The Microelectronics WebLab 6.0:

An Implementation Using Web Services and the iLab Shared Architecture

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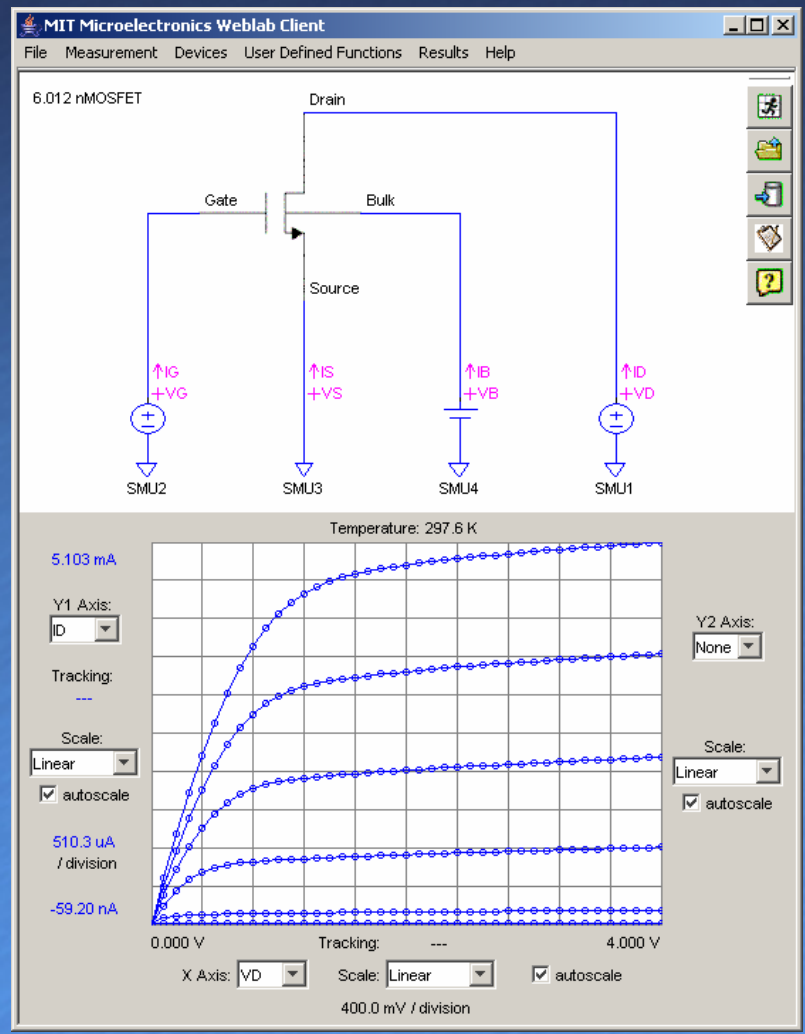
The MIT Microelectronics WebLab

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



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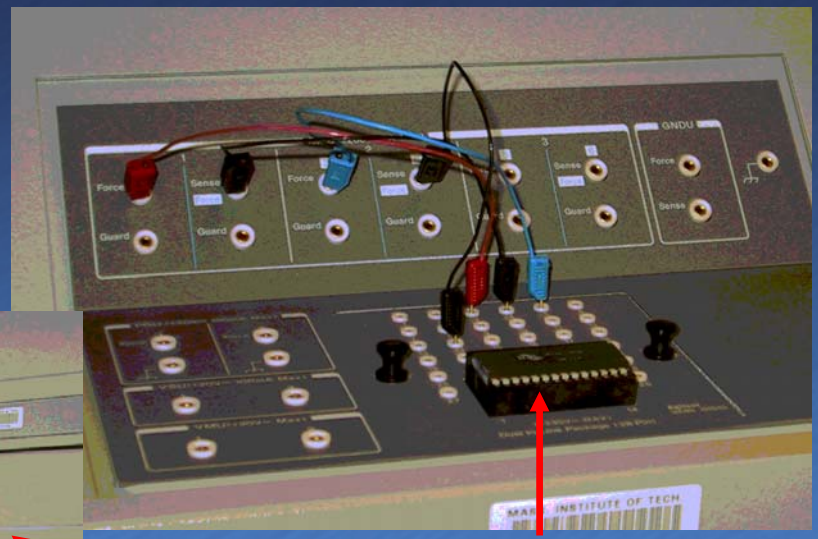
MIT Microelectronics WebLab

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.

