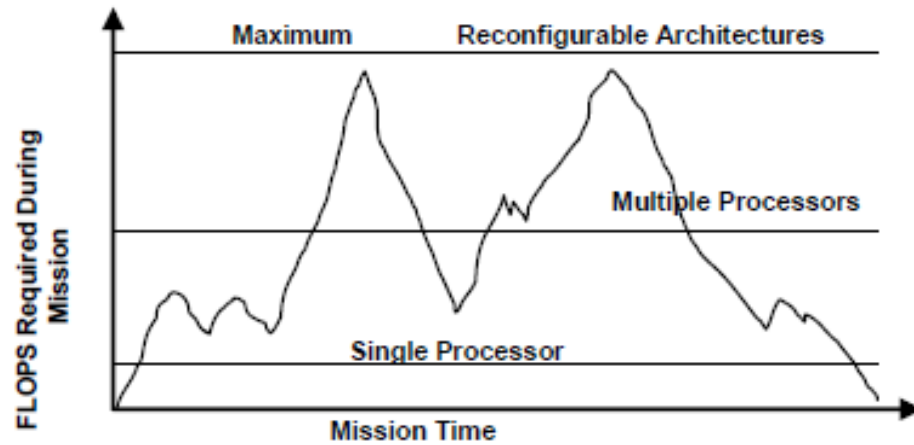


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benchmarking

Benchmarking/measurement



- paper-based analysis
- benchmarking phase
- insertion scenarios

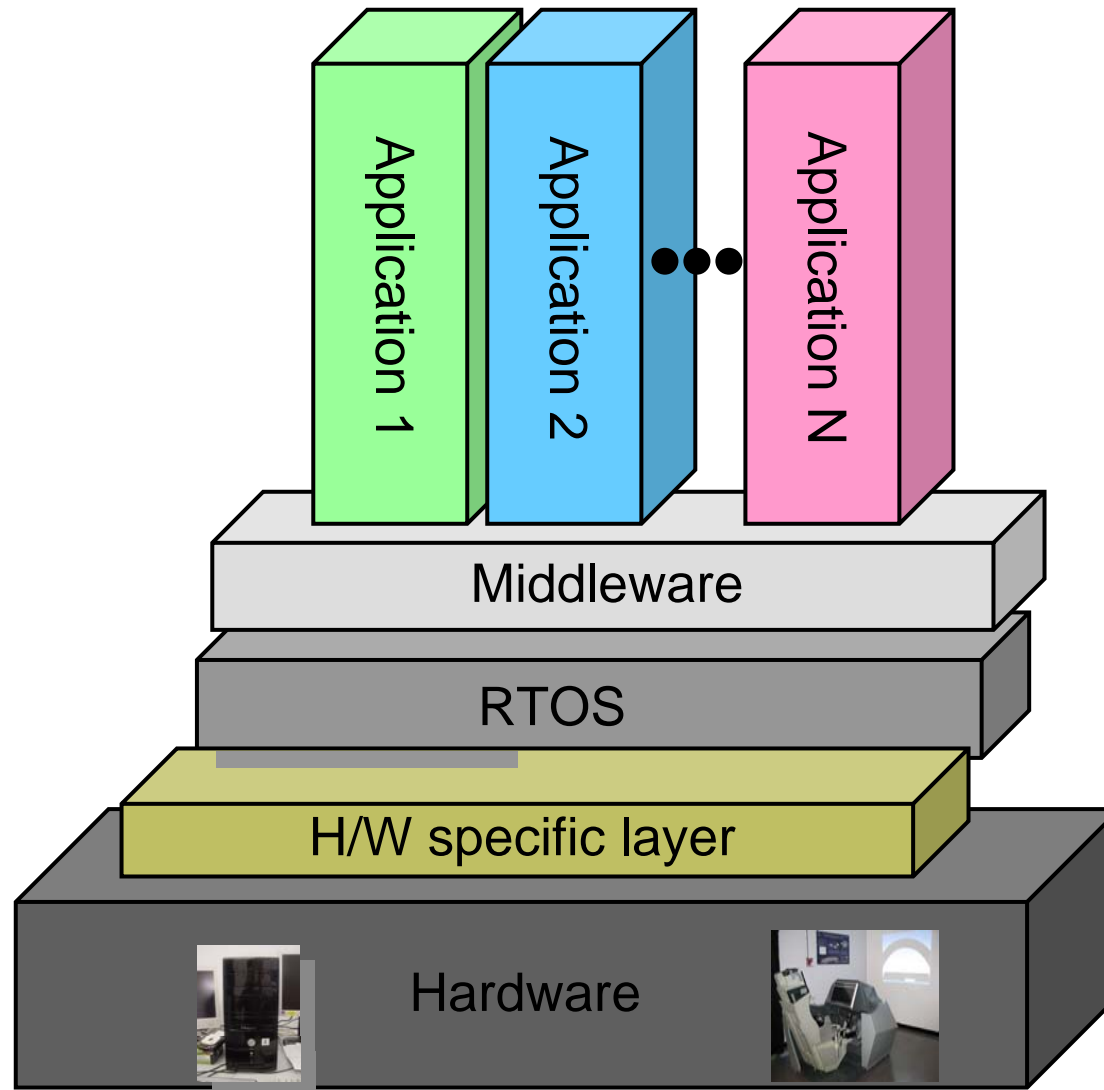


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benchmarking

Representative Mission System



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To conclude

- Acquirer prospective – risk assessment and mitigation
- Three approaches to performance evaluation based on limited information
- Using different approaches helps with validating the results
- Although the fidelity of these models is limited, they are a useful tool to monitor the risks and rigour of development.



Acknowledgments:

Ryan Hales – SPE-ED modelling

Simon Lemmo – benchmarking

Callum Baillie – Ptolemy DE model

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