

A Community of Agents for User Support of Remote Instrumentation

Line Pouchard

David Walker

Computer Science and Mathematics

Oak Ridge National Laboratory

Oak Ridge, Tennessee, USA

What is the MMC?

⌘ Materials Microcharacterization Collaboratory

⌘ Geographically dispersed expertise and resources:

- ◆ electron microscopes, diffractometry instruments (neutron beam, x-rays)

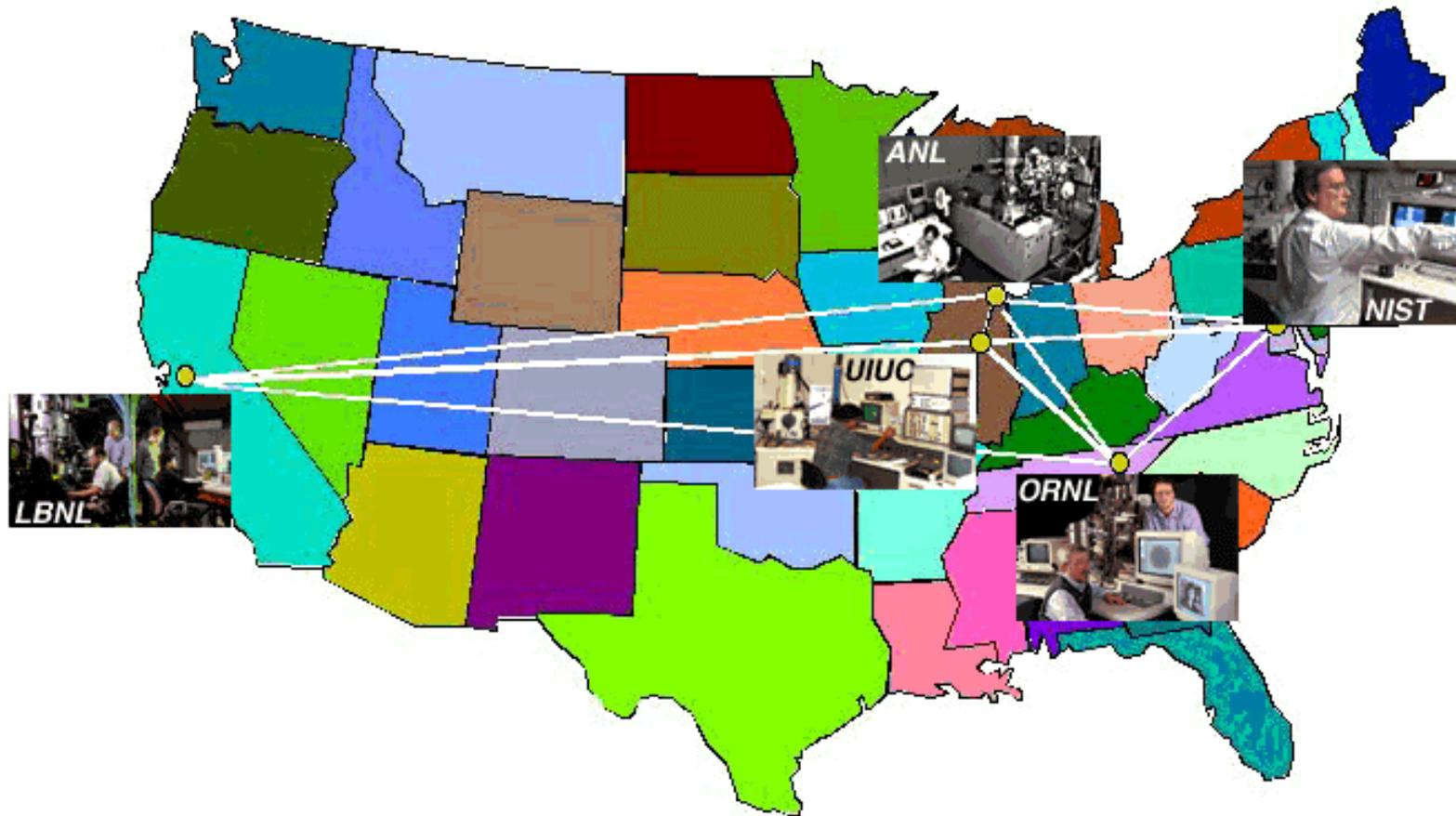
- ◆ world-renown scientists

⌘ Coordination and control of remote instruments

