



# THE WHITE ROSE GRID

## e-Science Centre of Excellence

# Dependability in Distributed Systems and Services

“Virtual Organisations (VOs) that overcome the limitations of physical organisations are anticipated to play a vital role in facilitating large scale resource sharing and dynamic collaboration.”

The research team at the University of Leeds on [Distributed Services and Systems](#) has an established track record and an internationally leading reputation in service-based software architectures and dependable distributed computing.

This group is currently researching and developing a number of advanced implementations in such areas as fault tolerance, security, and fault injection. Much of this work is part of the e-Demand project currently being investigated in conjunction with both the University of Durham and various industry partners (Sharp, Sun Microsystems and Sparkle Computer Technology).

### DSS-Net

In order to facilitate our research, a small network of high-performance machines (called DSS-Net) has been acquired (Figure 1). Each node in this network is a dual Xenon 3.06Ghz machine, with 1 gigabyte of RAM and a large SCSI hard drive. This network runs a variety of web service hosting environments (such as Apache Tomcat and IBM Websphere), UDDI repositories, and development software. It allows us to rapidly develop and trial implementations of our research.

### Security

Virtual Organisations (VOs) that overcome the limitations of physical organisations are anticipated to play a vital role in facilitating large scale resource sharing and dynamic collaboration. The privacy of a VO's members is one of the major concerns that may hinder the advance of this promising technology.

Our attack Tolerant private Information Retrieval (TIR) service for service-based applications (Figure 2) aims to protect the privacy of users against potential (unauthorised) observers, detect corrupted results, and retrieve correct results in the occurrence of failures and/or malicious attacks.

We have found that our approach is viable and promising; experimental results have shown that our TIR scheme is particularly effective

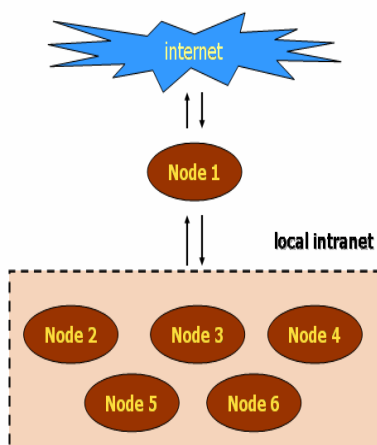


Figure 1: DSS-Net overview

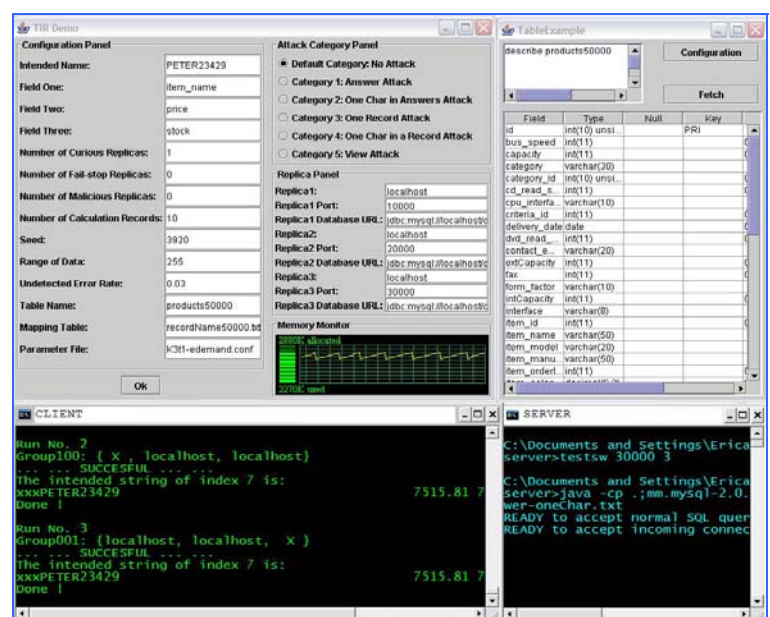


Figure 2: Attack Tolerant Information Retrieval application



“A fault injection tool called *WS-FIT (Web Service - Fault Injection Technology)* is being developed (Figure 4). *WS-FIT* is a fault injector that allows network level fault injection to be used to test SOAP based web service systems.”

against a variety of malicious faults. Incorrect results reconstructed from corrupted data can be detected with a high probability and thus masked from the user.

