Distributed Aircraft Maintenance Environment
DAME

DAME: Searching Against Distributed Data Using a Web Service Architecture

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Project Partners

EPSRC Funded, £3.2 Million, 3 years, commenced Jan 2002.
UK pilot project for e-Science, part of £220m UK programme.

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

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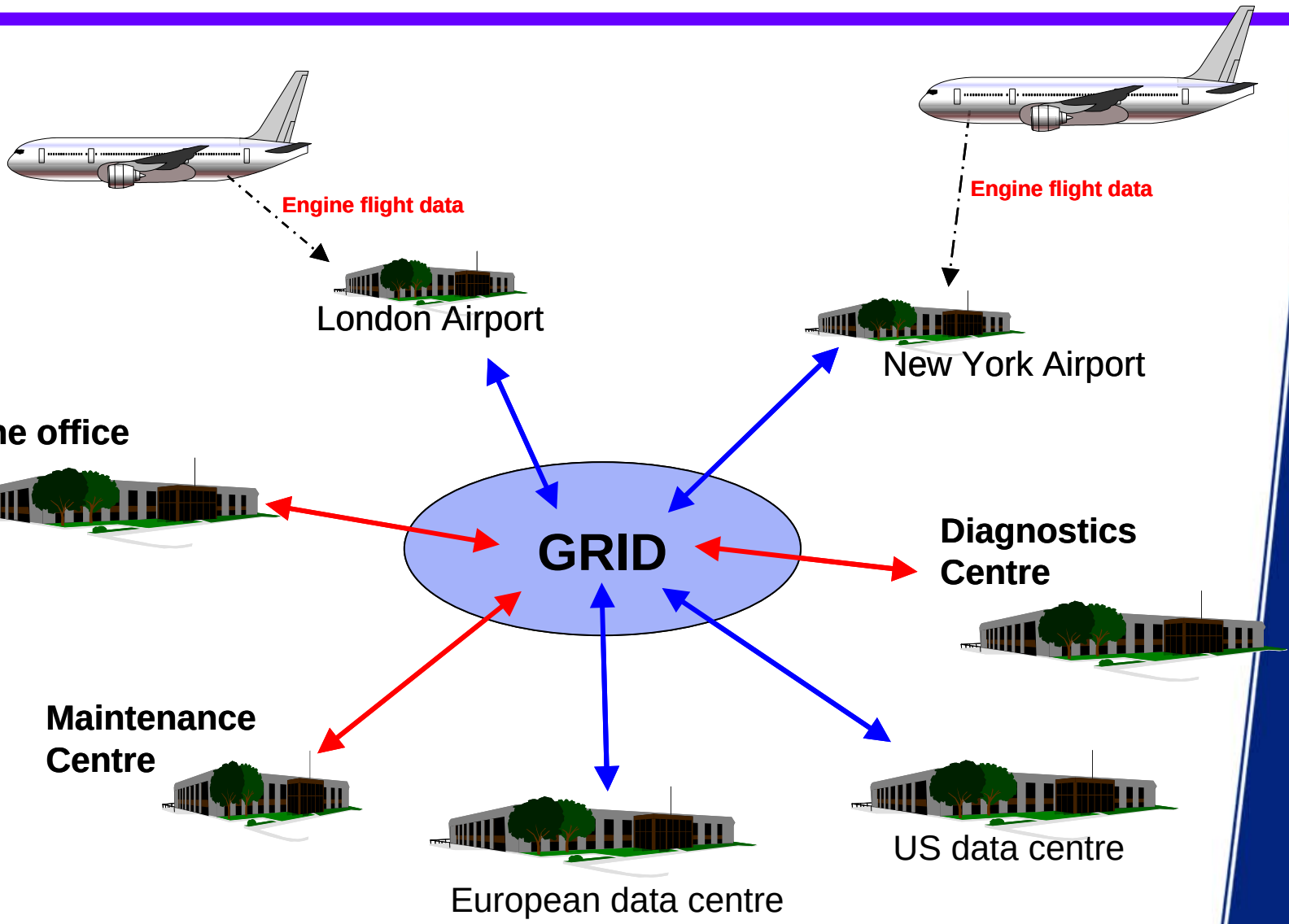
Operational Scenario