⌘ Visualization platforms

⌘ Data repositories, remote data analysis

MMC



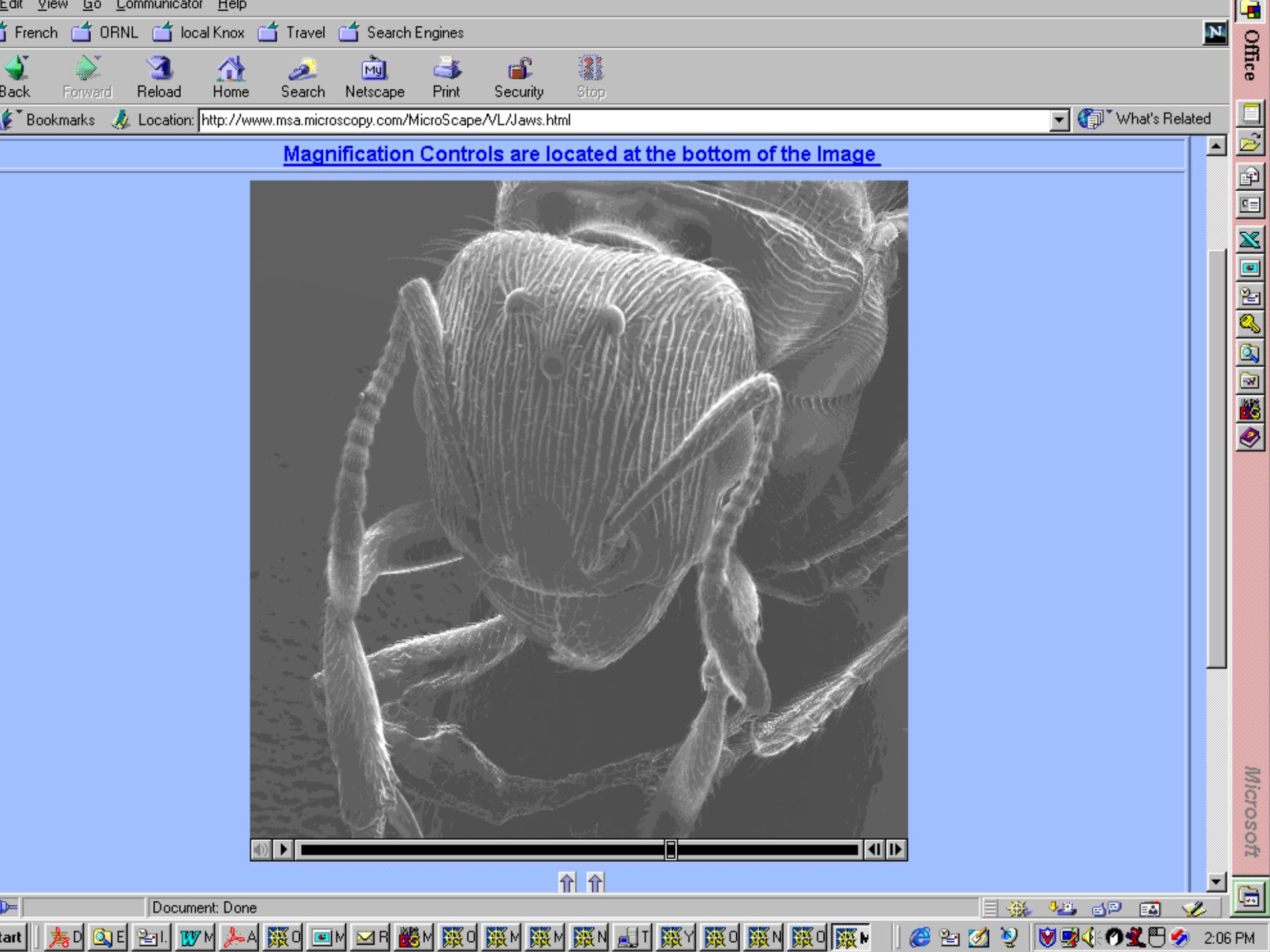
ARGONNE
National Laboratory



NIST

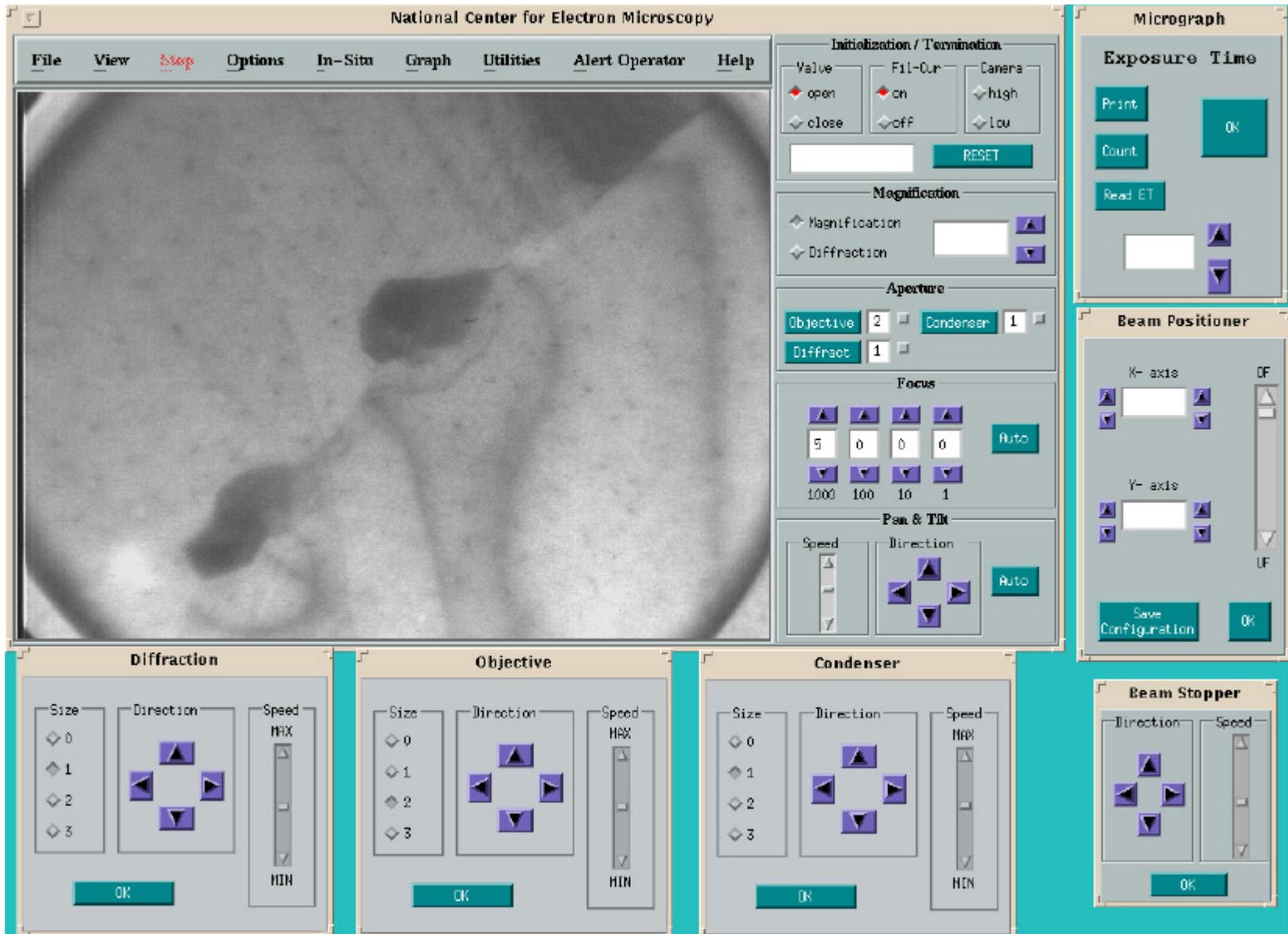
ornl

University of **Illinois**
Urbana-Champaign



Magnification Controls are located at the bottom of the Image





Needs



- ⌘ Support tools promoting efficient and effective use of resources
- ⌘ Attracting new users and retain current ones
- ⌘ Reducing expert staff workload
 - ◆ information requests and user proposals
 - ◆ scheduling on an instrument
 - ◆ administer safety and security training
- ⌘ Ensuring access control, authorization, and authentication

Desired Functionality

- ⌘ A query system supporting the production of user proposals
- ⌘ A scheduling system for MMC instruments
- ⌘ A safety and security training module
- ⌘ Integration of security features
- ⌘ Intelligent processing of images and analytical data including image recognition, feature extraction, and image interpretation based on simulation

