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Model Driven Benchmark Generation for Web Services

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Outline

- Unique Challenges in Web Services Performance Testing
- How Model Driven Development (MDD) Can Help
- Our Approach
  - Use OMG's MDA standards and an open source MDA framework implementation – AndroMDA
  - Design a domain specific "modelling" language for WS performance testing
  - Provide data collection and performance monitoring infrastructure
  - Generate deployable benchmark application
- Conclusion
- Limitations and Future Work

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Unique Challenges in WS Performance Testing

- Industry Observation
  - Industry reports e.g. "Web Services: A Nightmare for Testers"
- Limited Control Over
  - How services are consumed
  - Unforeseen usage scenarios
- Complexity
  - Coarse grained services (require one operation to handle vastly different payloads)
  - Large number of test combinations (endpoints, operations and data)
- Service Quality and SLA (Service Level Agreement)
  - Complicated: Web Services + Backend system + Networks (often Internet)
  - Ongoing monitoring/auditing during operation
  - Comformant with the standards
- Business (Service coordination essentially supports business transactions)
  - Service performance monitoring reflects critical business performance
  - Quickly build and performance test new services

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How MDD Can Help - 1/2

MDD is about raising the level of abstraction for software development, providing more powerful concepts for capturing and reusing knowledge in a specific domain.

We apply MDD to the performance testing domain.

- Raise the level of abstraction
  - Have all the basic benefits of using models
  - Integrate with other models (design, analysis and business)
- Design a Domain Specific Modeling Language (DSML) for performance testing
  - Encourage best practices and modular designs through the language
  - Gain productivity through using a DSML
  - Decouple and reuse modules such as testing data, testing logic

How MDD Can Help - 2/2

- Use code generation "cartridge"
  - Hide Complexity and integrate best practices
  - Allow users to inherit best practices
- Use standards if possible
  - Leverage existing expertise
    - UML and Tooling
    - UML 2.0 Testing Profile
    - UML Profile for Schedulability, Performance and Time.
  - Integrate with SDLC
- Provide monitoring platform infrastructure
  - Save effort
  - Vendor neutral
  - Layered approach (monitoring of components, Web services, service coordination and business processes)

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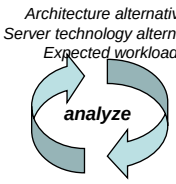
Our Approach - An Overview 1/3

MDD Approaches

• OMG's MDA standards (We follow MDA and use AndroMDA)

• proprietary approaches (MSFT DSL, Metacase, openArchitectureWare …)

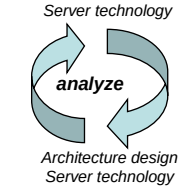
Architecture Design



MDAPerf

Architecture-based performance modeling and prediction tool

Benchmark



MDABench

Application benchmarking development toolkit

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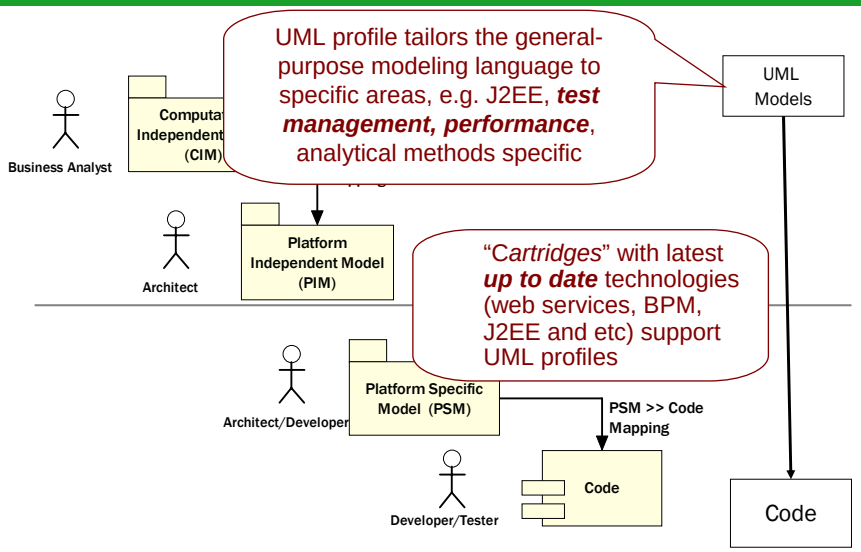