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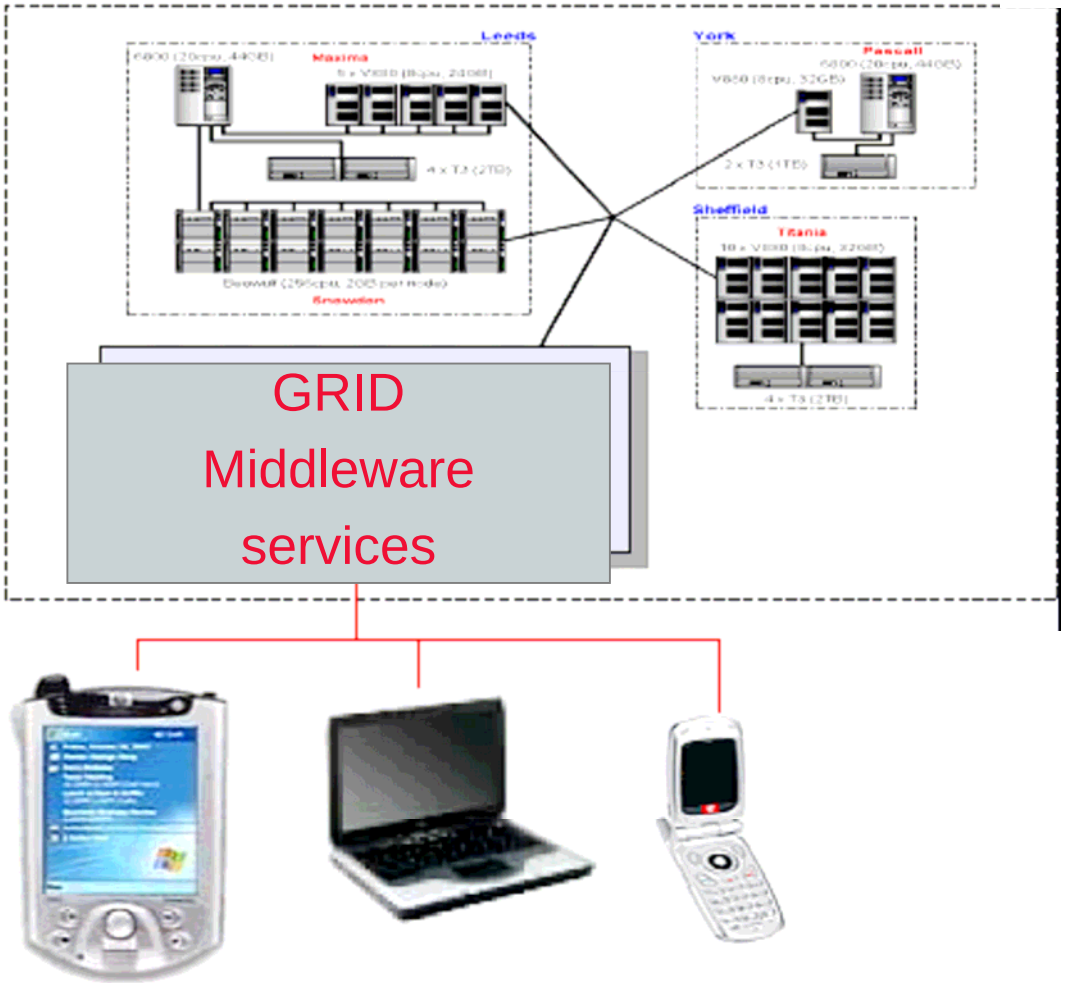
Access through thin clients

Grid Computing Environment



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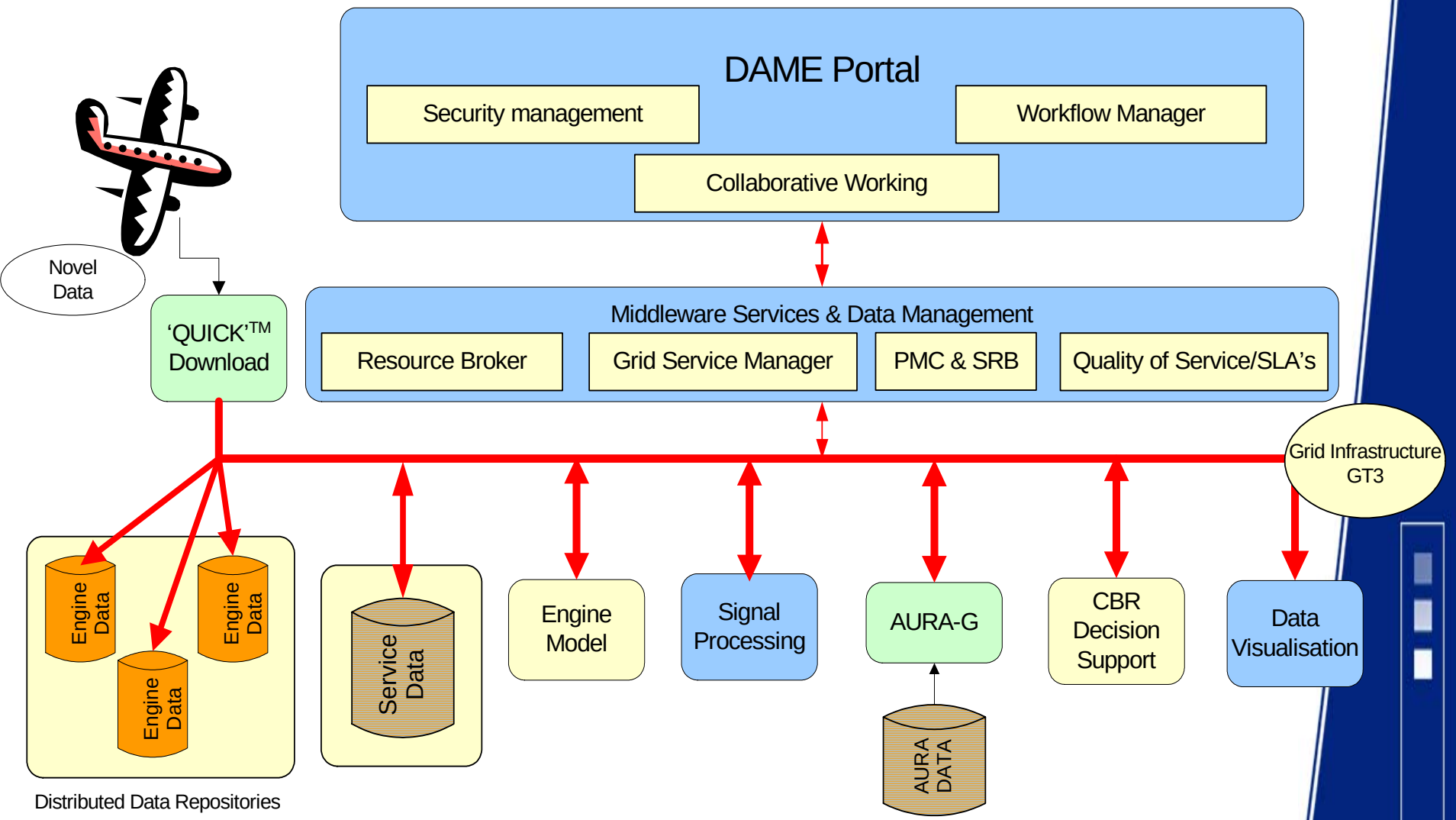
DAME Functional Overview