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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)

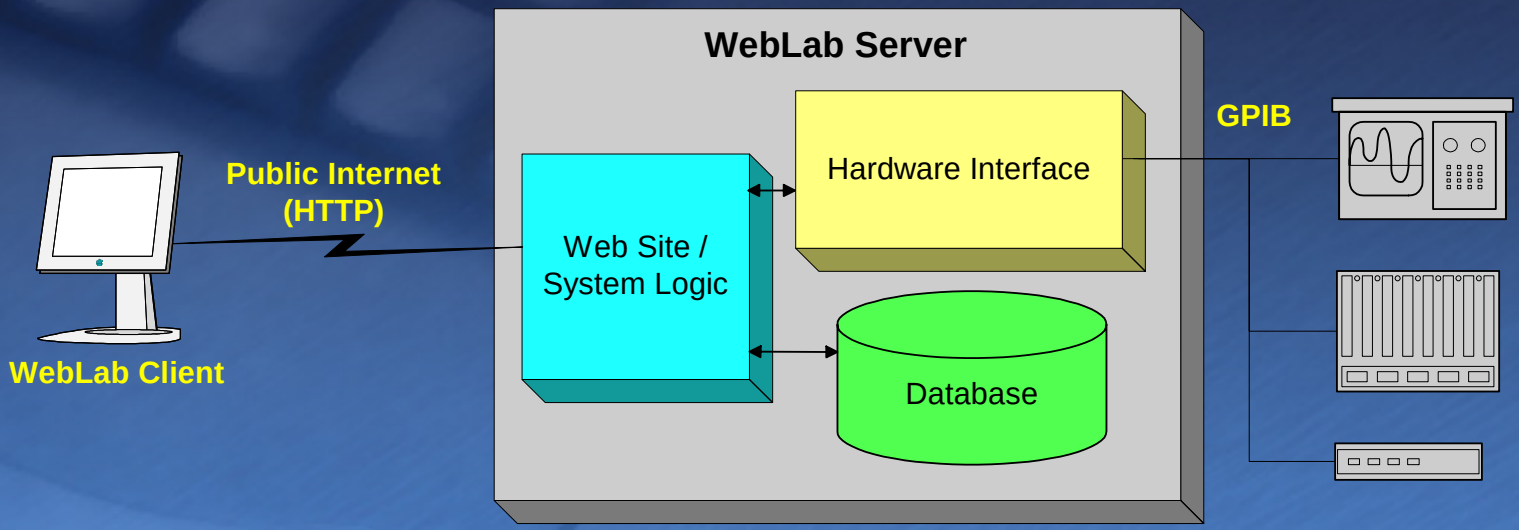
NTU Athens (Greece), Spring 2004 (35 st/yr)

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

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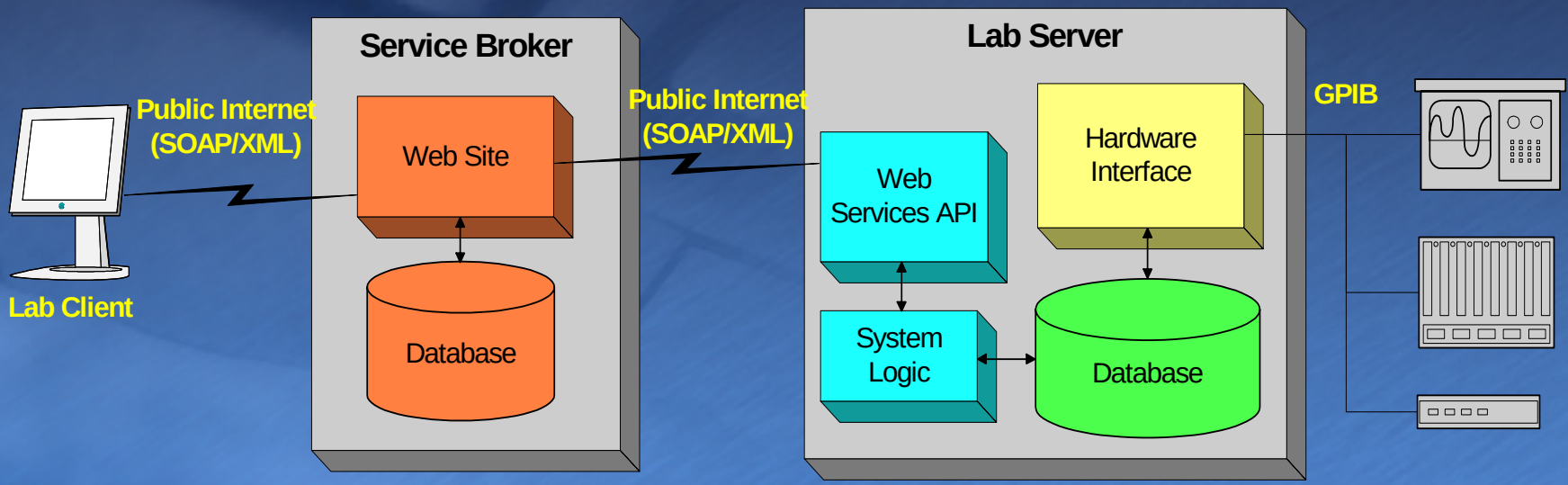
The iLab Shared Architecture*:
A generic architecture for online labs