A Community of Agents



A Controller Agent (CA)
authorizes users to access other agents



A Scheduling Agent (SA)
schedules users on instruments



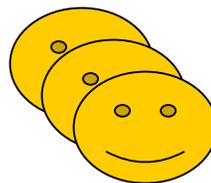
A Query Agent (QA)
answers user questions



A Training Agent (TA)
administers tutorials



A User Agent (UA)
represents individual users



Instrument Agents (IA)
represent individual instruments at
time of use

Architecture



- ⌘ Integration of heterogeneous, distributed, high level components in a single architecture
- ⌘ Integration with the DeepView collaborative framework
- ⌘ Execution on client machines for query and training agents (depending on interaction)
- ⌘ Scalable (up to 100 users)
- ⌘ Extensible (adding more agents)

Design

Four main agents acting on users' behalf

- ◆ Controller, Query, Training, Scheduling Agents

Other agents were added

- ◆ User and Instrument Agents, DeepView Agent

Agent roles and responsibilities

- ◆ Key role for the Controller Agent
- ◆ Use of certificates under evaluation

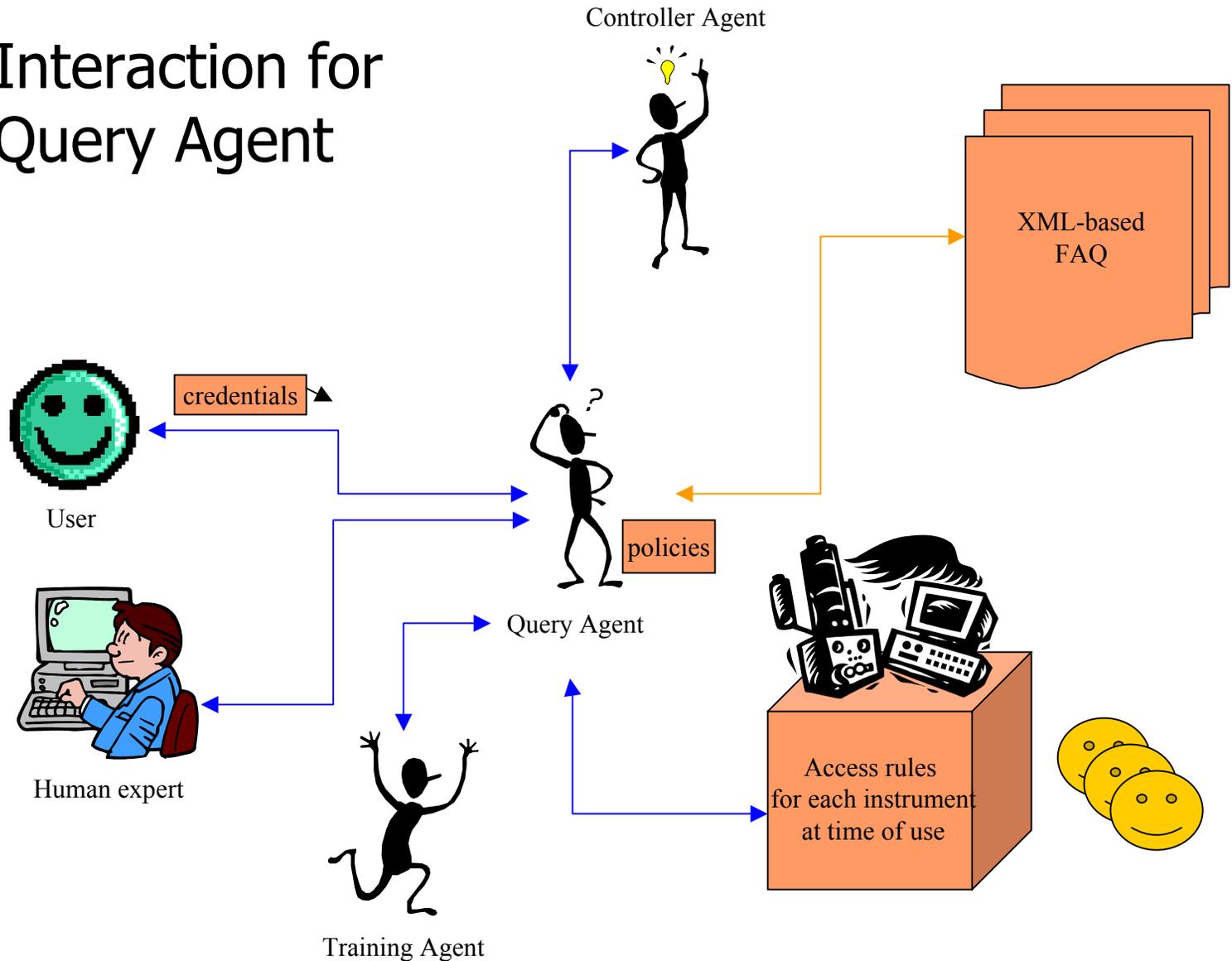
Technologies

- ◆ Agent Zeus toolkit (FIPA ACL)
- ◆ XML-tagged data for databases queries

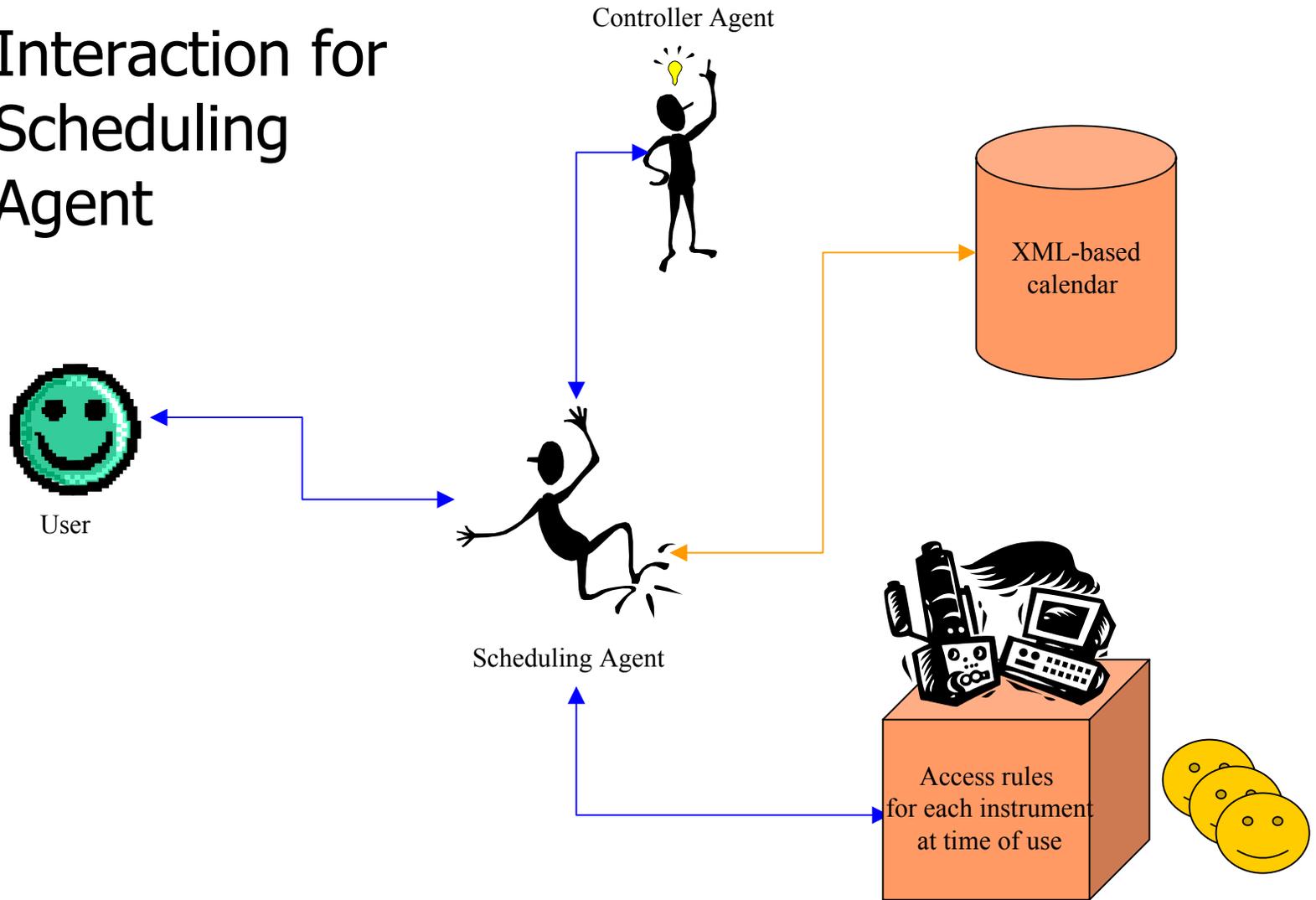
Interaction Model

- ⌘ The Controller Agent allows other agents to perform tasks on user's behalf according to:
 - ◆ user profile -- affiliation, experience
 - ◆ training
 - ◆ paid fees
- ⌘ The Training and Query Agents interact with XML-tagged web pages and databases
- ⌘ Future addition: a DeepView agent