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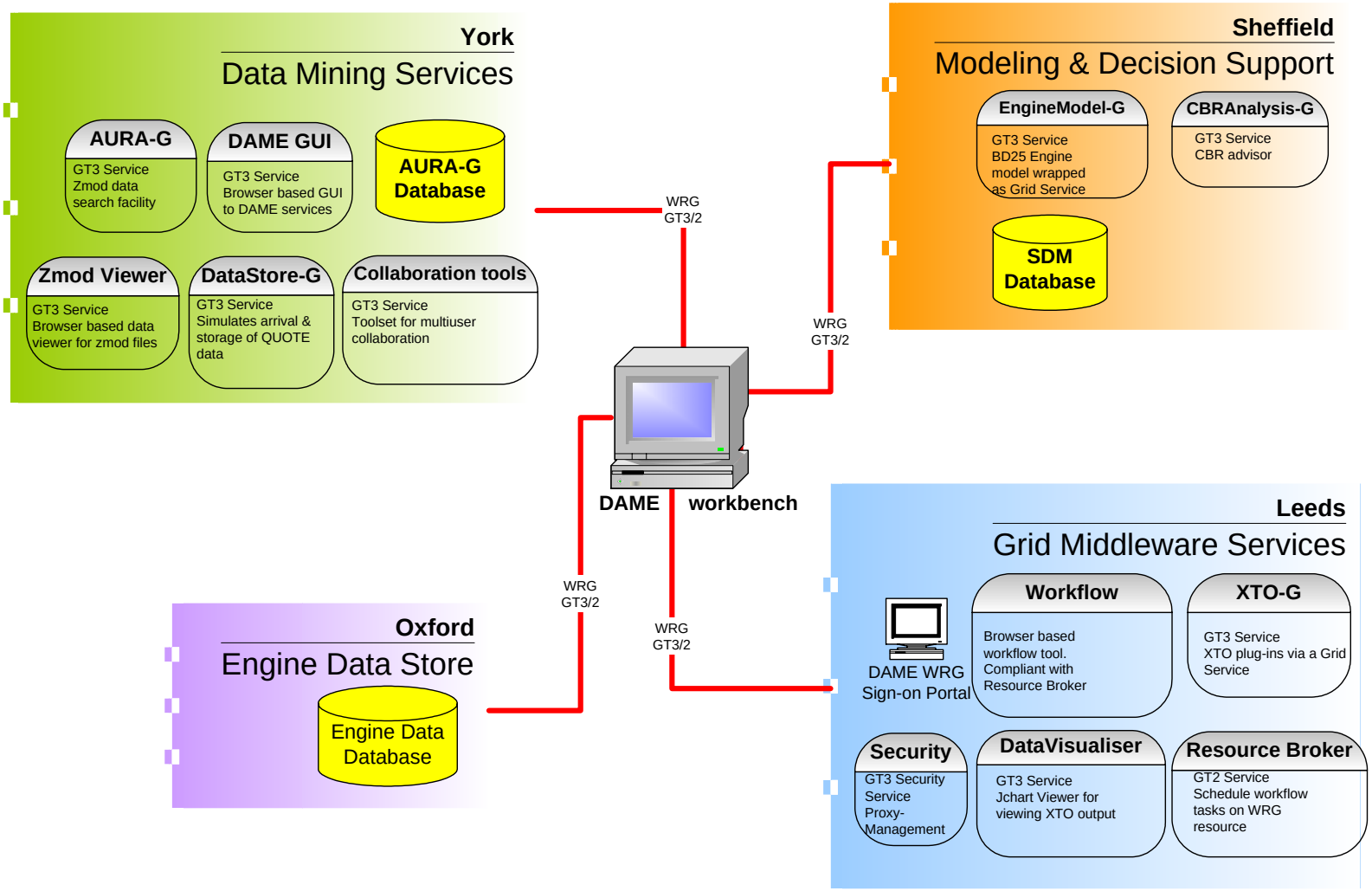
White Rose Grid Distribution