- 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

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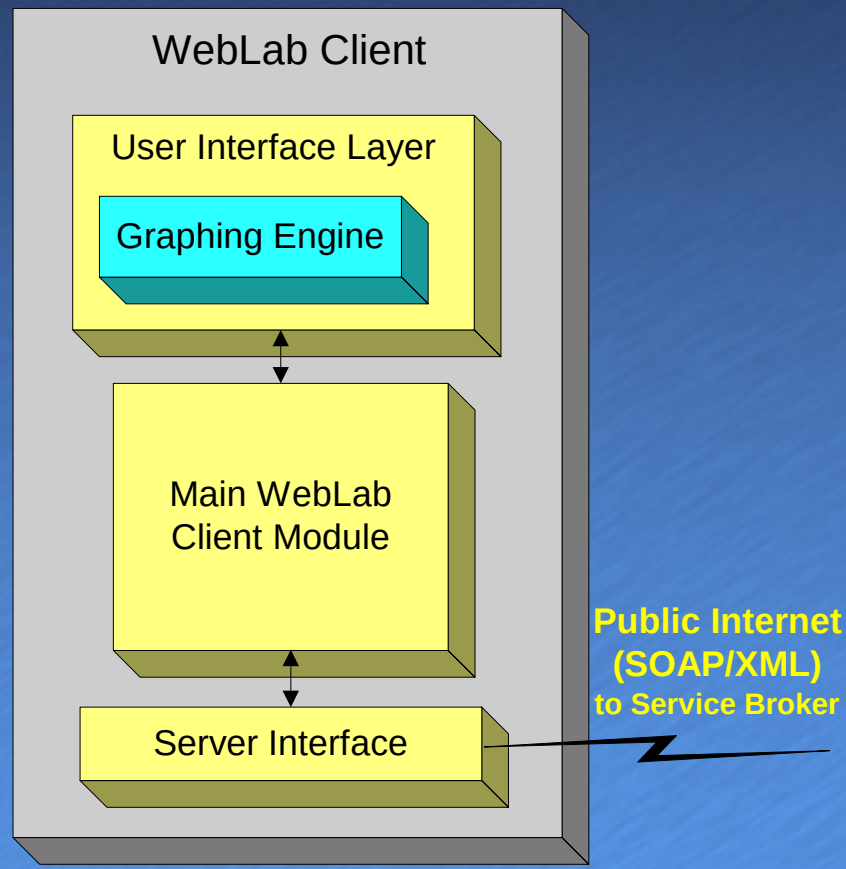
The WebLab 6.0 Client

- Implemented using Java technology
  - Multiplatform support
- Communicates via Web Services
  - kSOAP
- Designed for modularity, extensibility