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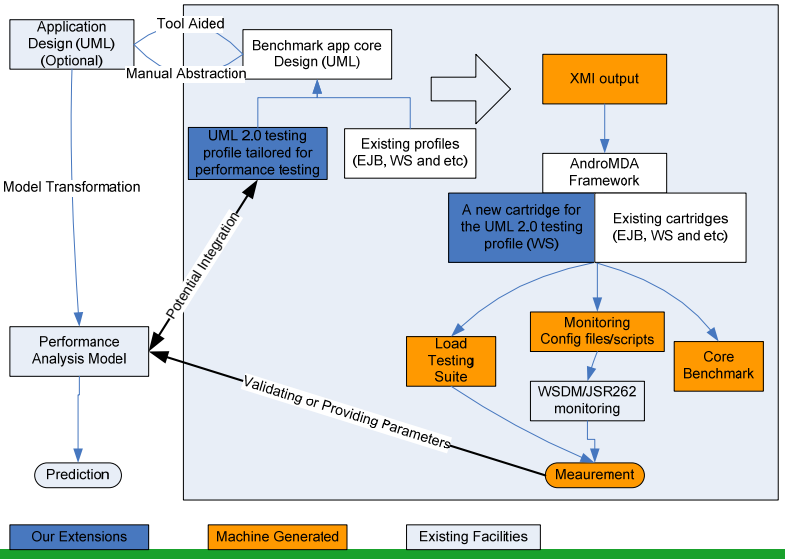
Our Approach - An Overview 3/3



Integrate Best Practices

- Internal Designs
  - SPEC jAppServer /ECperf : clients, controllers and drivers
- Performance Metrics
  - TCP-W v2
    - SIRT (Web Service Interaction Response Time
    - SIPS (Service Interactions Per Second)
  - Distribution Statistics
  - Timing details
- Load Testing Configuration
  - Grinder 3
  - MSFT Visual Studio Load Testing

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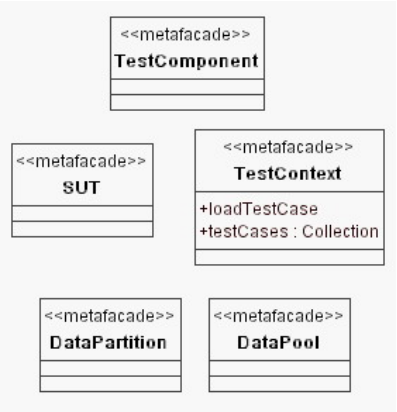
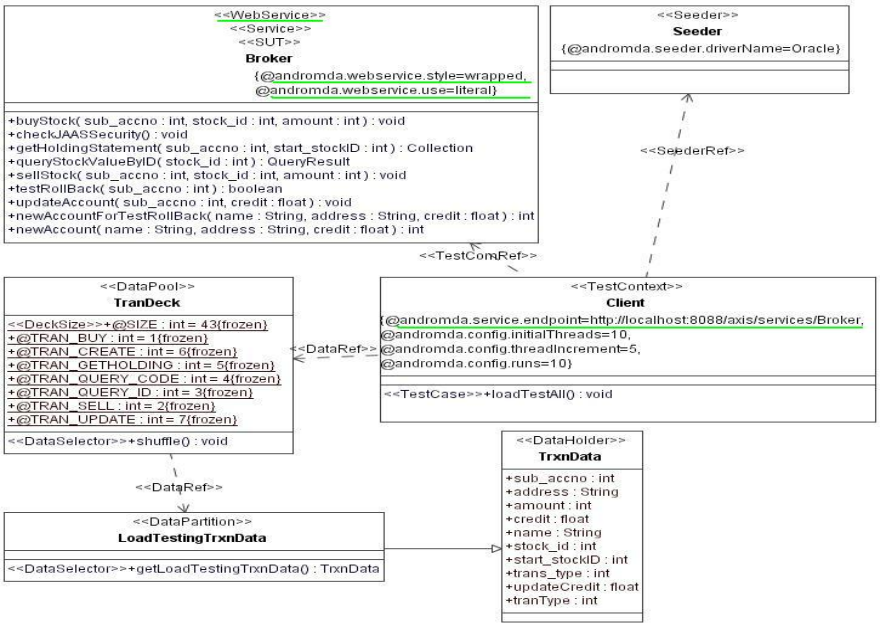
UML Profiles for Performance Testing