Distributed Search Service

Data Mining Services

- Objectives have been to develop a data mining service to search fleet archives of QUICK engine data within operational time constraints.
  - To support diagnosis and prognosis activities
  - To support long term fleet predictive maintenance
  - Business assumption is that data is archived remotely
- Two tools have been developed:
  - AURA-G: Grid enabled signal search engine;
  - Signal Data Explorer: Interactive search GUI for signal data
- Also developed middleware control architecture:
  - Pattern Match Controller

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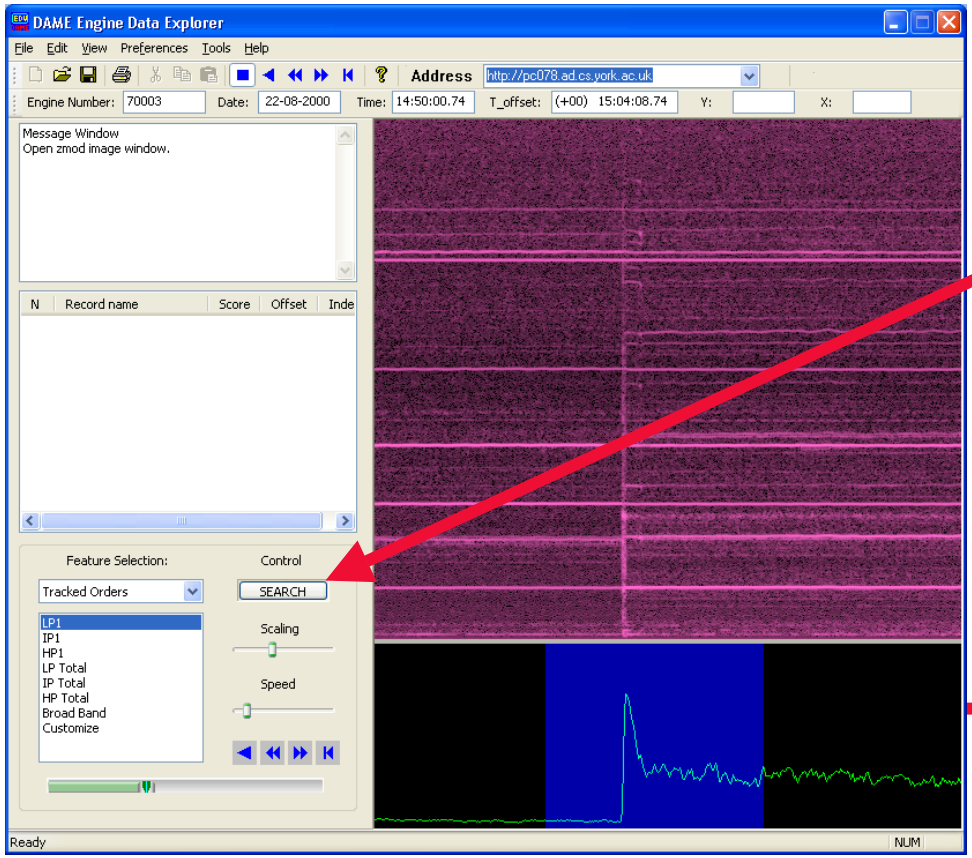
Distributed Pattern Search

- Complex time-series pattern matching process driven from a visualisation front end.