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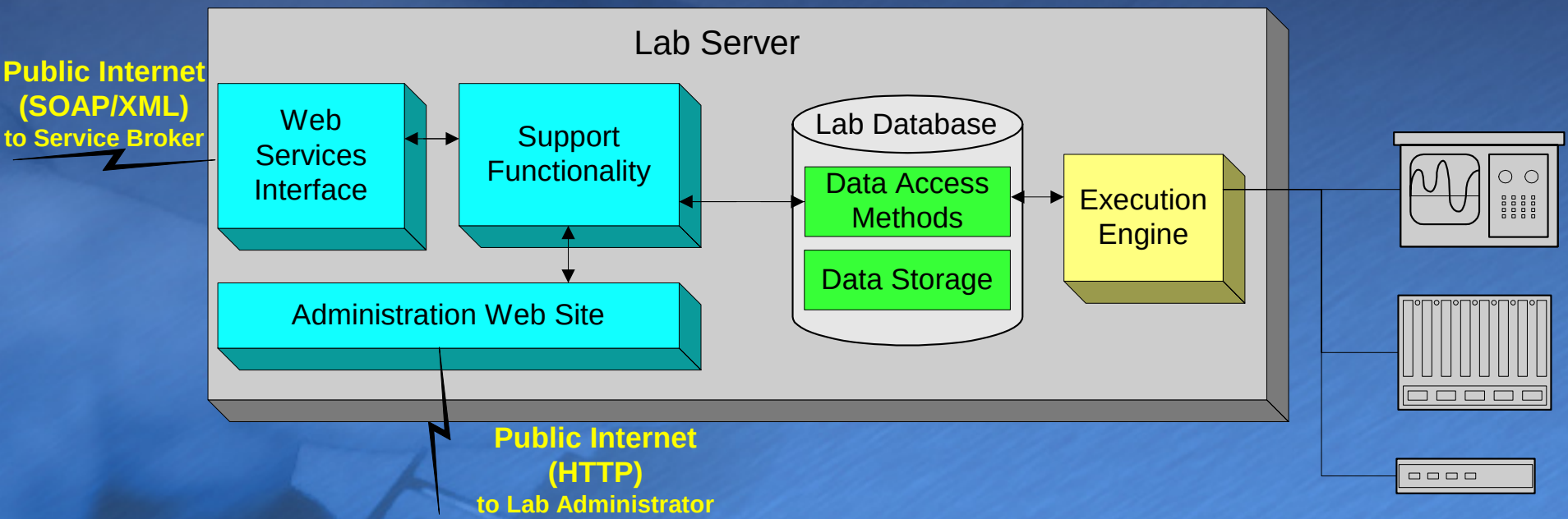
The WebLab 6.0 Lab Server



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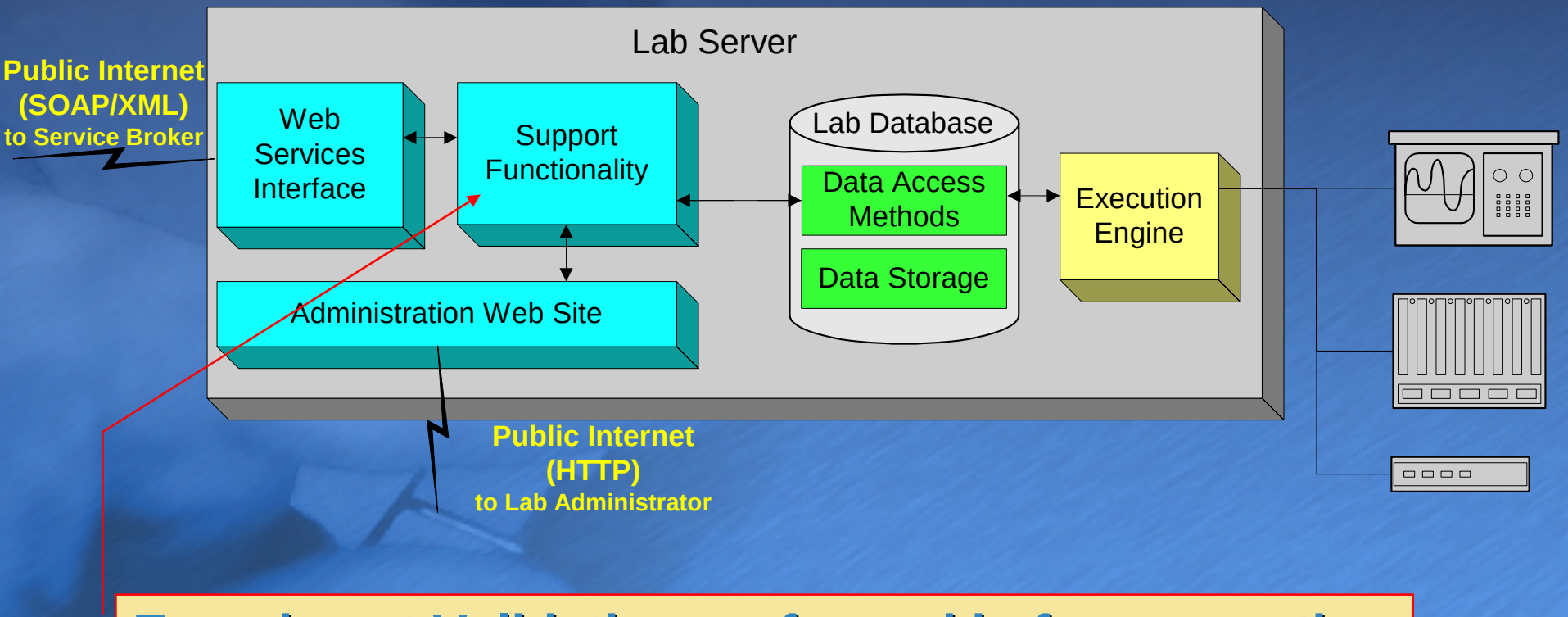
Lab Server Features