Extending UML 2.0 Testing Profile

- **Stereotypes**
  - SUT: The application to be test
  - TestContext: A collection of test cases
  - TestComponent: Classes of the application to be test
  - DataPool: A collection of explicit values that are used by a test context or test components during testing.
  - Data Partition: Logic values for a method parameter used in testing
- **Tagged Values**
  - Testing Control
    - config.InitialProcesses
    - config.processIncrement
    - config.processIncrementInterval
    - config.stablizationperiod
  - What to measure





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Performance Monitoring

- Client side: Response time average/distribution/graph and throughput
- Server side : platform specific performance data
  - Through both consoles and generated scripts
  - Hide platform specific details in model to scripts generation
  - Previously
    - Use component technology management/monitoring API such as JMX monitoring, e.g. cache hit ratio, method invocation time
  - Now
    - OASIS Web Services Distributed Management (WSDM) compliant manageability endpoint : Performance Metrics
    - JSR 262: Web Services Connector for JavaTM Management Extensions (JMXTM) Agents

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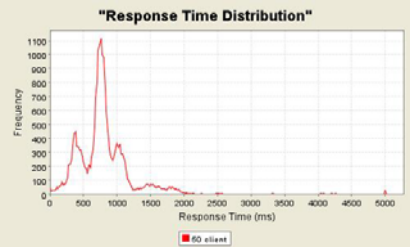
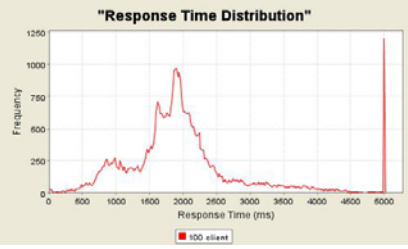
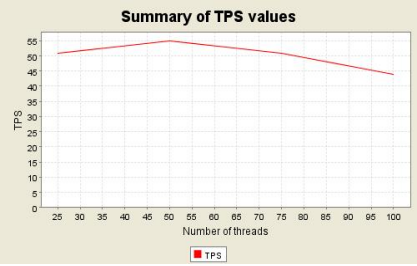
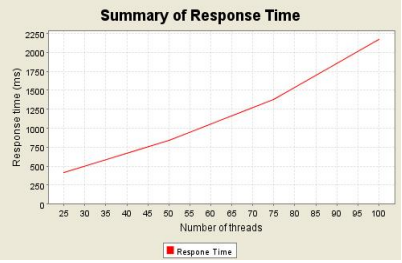
Automatically Generated Results









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Conclusion

- The benchmark generation is compliant with MDA
  - Provide a domain specific modeling language for WS performance testing
  - Quick modeling and configuration of WS performance testing
  - First implementation of a tailored UML 2.0 Testing Profile
- Provide performance testing generation cartridges and monitoring infrastructure
  - Incorporate best practice of WS performance testing
  - A default implementation and test data generation saves a large amount of effort for normal load testing.
  - Reuse WS test data and test logic separately
- Save effort and improve quality by
  - plumbing and best practice integrated in code generation cartridges/framework
  - Working with latest technologies by tapping into AndroMDA's cartridge pool
  - Leveraging UML expertise and standards
- Part of a bigger picture of capacity planning research at NICTA

Limitations and Future Work

- Test data generation
  - Exception modelling
  - Integrate real world load profile
- Extend to other areas
  - Performance testing and monitoring for Web services coordination and choreography
  - Link with Business Activity Monitoring (BAM) and business process performance monitoring