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Web Labs in the OVB Context

Eliane G. Guimarães

Robotics and Computer Vision Division
Renato Archer Research Center - CenPRA
and
School of Electrical and Computer Engineering
University of Campinas – Unicamp
Campinas, SP
Brasil

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Web Labs

A laboratorial facility accessible from a remote site through the public Internet or private network. The access is commonly performed via Web technologies (Web browsers and protocols).

Lab facilities can be physical (e.g., robots) or logical (e.g., images). Users perform experiments on such facilities.

Due to the stringent requirements of interactivity, Web Labs demand high speed network connections.

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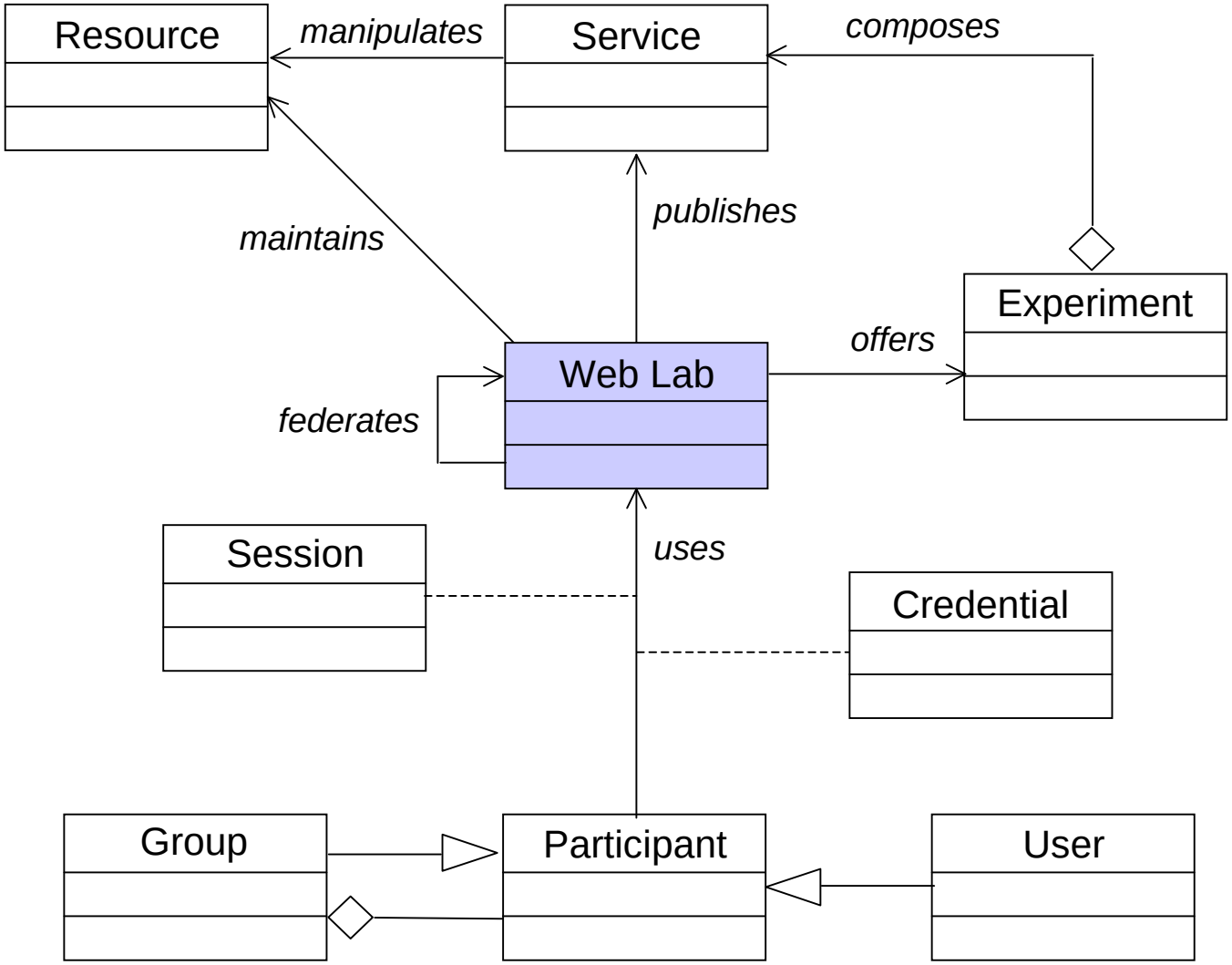
Web Lab: Challenges

How to develop Web Labs where:
- experiments are easily assembled and modified;
- access control is flexible and configurable;
- interactivity is easily incorporated into the experiments.

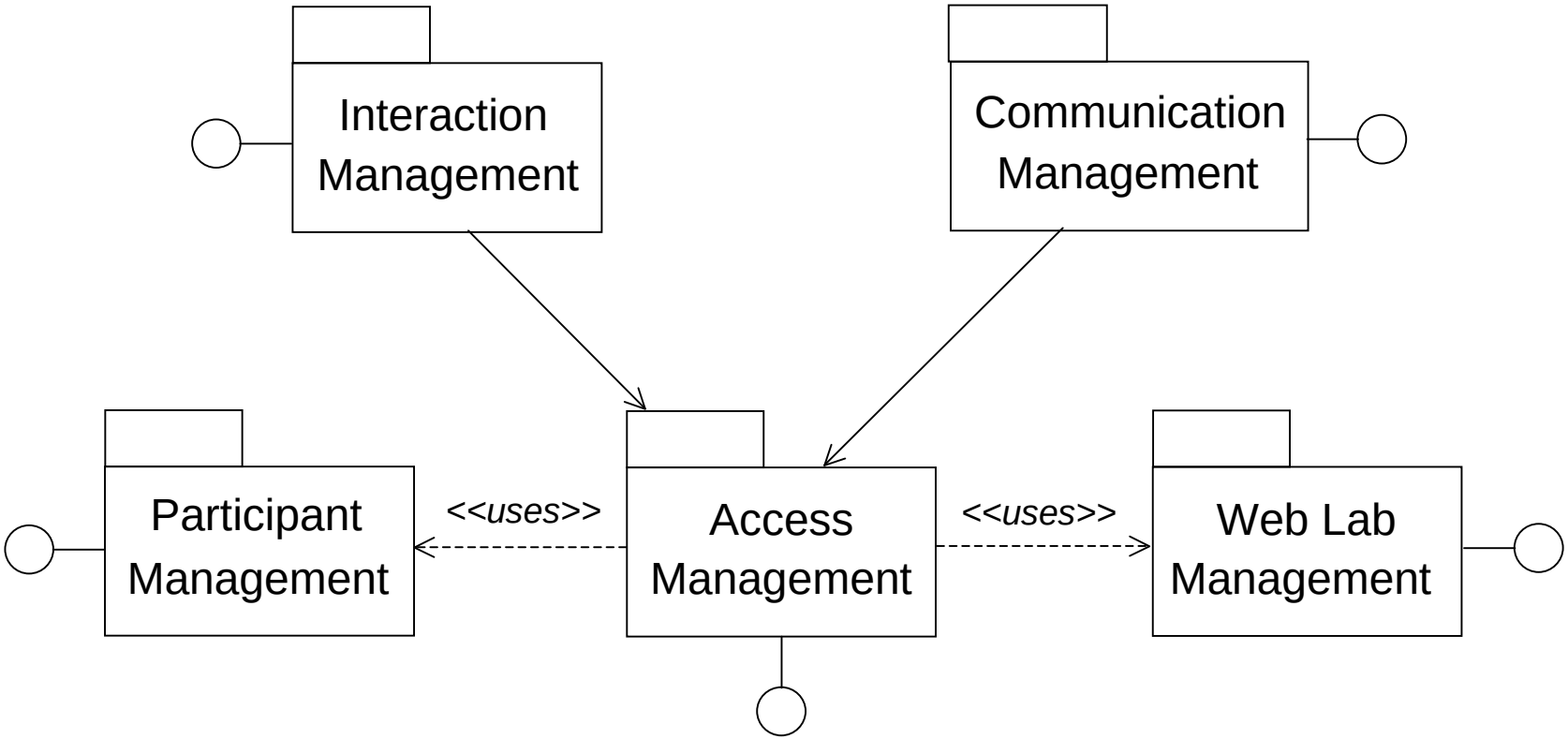
Solution: to develop an architecture for supporting management functions common to all Web Labs.

