DAME: A Distributed Diagnostics Environment for Maintenance

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Project Partners

- EPSRC Funded, 3 years, commenced Jan 2002.
- 4 Universities:
  - University of York, Dept of Computer Science
  - University of Sheffield, Dept of Automatic Control and Systems Engineering
  - University of Oxford, Dept of Engineering Science
  - University of Leeds, School of Computing and School of Mechanical Engineering
- Industrial Partners:
  - Rolls-Royce
  - Data Systems and Solutions
  - Cybula Ltd

Distributed Aircraft Maintenance Environment - DAME

Operational Scenario

DAME Grid Challenges

- Two primary Grid challenges:
  - Management of large, distributed and heterogeneous data repositories;
  - Rapid data mining and analysis of fault data;
    - York AURA technology is critical component for data mining activity
- Other key issues:
  - Remote, secure access to flight data and other operational data and resources;
  - Management of distributed users and resources;
  - 24/7 operation – QoS issues

The Data

DAME demonstrator activity has focussed on the implementation of a portal workbench
- Provides access to a range of analysis tools for the engine diagnosis process
- Manages issues of distributed diagnosis team and virtual organisations
- Manages issues of security and user roles.

Portal Environment
Distributed Aircraft Maintenance Environment - DAME

**DAME Architectural Overview**

**Data Mining**
- Decision Support
- Case Based Reasoning
- Novel Data
  - Raw Engine Data
  - Vibration Data
  - Shaft Speed
  - Fuel Flow
  - Service Data
  - Parts Data

**DAME Diagnostics Portal**
- Grid Services Management
- Modelling/Simulation
- Operational Data
- The Grid

**WRG Distribution**
- Grid Middleware Services
- Modeling & Decision Support
- DAME WRG
- Sign-on Portal
- SDM Database
- CBRAnalysis-G
- Engine Model-G
- GT3 Service
- CBR advisor
- GT3 Service
- BD25 Engine model wrapped as Grid Service
- XTO-G
- GT3 Service
- XTO plug-ins via a Grid Service
- DataVisualiser
- GT3 Service
- Jchart Viewer for viewing XTO output
- Workflow Browser based workflow tool.
  - Compliant with Resource Broker

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**Data Mining Services**
- The AURA correlation matrix technology is used for rapid pattern matching;
- Two-tier architecture.
  - First tier hosts a generic AURA service
  - Second tier containing application specific code
- Clients interact directly with the second tier, allowing application developers to abstract away from the pattern match domain.

**Case Based Reasoning**
- CBR service is provided via a Grid service interface to a commercial CBR package;
- A Service Factory supports the creation of multiple CBR instances
  - Permits many CBR processes to be executed in parallel from a single service access point
- CBR provides decision support for fault ranking and workflow advice;

**Engine Model Service**
- GSI enabled engine performance simulation for different flight operational conditions and requirements, e.g. Idle, Take-off, Climb
- The Factory Service can generate a group of engine simulation instances for different client requirements.
- Both Transport Level and Message Level Security are implemented to protect the secure sensitive engine model and user data.

**Signal Processing Services**
- Grid based deployment of the vibration analysis algorithms:
- Provides:
  - Opportunity for finer grain analysis;
  - More powerful algorithms;
  - Testing environment for development of new algorithms;
Workflow Engine

- Workflow Engine provides management of manual and automated workflows.
- Also handles certification and role management

Workflow Engine

Brokering and SLA’s

- Brokerage system is used for job allocation on available Grid resource
- Due to commercial application domain, broker should also demonstrate capability to manage QoS issues, and specifically Service Level Agreements (SLA’s)

Brokering and SLA’s

Dependability Issues

- Contribute to the GRID community dependability and security studies, where possible.
- Provide dependability and security analysis to support the ultimate deployment of DAME as a working engine diagnosis environment.
- If possible, provide a basis (identify good practices) for dependability and security analysis for the deployment of DAME as a working diagnosis environment for other domains e.g. medical.
- Dependability analysis has meant need for business process analysis, asset identification, risk identification.

Dependability Issues

GT3 Experiences

- Transition from web services to OGSA grid services reasonably straightforward;
- However, poor documentation and technical support in early GT3 releases;
- Fairly substantial changes in OGSA/OGSI spec between releases (e.g. registry definitions);
Future Work

- Development of work-flow manager in the portal, for flexible workflow configuration;
- Further analysis of dependability properties, including detailed studies on timeliness properties and security issues;
- Larger scale database deployment, and possible OGSA-DAI development;
- Further development of Grid monitoring services as basis for SLA and brokering;
- Continued development of data mining capability;
- Enhanced data visualisation and processing capability.

Thanks…

The development team:
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Further info: http://www.cs.york.ac.uk/dame