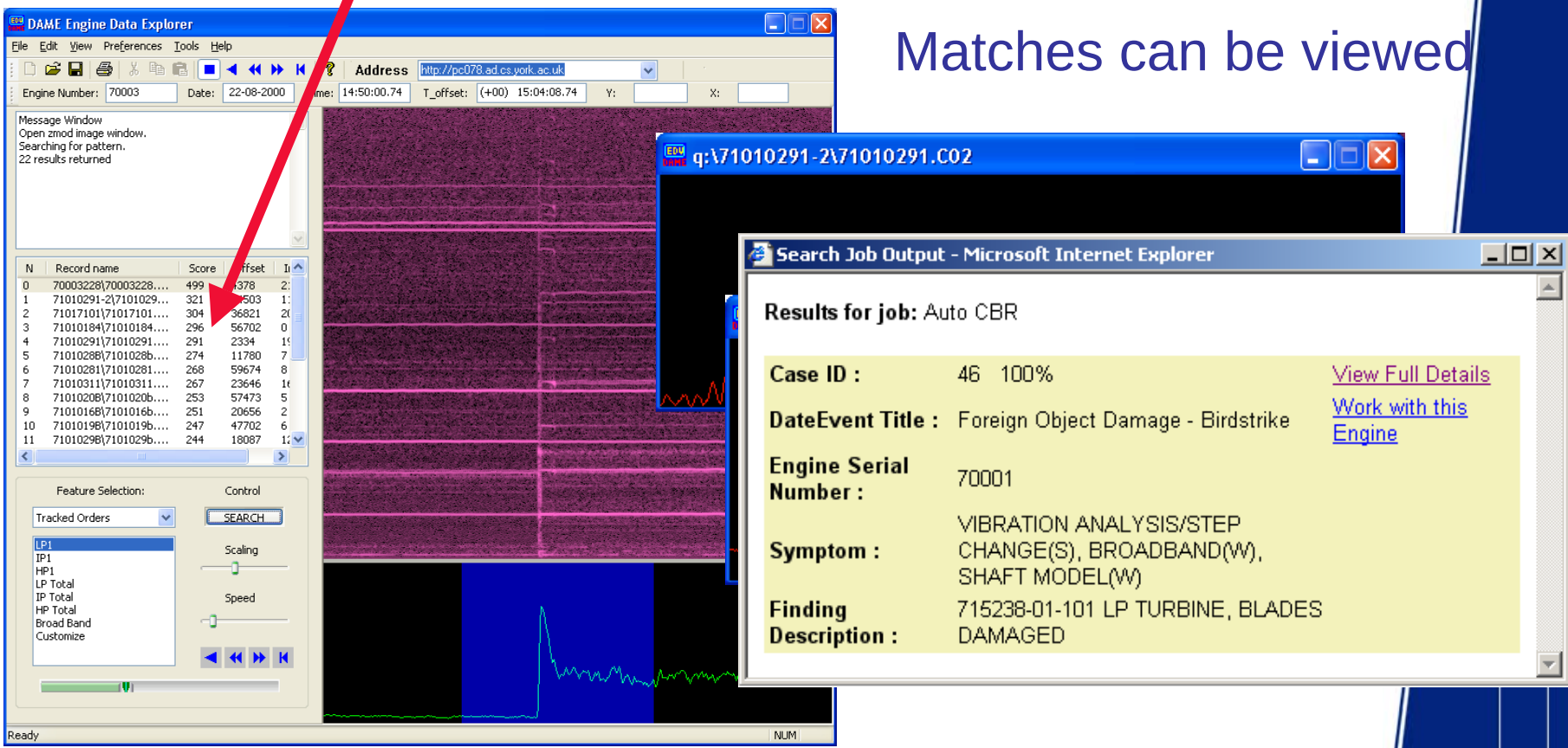
A search is launched across the fleet data archives using the Grid enabled AURA search engine

Engineer selects region of interest

Distributed Pattern Search, 2

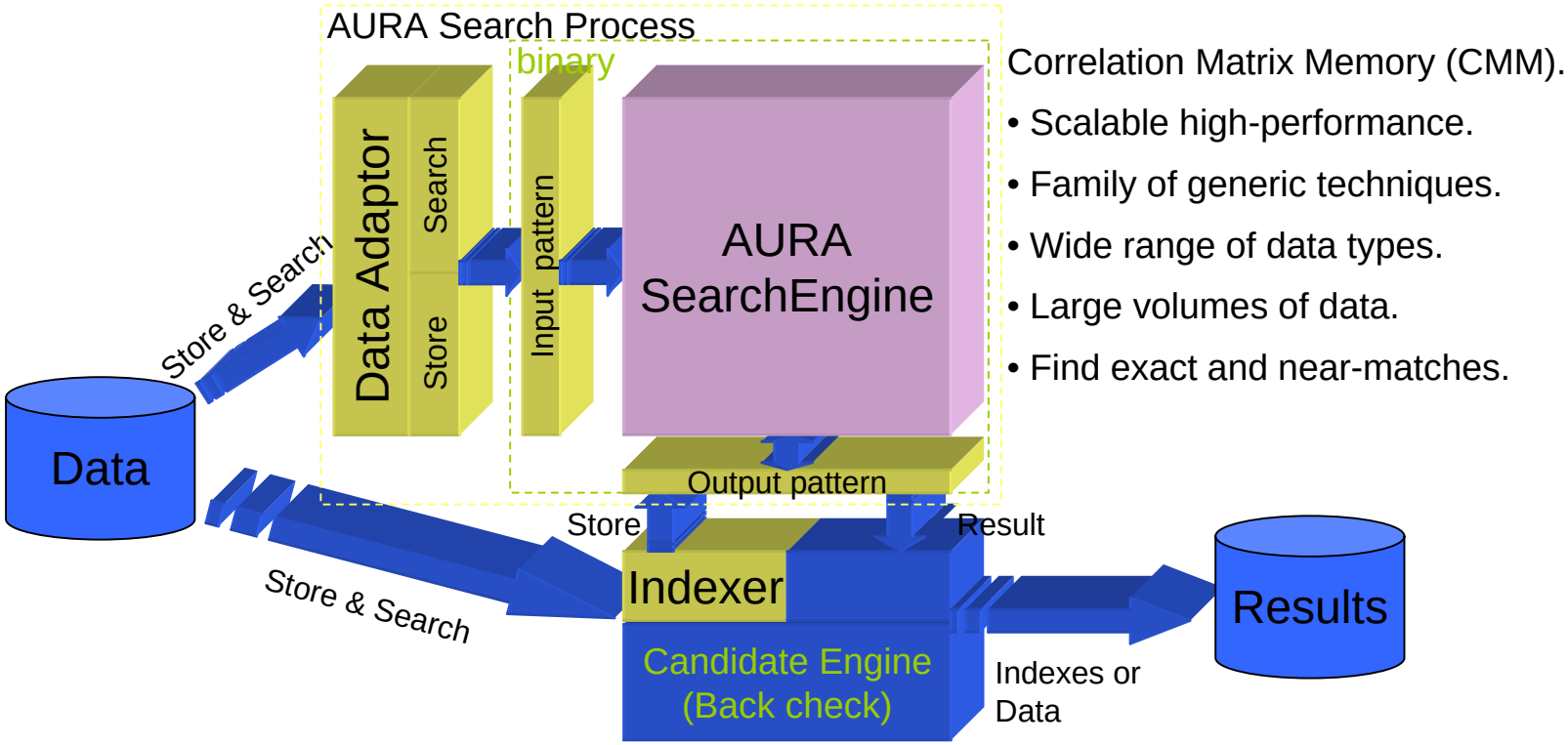
- All matched pattern records are retrieved from the fleet archives and ranked according to similarity