In order to design such an architecture, we need a reference model general enough to represent a wide range of Web Labs.

A Reference Model for Web Labs



A Service-oriented Architecture for Web Labs



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Participant Management Service

The participant management service offers operations for:

- subscription and unsubscription of participants (individual user or group of participants);
- assignment of credentials (roles, permissions, privileges) to participants;
- assignment of restrictions to participants (e.g., maximum reservation time for a given experiment);
- scheduling of reservation slots for participants to perform experiments.

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Web Lab Management Service

The Web Lab management service offers operations for managing resources and experiments maintained by a Web Lab.

Management of resources:

- registration of resources (cameras, robots, etc.);
- assignment of restrictions to resources (e.g., period of unavailability).

Management of experiments:

- registration of experiments;
- assignment of resources to experiments;
- activation of experiments (make available for execution).

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Access Management Service

The access management service offers operations for:

- user authentication (e.g., username, password);
- policy-based authorization (authorization to perform an experiment depends on the user's credentials);
- secure access (e.g., privacy through cryptography);
- usage control (e.g., detection of inactivity and expiration of reservation period);
- federated access (e.g., single sign-on).

The access management service establishes and controls *access sessions*.

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Communication Management Service

The communication management service offers operations for managing the configuration and interconnection of information producers and consumers. The service must support:

- synchronous communication (RPC style);
- asynchronous communication (messaging, event reporting);
- flow-based (multimedia) communication (real time video and audio).

The communication management service establishes and controls *communication sessions*.

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Interaction Management Service

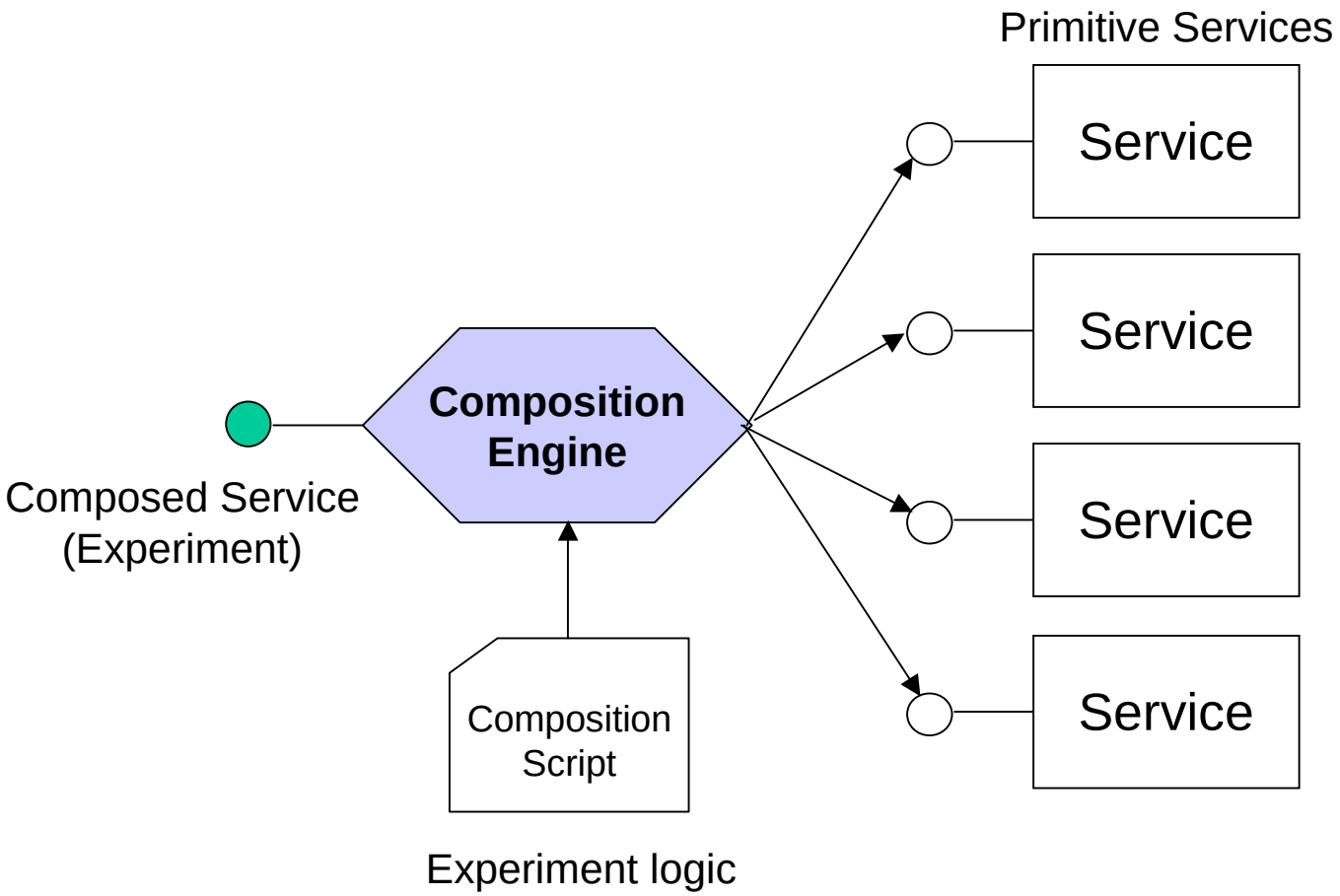
The interaction management service offers operations for managing the workflow of service invocations demanded by the experiments.

The workflow of service invocations can be modeled as a composition of the services supported by the Web Lab.

The service also supports logging of the execution of experiments (important for grading).

The interaction management service establishes and controls *interaction sessions*.

Web Labs: Experiments



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Web Labs: Implementation

Technologies on the lab's side:

- HTTP servers
- HTTP servers with extensions (CGI)
- Dynamic server pages (JSP, ASP)
- Distributed objects (CORBA, RMI)
- Software components (EJB, COM+, CMtel)
- **Web services**

Technologies on the user's side:

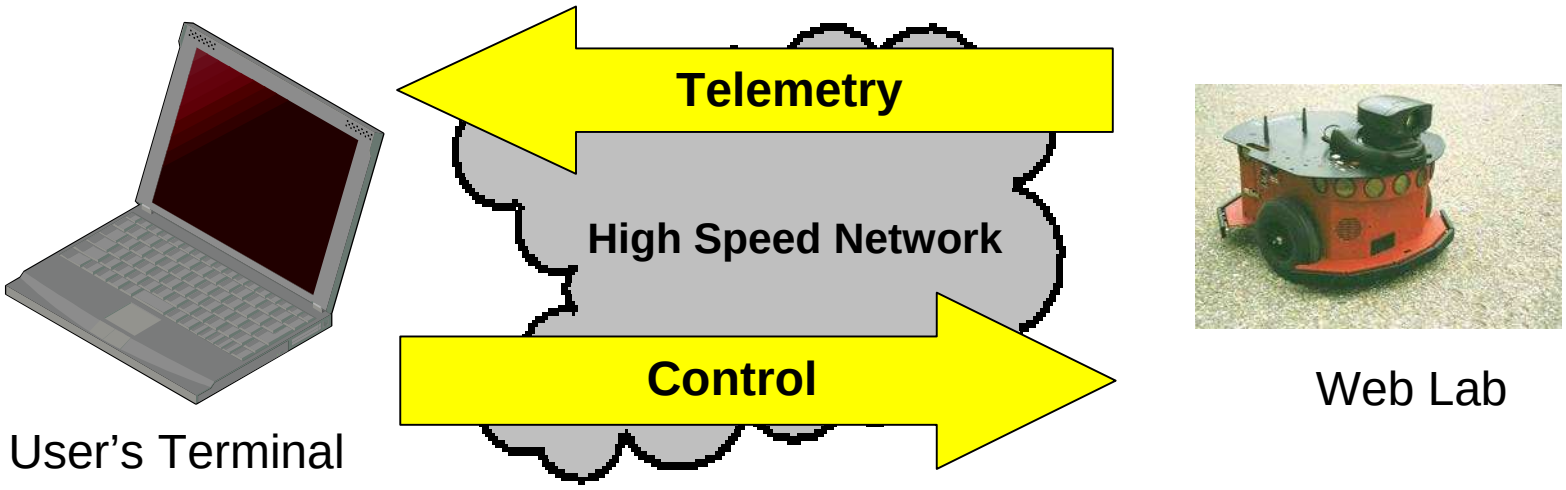
- Web browsers (applet, ActiveX)
- Media players (Mplayer, JMF, QT, WMP)
- Java clients

The GigaBOT Web Lab

A Web Lab for teaching mobile robotics supported by RNP (Giga Project).

