The Microelectronics WebLab 6.0:
An Implementation Using Web Services and the iLab Shared Architecture

Massachusetts Institute of Technology

Sponsored by Microsoft Corporation
The MIT Microelectronics WebLab

- Research project started in 1998
- DC characterization of microelectronic devices via the Internet.
- Real devices measured with state-of-the-art equipment.
MIT Microelectronics WebLab

Semiconductor Parameter Analyzer, Switching Matrix (donation of Agilent Technologies)

Device under test

Device test fixtures (donation of Agilent Technologies)

W2000 Server

Two complete systems: one for student use, one for development.
Educational Experiments

MIT graduate and undergraduate courses (220 st/yr)
NUS (Singapore), Fall 2000-03 (20-30 st/yr)
Chalmers U. (Sweden), Spring 2003-05 (350 st/yr)
NTU Athens (Greece), Spring 2004 (35 st/yr)
CCU Taipei (Taiwan), Fall 2004 (200 st/yr)
Makerere U. (Uganda), Fall 2004 (150 st/yr)

Over 2400 student users (for credit) since 1998
Previous WebLab Implementations

- Monolithic design
  - complex to debug, upgrade
  - limited scalability (in terms of features and capacity)
- Lab owner responsible for all management
  - The lab itself
  - Individual user accounts, data storage
The iLab Shared Architecture:  
A generic architecture for online labs

- A three-tier architecture
- The Service Broker:
  - captures functionality generic to all labs
  - facilitates communication between Lab Client and Server via Web Services.
- Lab Server and Client perform lab-specific functionality.

* Harward, ICEE 2004
The WebLab 6.0 Client

- Implemented using Java technology
  - Multiplatform support
- Communicates via Web Services
  - kSOAP
- Designed for modularity, extensibility
The WebLab 6.0 Lab Server

- Web Services Interface
- Support Functionality
- Administration Web Site
- Lab Database
  - Data Access Methods
  - Data Storage
- Execution Engine

Connections:
- Public Internet (SOAP/XML) to Service Broker
- Public Internet (HTTP) to Lab Administrator
Lab Server Features

Experiment Validation performed before execution
Lab Server Features

- Administration Web Site
- Public Internet (SOAP/XML) to Service Broker
- Public Internet (HTTP) to Lab Administrator
- Web Services Interface
- Support Functionality
- Lab Database
- Data Access Methods
- Data Storage
- Execution Engine
- Experiment Execution Queue maintained in database
Lab Server Features

- Administration Web Site
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- Web Services Interface
- Support Functionality
- Lab Database
  - Data Access Methods
  - Data Storage
- Execution Engine

Web Server activity and experiment execution performed independently, concurrently
First deployed in Feb. 2004 at MIT (>100 undergraduates).

- Per hour load at record levels (~120 jobs/hr.)
- No serious failures encountered

Used by students on 4 continents
WebLab 6.0 vs. WebLab 5.0

- **6.0 Lab Server performs better despite higher functional load:**
  - Validation
  - SOAP/SSL overhead
  - XML parsing

- **6.0 Client is smaller**
  - Reduced by ~9kB (to 255kB)

- **System modularity is key:**
  - Organized, independent & specialized modules
  - Concurrent Web Server activity, job execution

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**Lab Server Efficiency**

- **Computational Overhead**
  - WebLab 5.0: 8%
  - WebLab 6.0: 4%

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*MIT Campus*
Conclusions

◆ **WebLab 6.0: First lab implemented using the iLab Shared Architecture**
  - Supported >900 students in 8 courses across 4 continents.
  - Upgrade in performance, reliability.

◆ **WebLab 6.0 marks a shift in lab design**
  - Distributed system using Web Services
  - Increased component modularity, specialization
  - Concurrency of operations
Online Resources

- Service Broker install kit released with WebLab Client & Lab Server code as example.
  - http://icampus.mit.edu/iLabs

- Tour the lab!
  - http://openilabs.mit.edu