Matches can be viewed



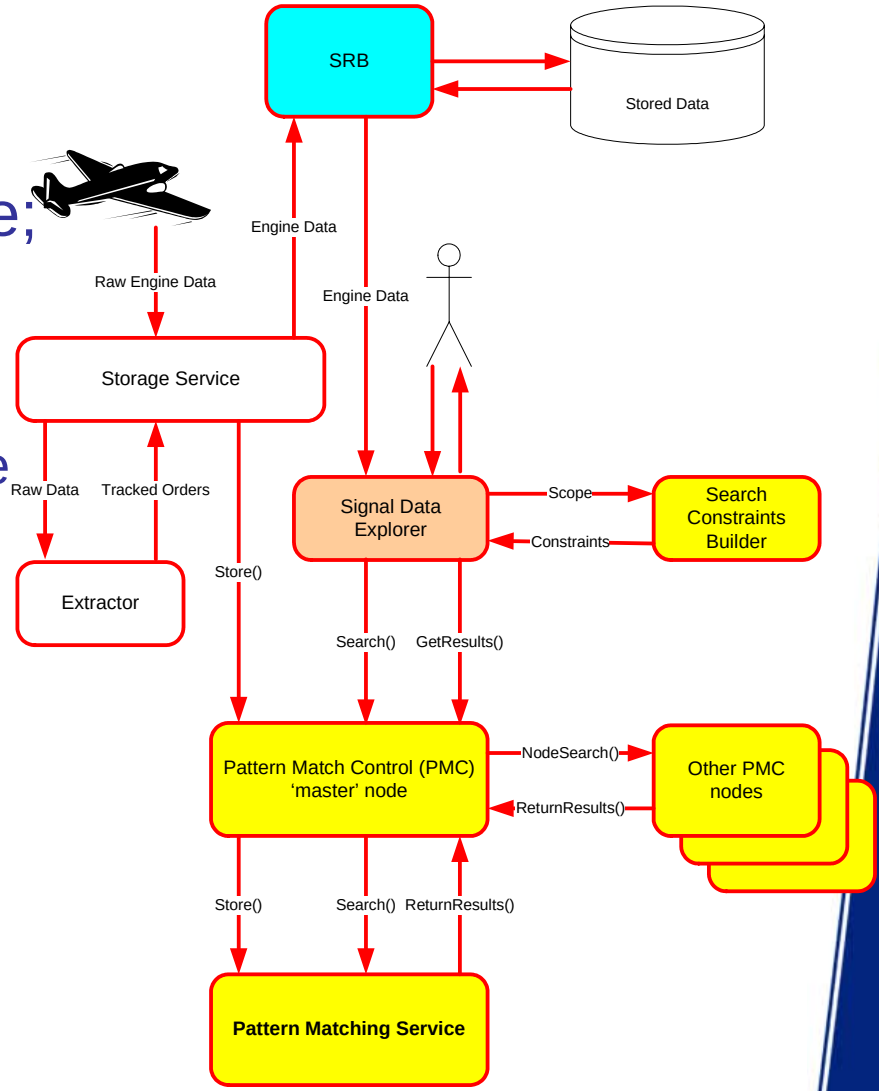
AURA Integration & Deployment

- AURA is a collection of processes; data adaptors, search-engine and back-check. It wraps around an **existing data storage** system;