Runs over the RNP Giga Network (preferably) or public Internet.

Needs high speed networks since the experiment logic can be executed on the user's side.



User's Terminal running experiment

Web Lab

GigaBOT: Hardware

Mobile Robots
Activmedia P3-DX

Net Camera
AXIS 213 PTZ

GIGA Net

Dell D510

Gigabit
Ethernet
Switch

Access Point
IEEE 802.11g

Bi-processed Server
(Intel Xeon)

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GigaBOT: Software

Apache Axis and Apache Tomcat containers.

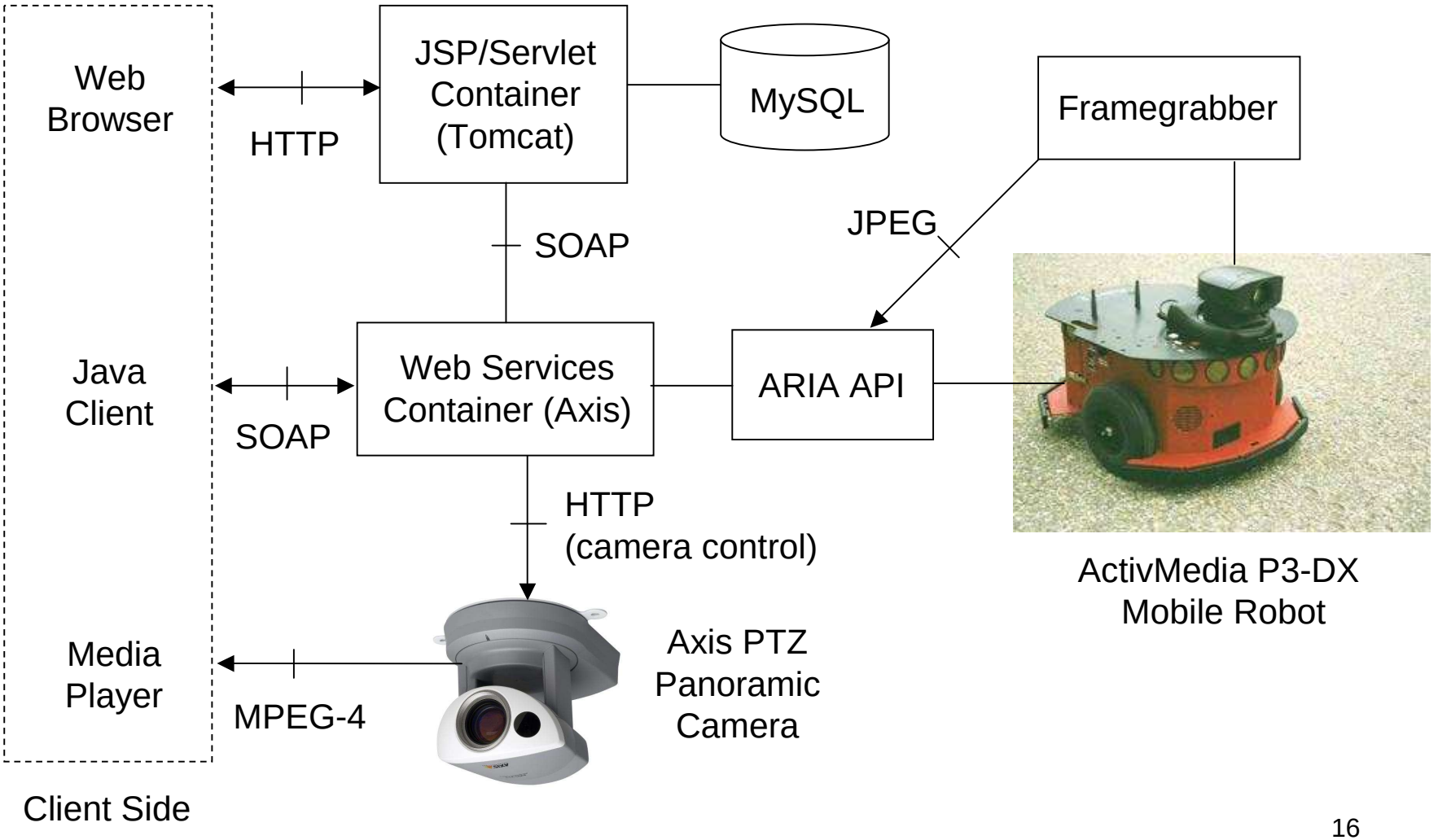
ARIA API from ActivMedia.

ActiveBPEL composition engine.

MySQL relational database.

Linux everywhere (server, robots, net cameras).

GigaBOT: Server Side Infrastructure



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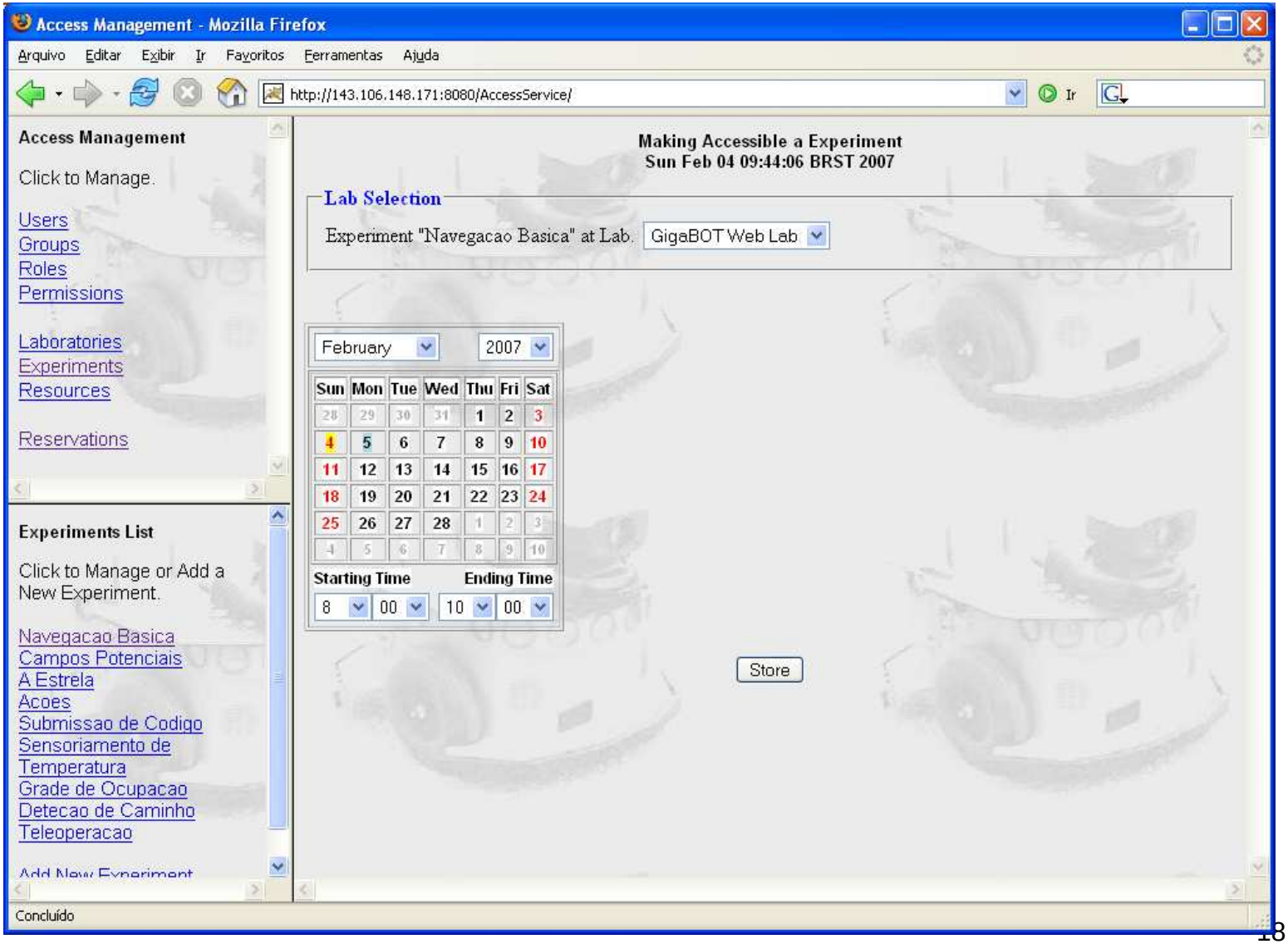
GigaBOT: Services

Participant and Web Lab management services are implemented in Java and JSP (Java Server Pages). Offer HTML interfaces.