Experiment Validation performed before execution

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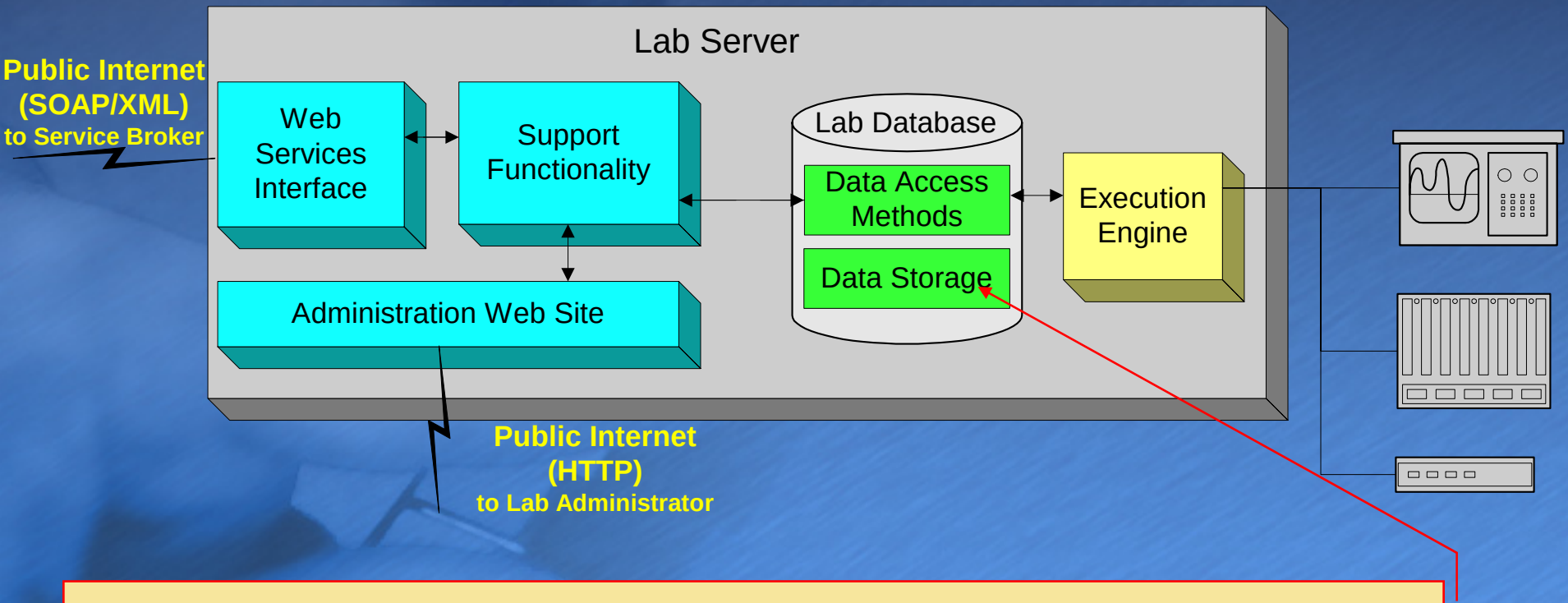
Lab Server Features