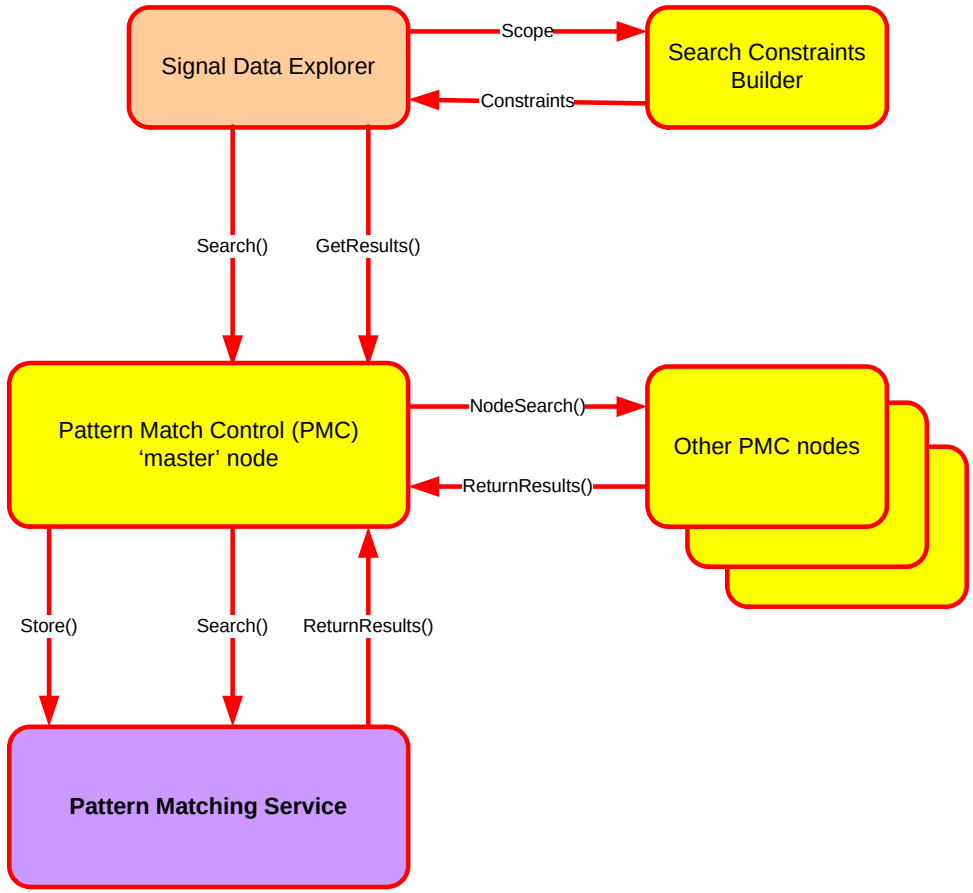
Pattern Match Control

- The SDE interfaces to the PMC middleware;
- PMC provides:
  - Distributed search
  - Interface to data archive system (SRB or other)
  - Scalability
  - Robustness



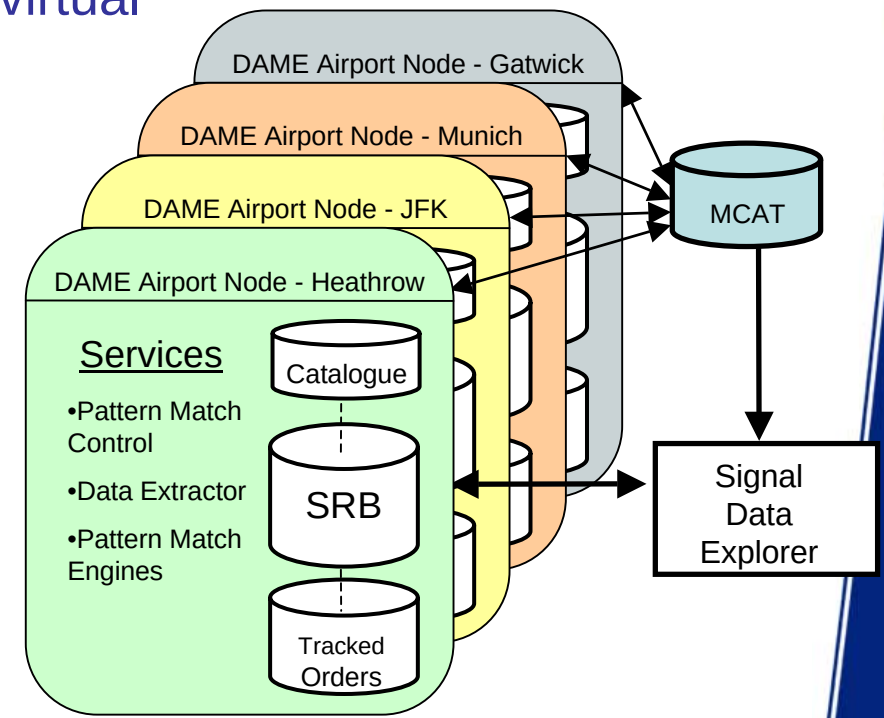
Pattern Match Control

- Generic search capability – any search algorithm can be plugged in as a web service PMS



PMC cont

- PMC architecture has been developed on business premise of remote data.
- E.g. Airports act as data repositories for Engine health data
- SRB provides hugely scalable virtual catalogue & index system



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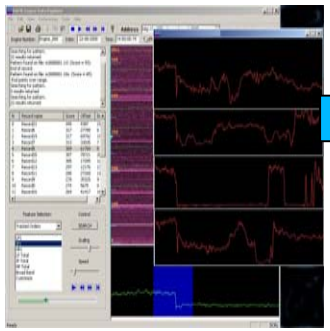
The node receiving the request becomes the 'master' for a search.

The master PMC service replicates the search request to all other nodes.



Signal Data Explorer (Client Application)

Search(…)

Master Node

PMC

NodeSearch(…)

Slave Node

PMC

Search(…)

Slave PMC services also initiate searches by local PME.

In addition, the master PMC service initiates a search by a Pattern Matching Engine at that node.

Pattern Match Engine

Pattern Match Engine

Pattern Match Engines request and stream data from SRB.