Access management service is implemented in Java. Offers Web service interface (WSDL) for user authentication and establishment and control of access sessions.

Communication management service implements a publish-subscribe diffusion service for asynchronous transferring of XML documents. It is written in Java and offers Web service interface for the management of communication sessions. Flow-based communication relies on MPEG-4 network cameras.

GigaBOT: Management Services



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GigaBOT: Interaction Services

Interaction management service comprises of six specific services:

- Locomotion service;
- Telemetry service;
- Vision service;
- Panoramic camera service;
- Action service;
- Code submission service

The services above hide the particularities of the equipments maintained by the Web Lab.

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GigaBOT: Experiments

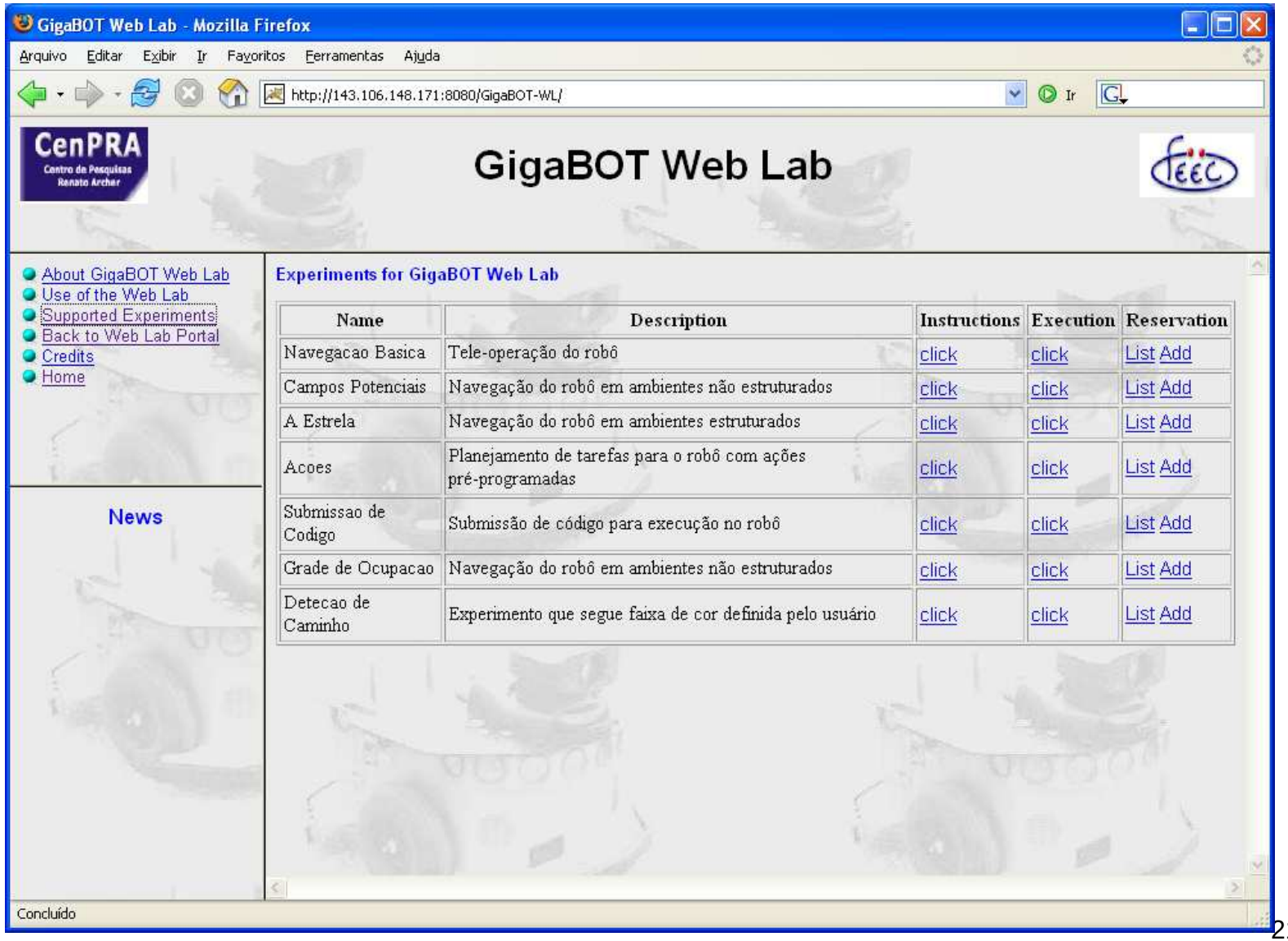
Experiments already implemented:

- Basic Control &Telemetry;
- Combination of existing actions;
- Environmental mapping;
- Navigation on structured environments;
- Navigation on non-structured environments;
- Vision-based navigation.

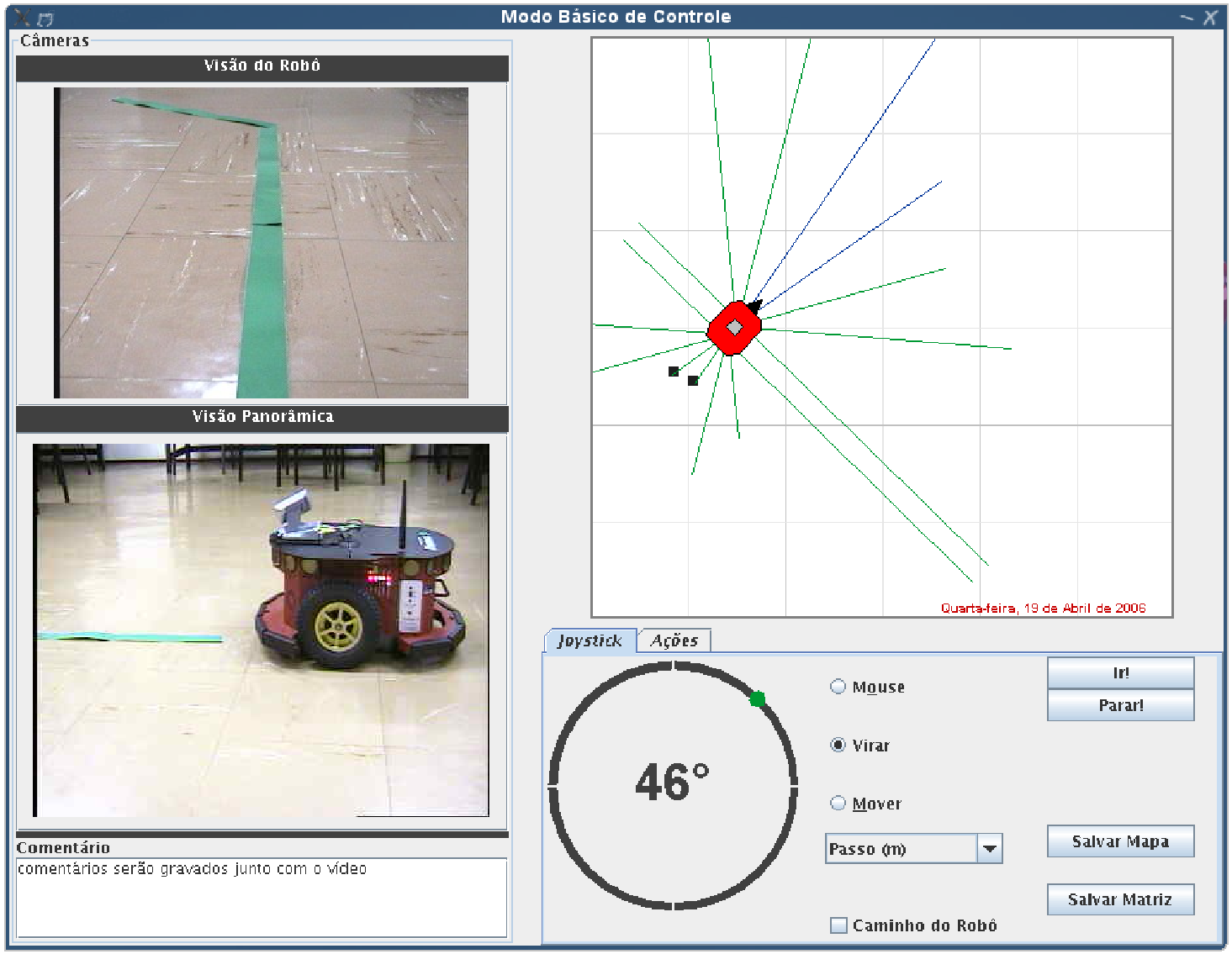
Facilities for creating new experiments:

- Code submission;
- Composition of services.

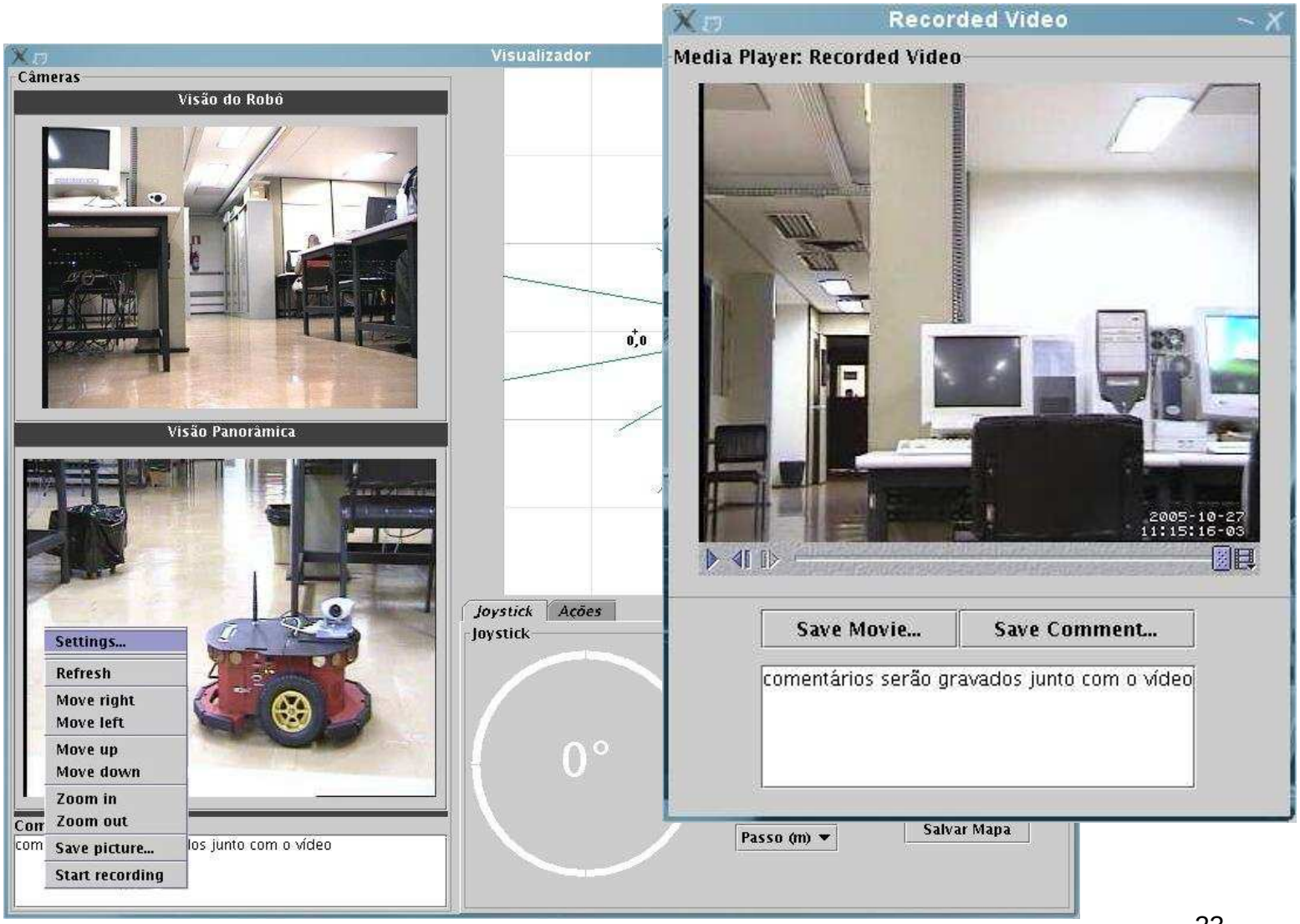
GigaBOT: Experiments



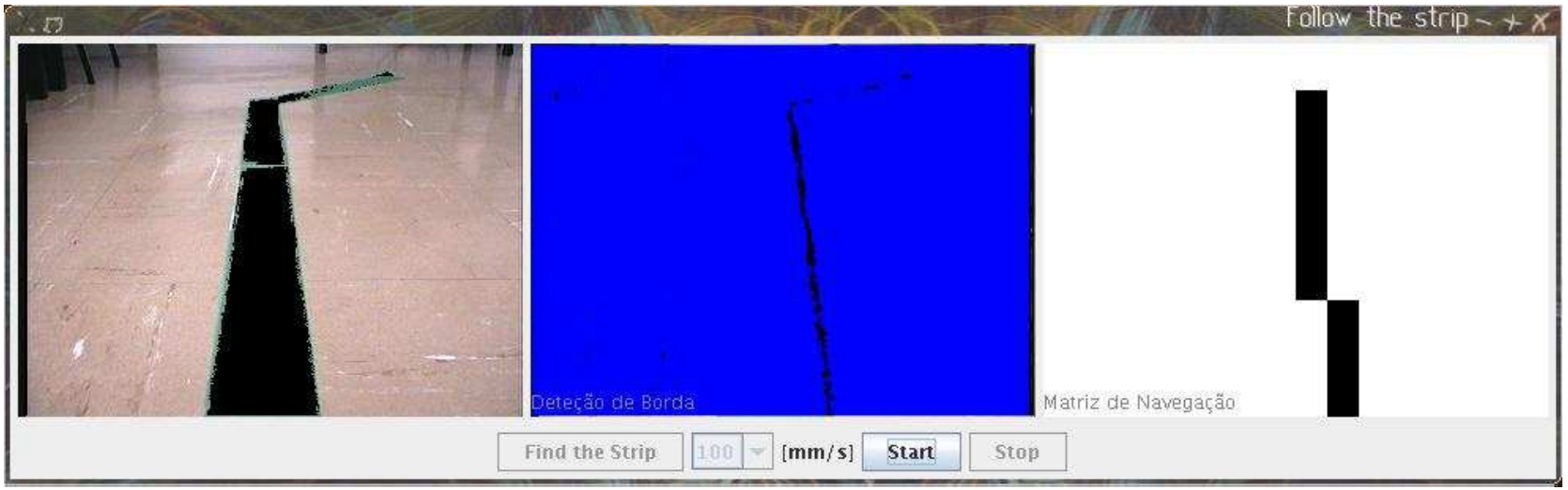
GigaBOT: Basic Control & Telemetry



GigaBOT: Basic Control & Telemetry



GigaBOT: Vision-based Navigation



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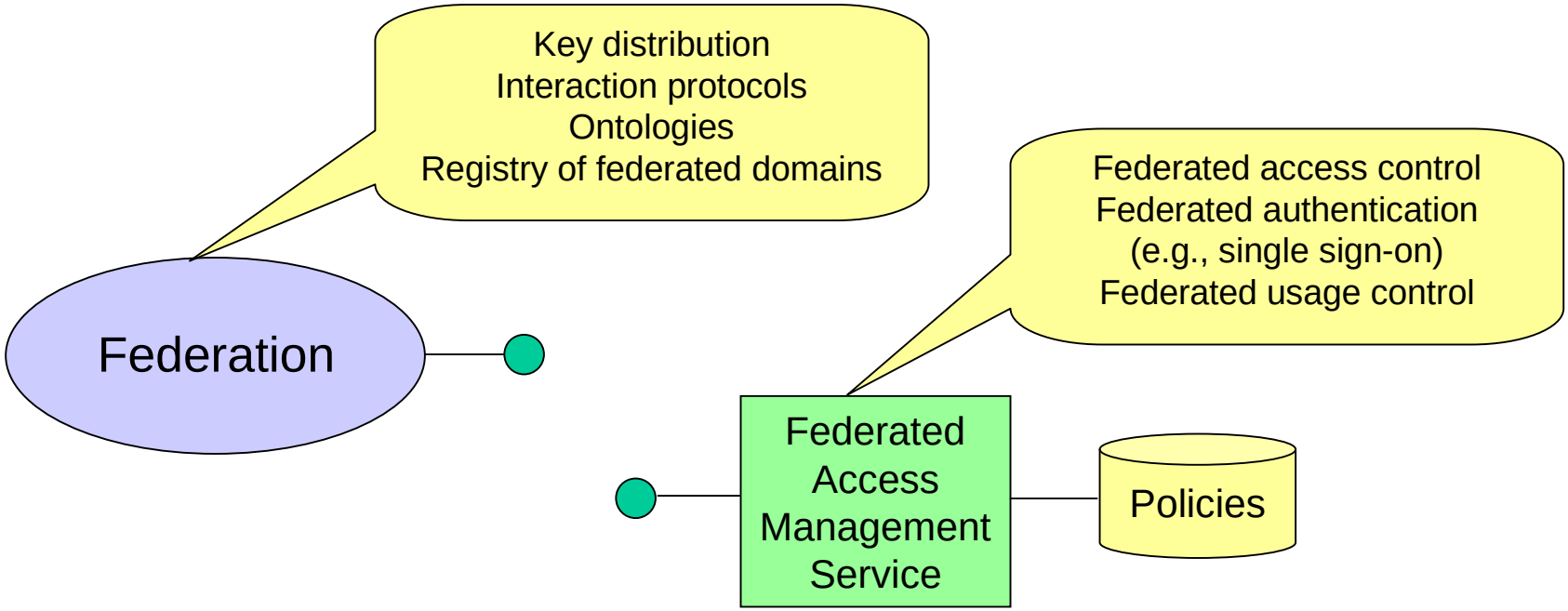
GigaBOT: Vision-based Navigation

This experiment runs at the user's computer, being sensitive to network throughput and delay.