Experiment Execution Queue maintained in database

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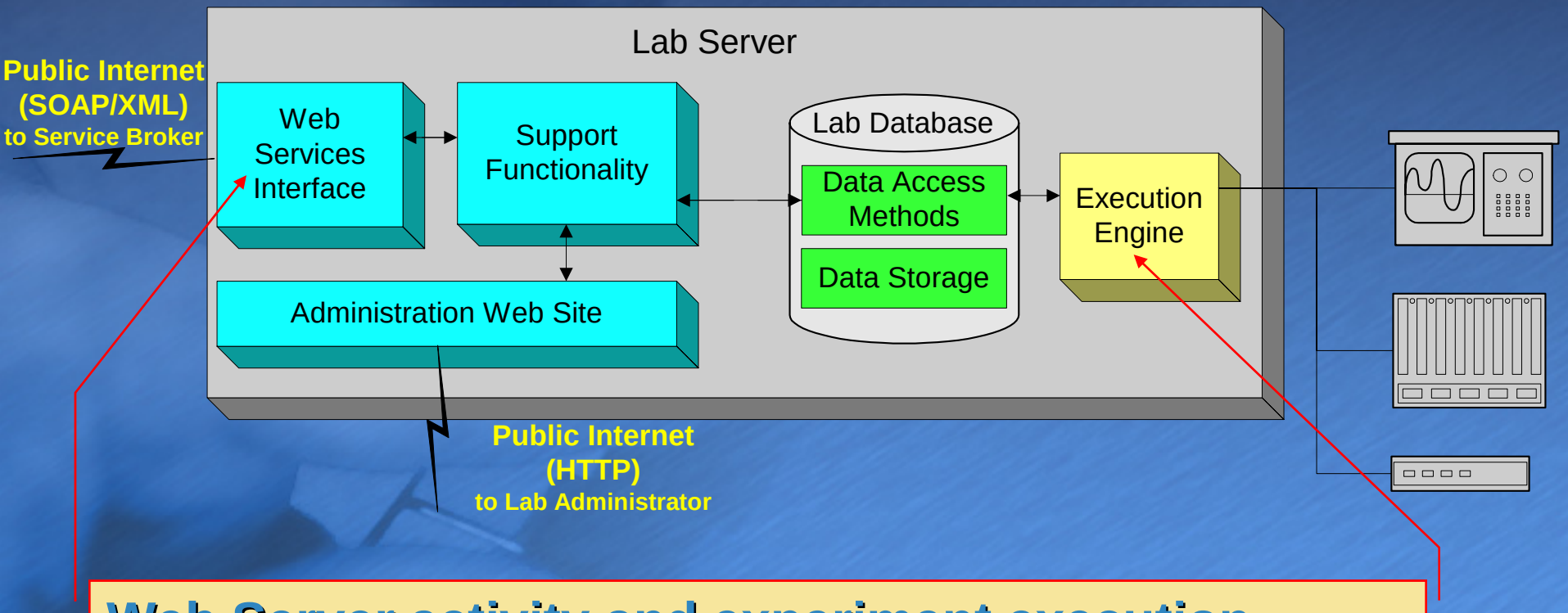
Lab Server Features



Web Server activity and experiment execution performed independently, concurrently