SRB

SRB

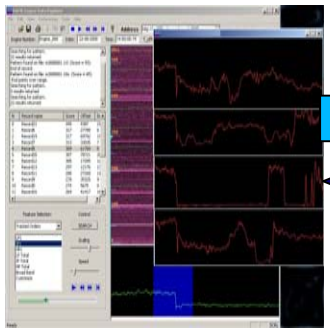
Heathrow

Gatwick

The client can request the current result set at any time.

The master PMC combines all the results received into a single set.

Slave PMCs deliver their results to the master PMC service.



Signal Data Explorer
(Client Application)

Master Node

Slave Node

PMC

PMC

GetResults(…)

ReturnResults(…)

ReturnResults(…)

ReturnResults(…)

Pattern Match Engine

Pattern Match Engine

After searching, Pattern Matching Engines return results to the calling PMC service.

SRB

SRB

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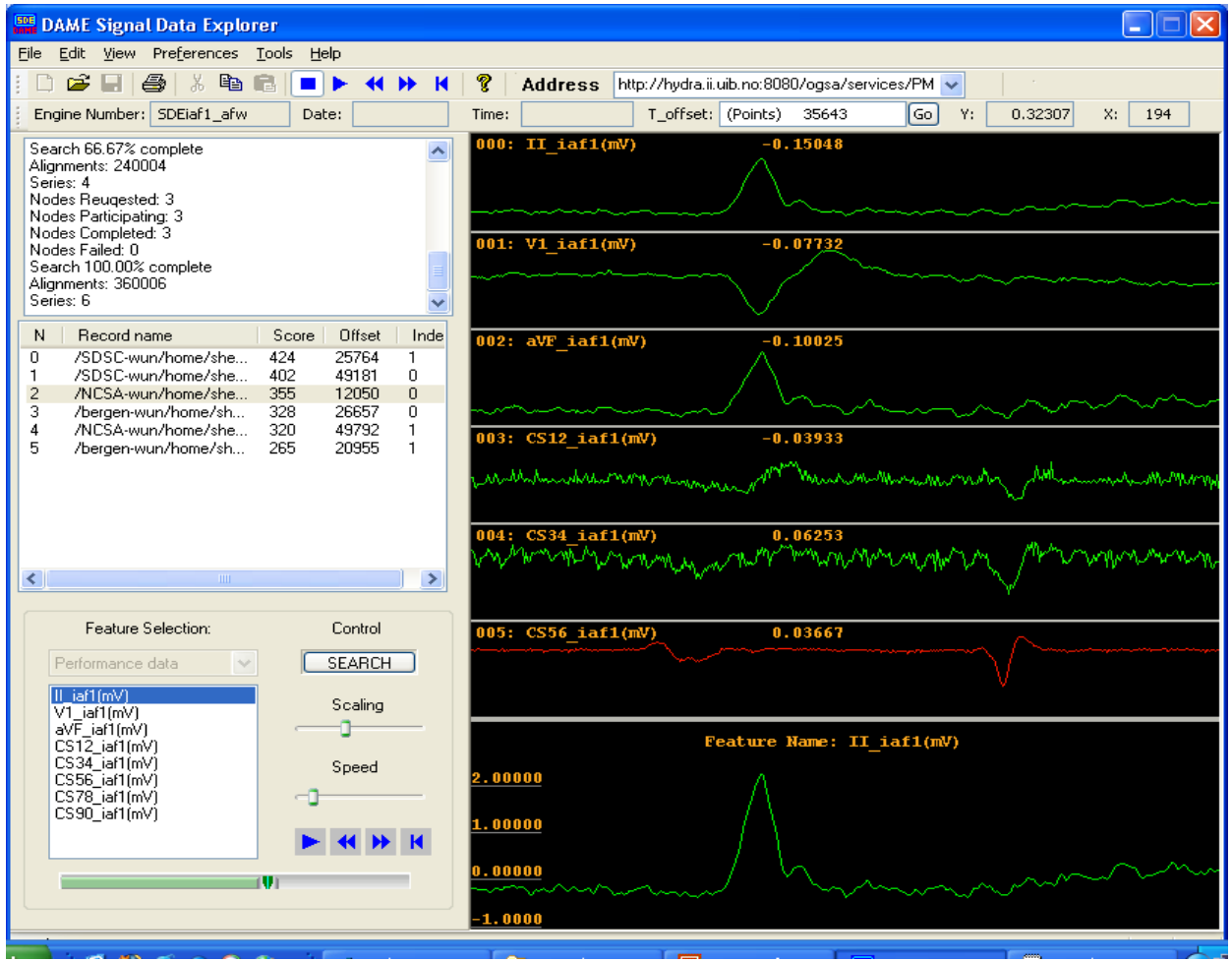
ECG Data - WUNDemo



Summary

- DAME is demonstrating the potential of Grid-based diagnostics for health-monitoring applications;
- A grid/web service middleware stack has been developed that permits complex search queries to be run across distributed data;
- Distribution is handled by SRB, and abstracts problem of location away from the user;
- SRB also provides means to minimise the volume of data moved around the system until required;
- Middleware stack is generic and any web-service search algorithm can be plugged into the architecture.