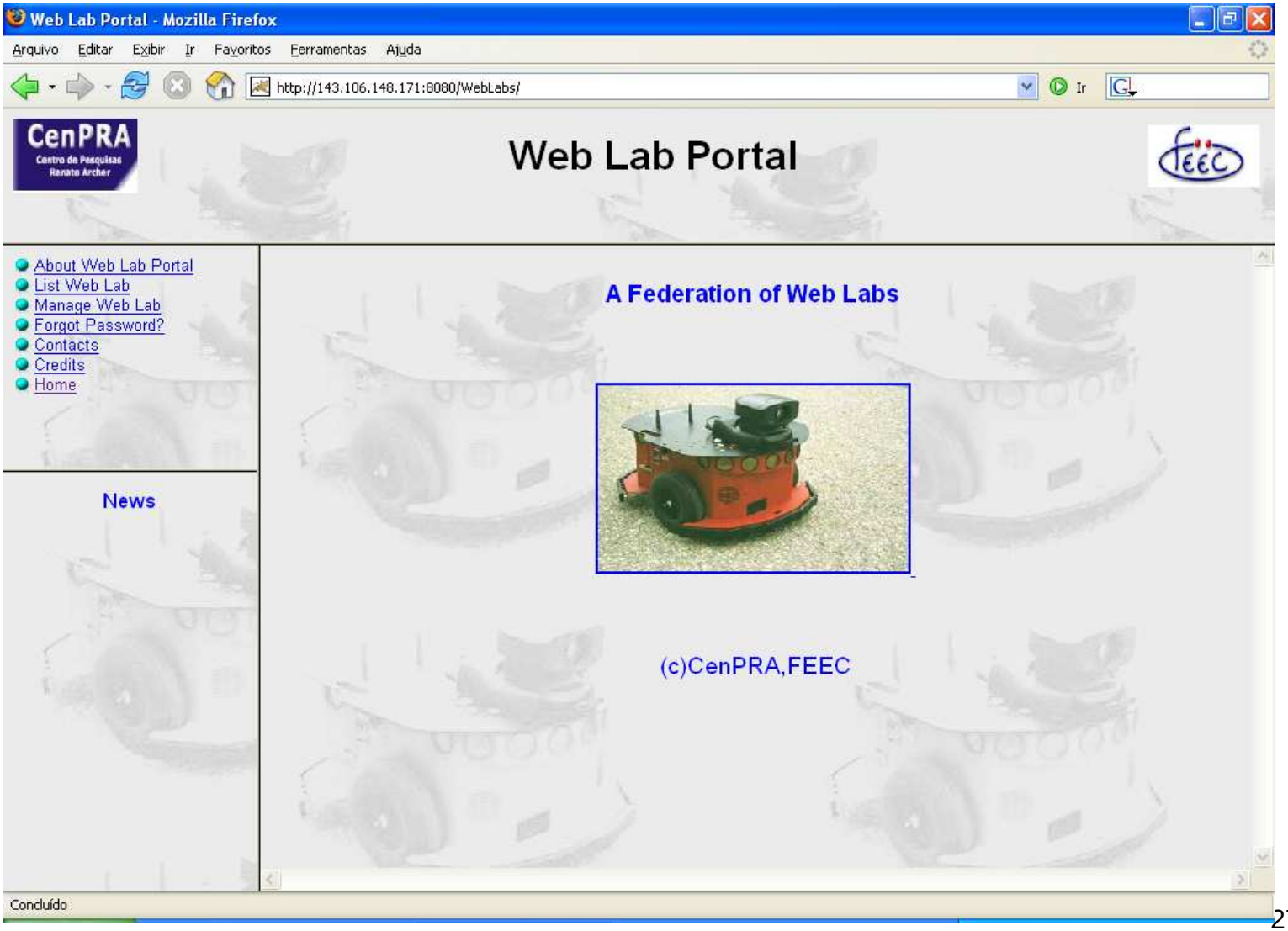
Access Network	Max. Speed (mm/s)	Bandwidth (Kbps)	Control Freq. (c/s)
Local Ethernet	170	23500	3
Campus Ethernet	90	1250	2
Public Internet	50	---	--
Residential ADSL	30	970	0.5
Giga Network (VPN)	200	23700	4

Federation of Web Labs

The access services can be designed to operate within a federation (our current work).



The Beginning of a Federation....