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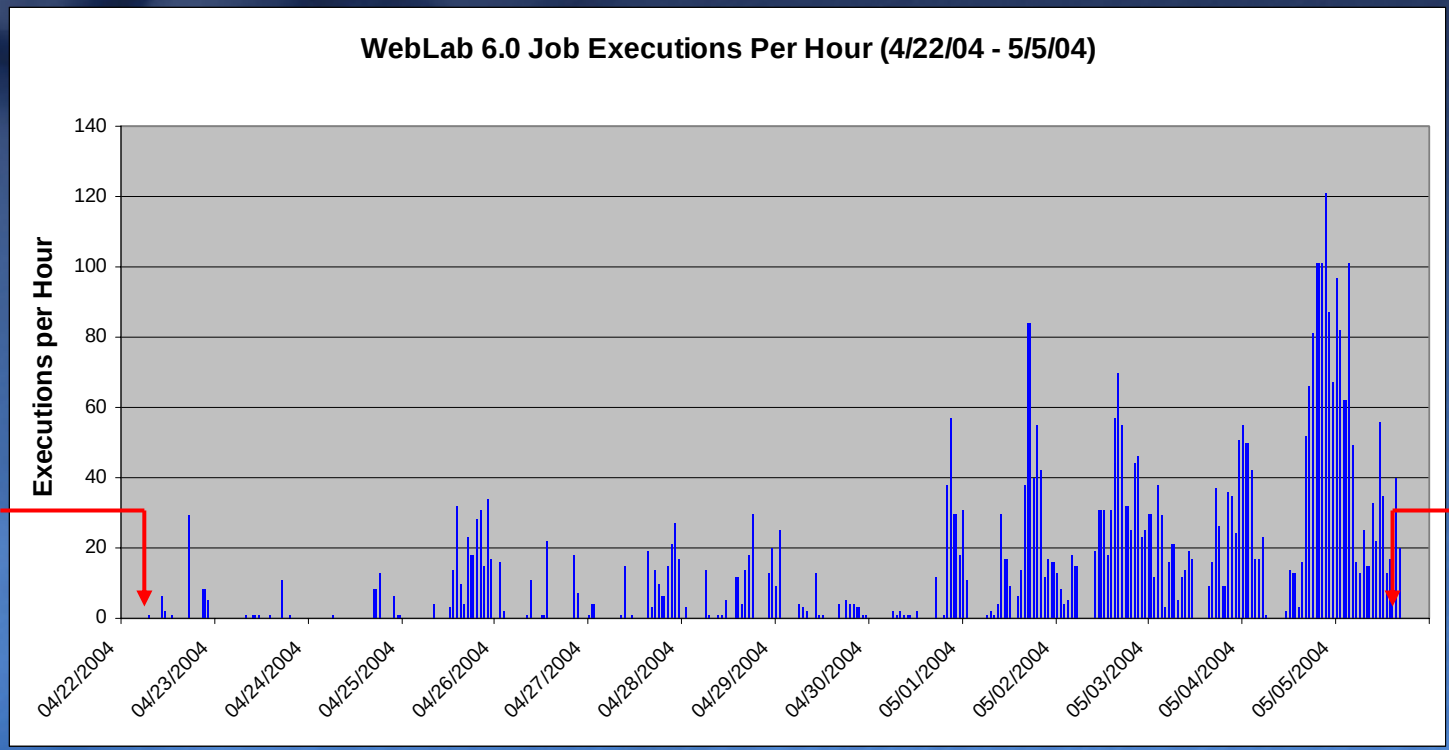
Deploying WebLab 6.0



- 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

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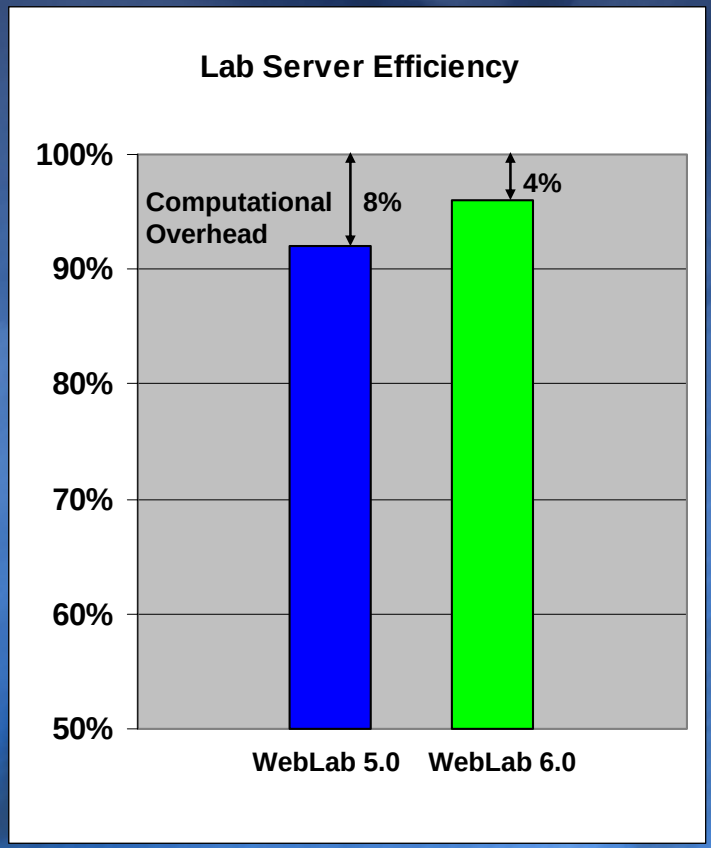
WebLab 6.0 vs. WebLab 5.0



- 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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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

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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

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