The system exhibits good performance: for example the service takes less than 32% extra processing time to reconstruct a correct result in the presence of two malicious servers from a total of five servers, in comparison with fault-free situations. The total

should be caught in the voting procedure.

We are therefore developing a service (*FT-Grid*) for providing dynamic, replication-based fault tolerance at run-time for service-oriented applications. This is based upon an improved fault model that we have created to deal with issues arising in the e-science community.

A demonstration application of this system has been created (Figure 3). This application allows a user to manually search through any number of UDDI repositories, select a number of functionally-equivalent services, and bind and invoke those services. The application can then perform voting on the results returned by the services, with the aim of “filtering out” any anomalous results.

#### Grid Middleware Testing

A fault injection tool called *WS-FIT (Web Service - Fault Injection Technology)* is being developed (Figure 4). *WS-FIT* is a fault injector that allows network level fault injection to be used to test SOAP based web service systems. This implementation specifically handles the problems associated with modifying SOAP messages when signing and encryption are being used.

*WS-FIT* is designed around an engine to decode SOAP messages and presents an interface at the script API level with the information included in a SOAP RPC easily accessible. WSDL is utilized to produce a framework for the scripts and a customizable fault model is used to assist in the generation of test scripts.

#### Further Information:

Contact:  
Professor Jie Xu  
School of Computing  
University of Leeds  
email: [jxu@leeds.ac.uk](mailto:jxu@leeds.ac.uk)

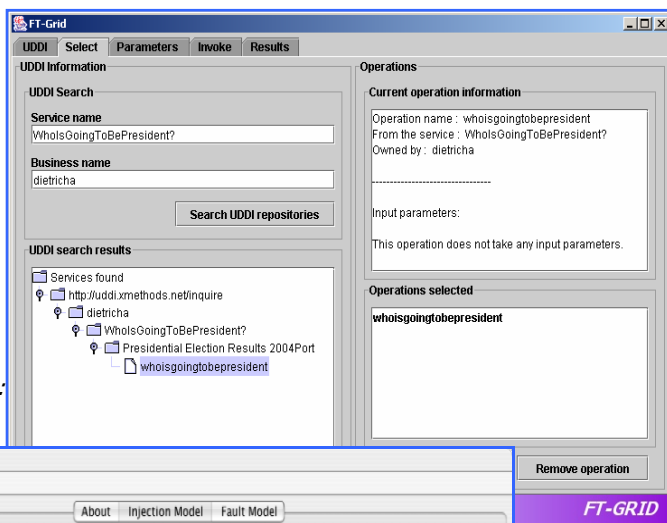


Figure 3 (right):  
*FT-Grid*

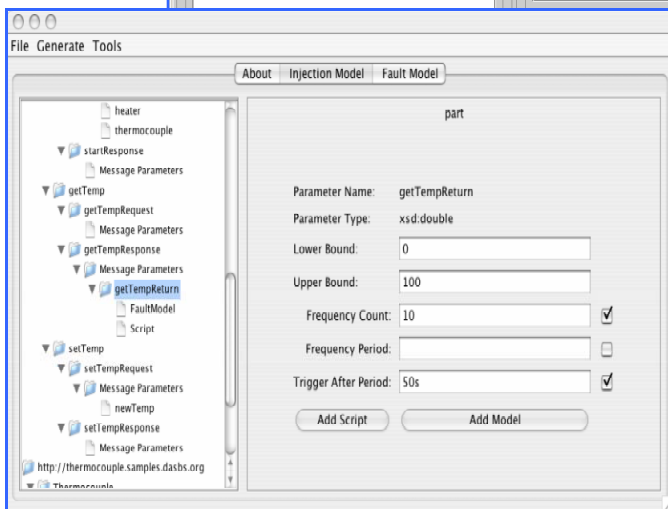


Figure 4: *WS-FIT*

processing time is much less than one second, even in the presence of malicious attacks.

#### Fault Tolerance

As the individual nodes on a Grid may be potentially

unreliable or insecure (for example, they may be owned by an outside organisation), job replication is an obvious way of reducing the chances of an erroneous or maliciously-altered result being received, as anomalous results