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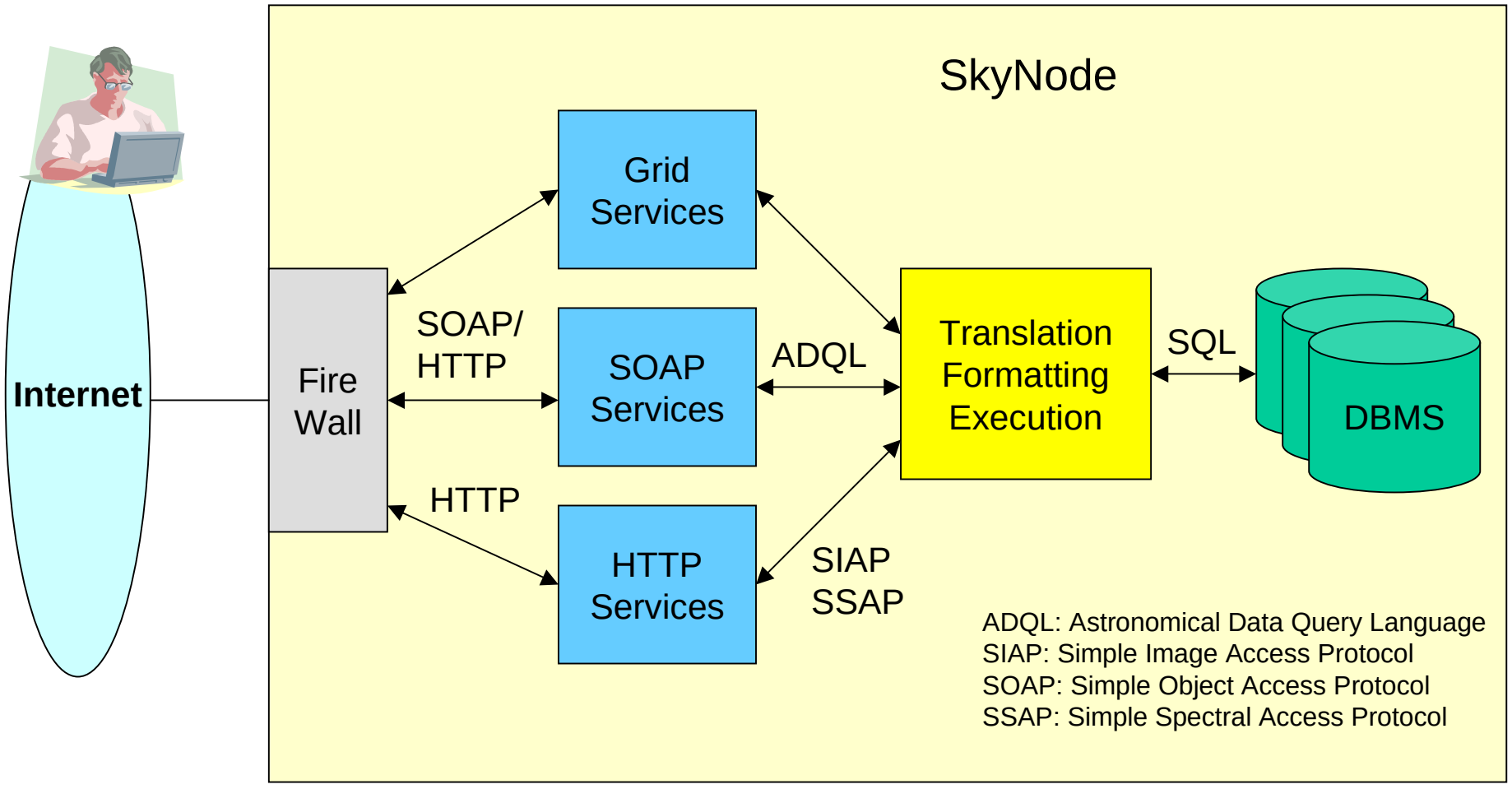
Virtual Observatories

Virtual Observatories (VOs) and Web Labs have some common requirements:

- Access control (subscription, authentication, authorization, etc.);
- Web-based access;
- Reservation of shared resources (telescopes, robots, etc.);
- Transferring of large amounts of data (images, videos, etc.);
- Federated use of resources (grids, databases, etc.).

As Web Labs, VOs demand high speed networks.

IVOA's VO Architecture



VO Applications

User

VO Application

Aplication can run:
- In the user's terminal
- In the portal (interface in the user's terminal)

Job

Result

Portal

Registry

WSDL

Workflow Engine

SOAP

WSDL Interface (local services)

SOAP: Simple Object Access Protocol
WSDL: Web Service Description Language

Web Service

Grid computing

Web Service

Web Service

Web Service

Web services offered by other portals

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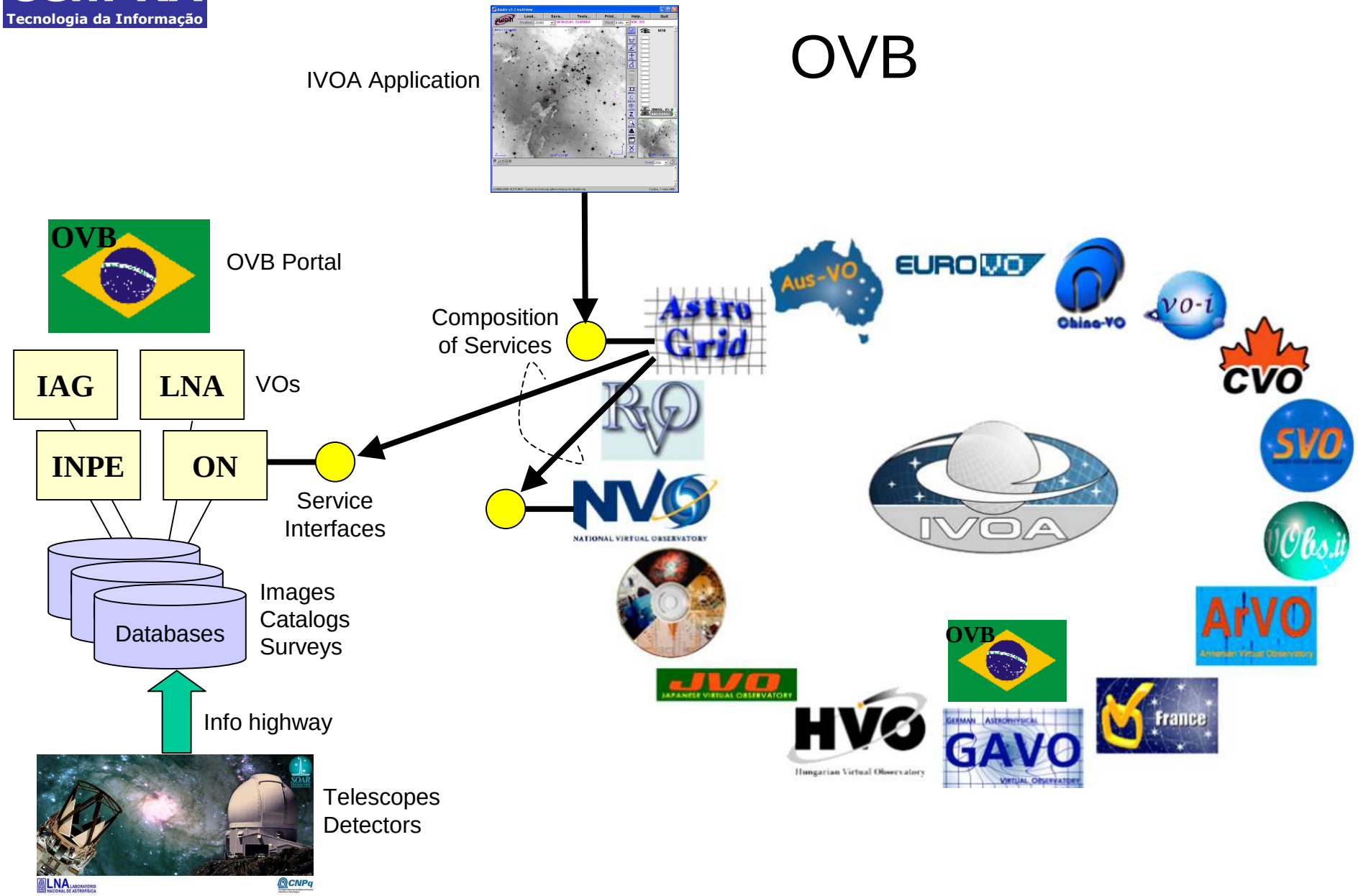
OVB



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Web Labs and VOs

A Web Lab is equivalent to a VO Portal:

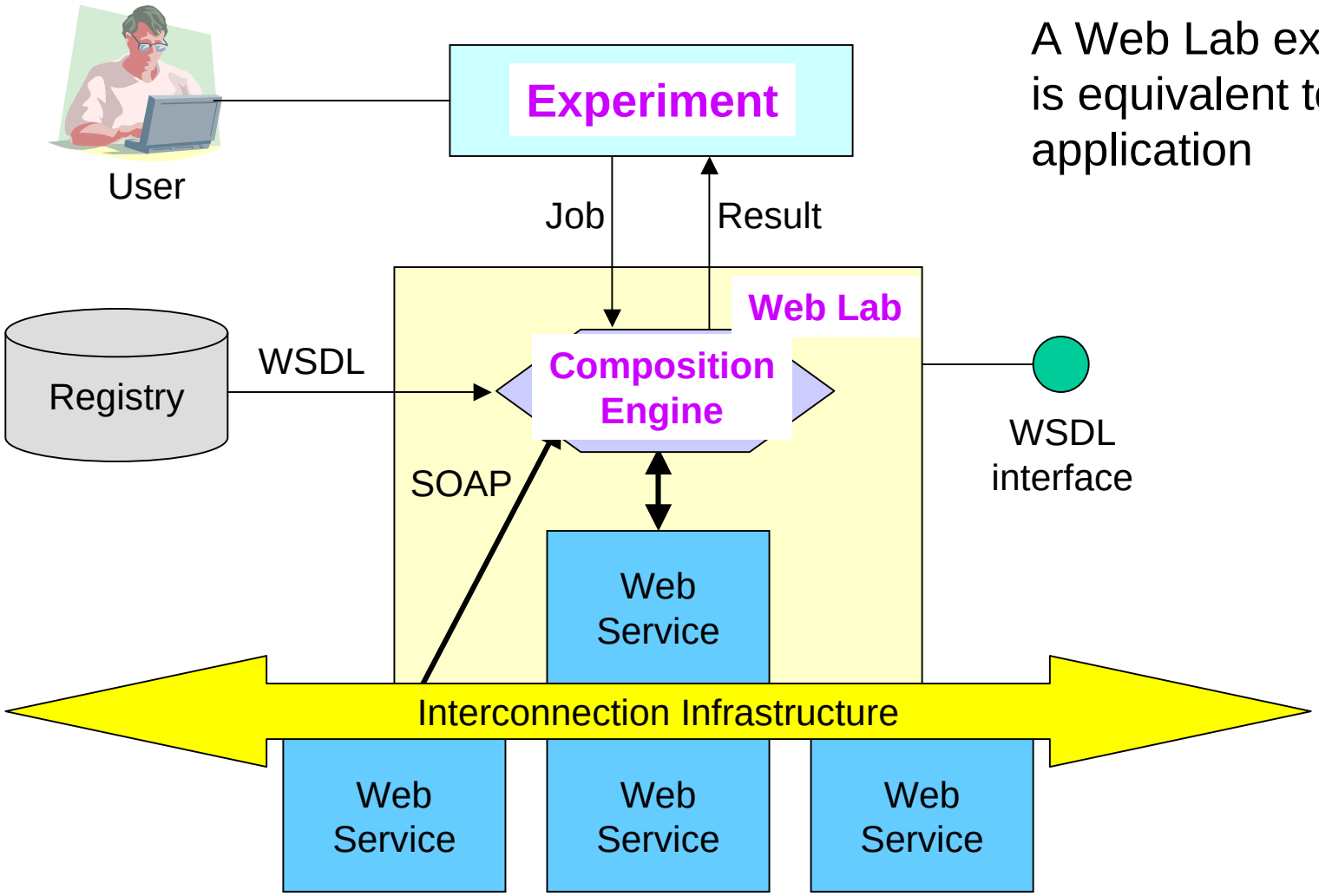
- Web Labs aggregate resources and experiments;
- VO Portals aggregate resources (images, catalogs, etc.) and VO applications.

Access, Participant, Communication, and Web Lab (VO) management services are identical.

Interaction management services differ.

Implementation technologies are the same (distributed computing based on SOA/Web Services/Grid)

Web Labs and VOs



A Web Lab experiment is equivalent to a VO application

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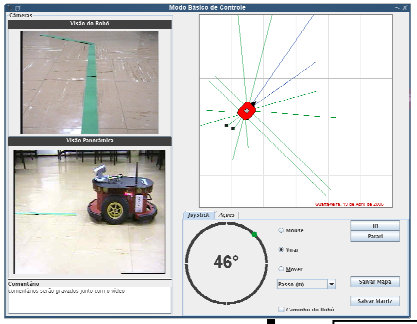
Web Labs and VOs

A Web Lab federation is equivalent to the OVB



Federation Of Web Labs

Federated Web Labs

Logical Resources

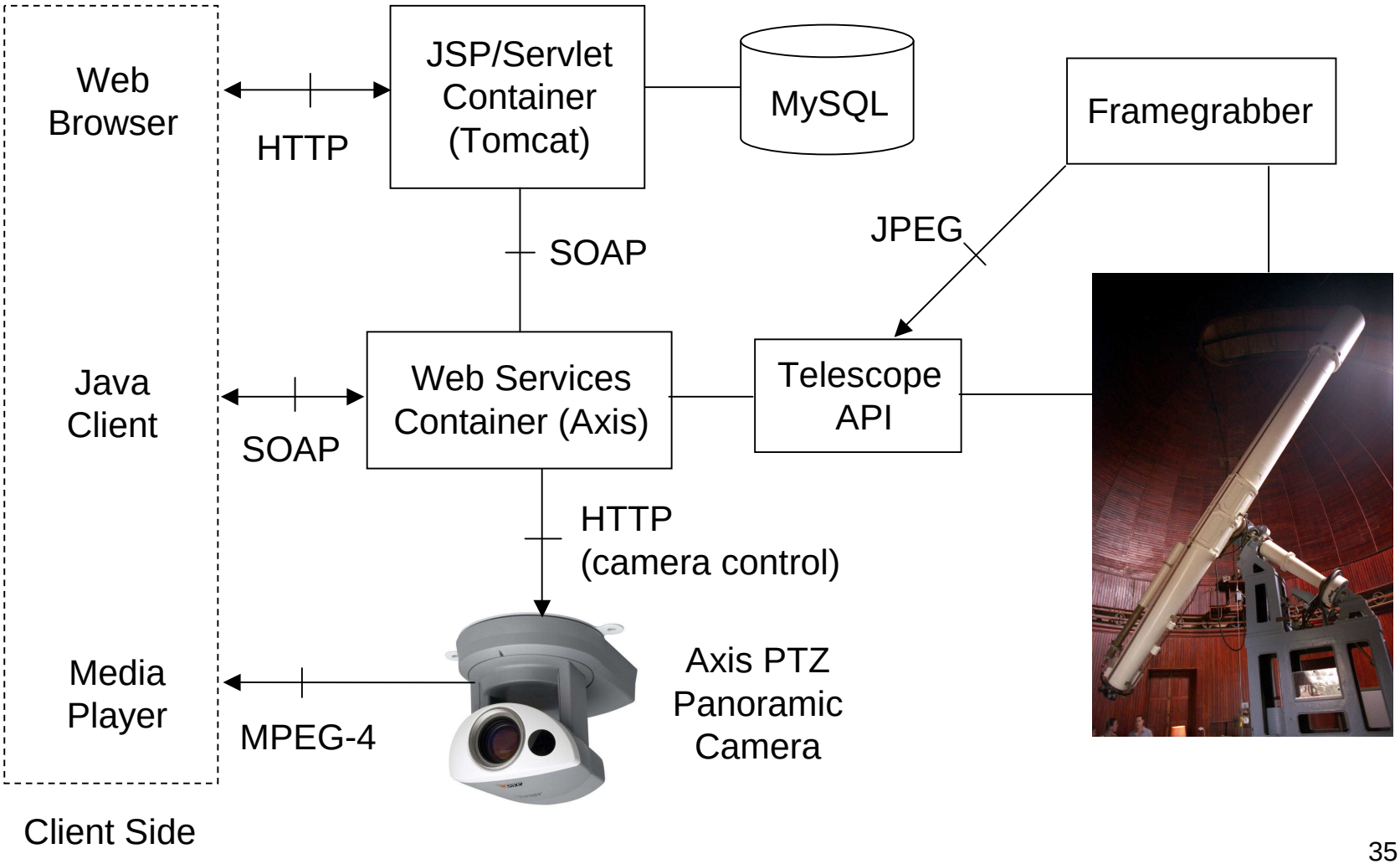
Composition of Services

Info highway

CenPRA
FEEC/Unicamp
IC/Unicamp
UFRJ
UFU
PUC/RS
Ignis

(GigaBOT Project Members)

Web Labs and OVs



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Conclusions

Web Labs and OVs share many common requirements.

Common services to Web Labs can serve OVs as well.

Experiences in federation of Web Labs can help the technical structuring of OVB.

Web Labs and OVs are being built over the same technological framework (SOA/Web Services).