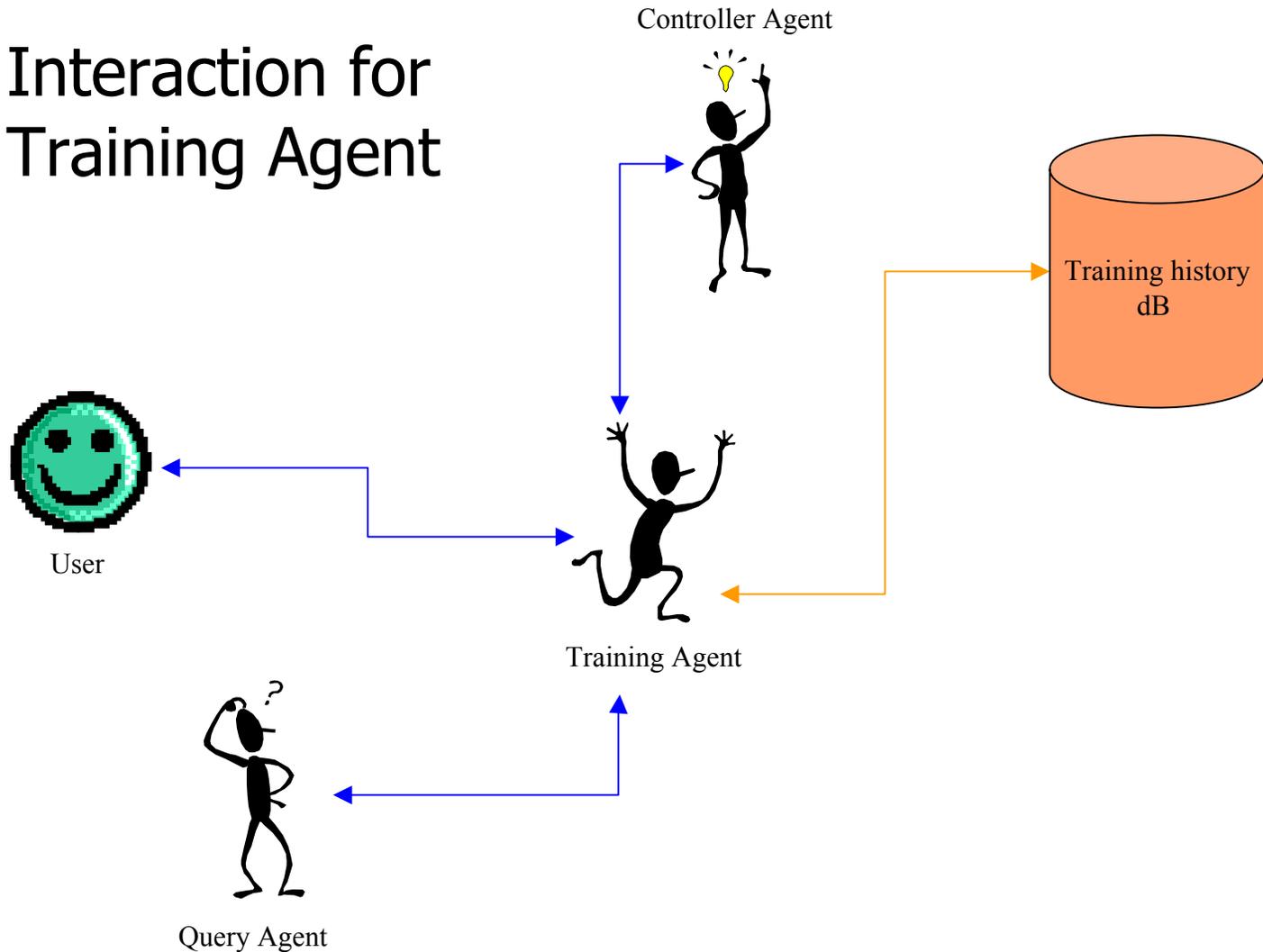
Interaction for Query Agent



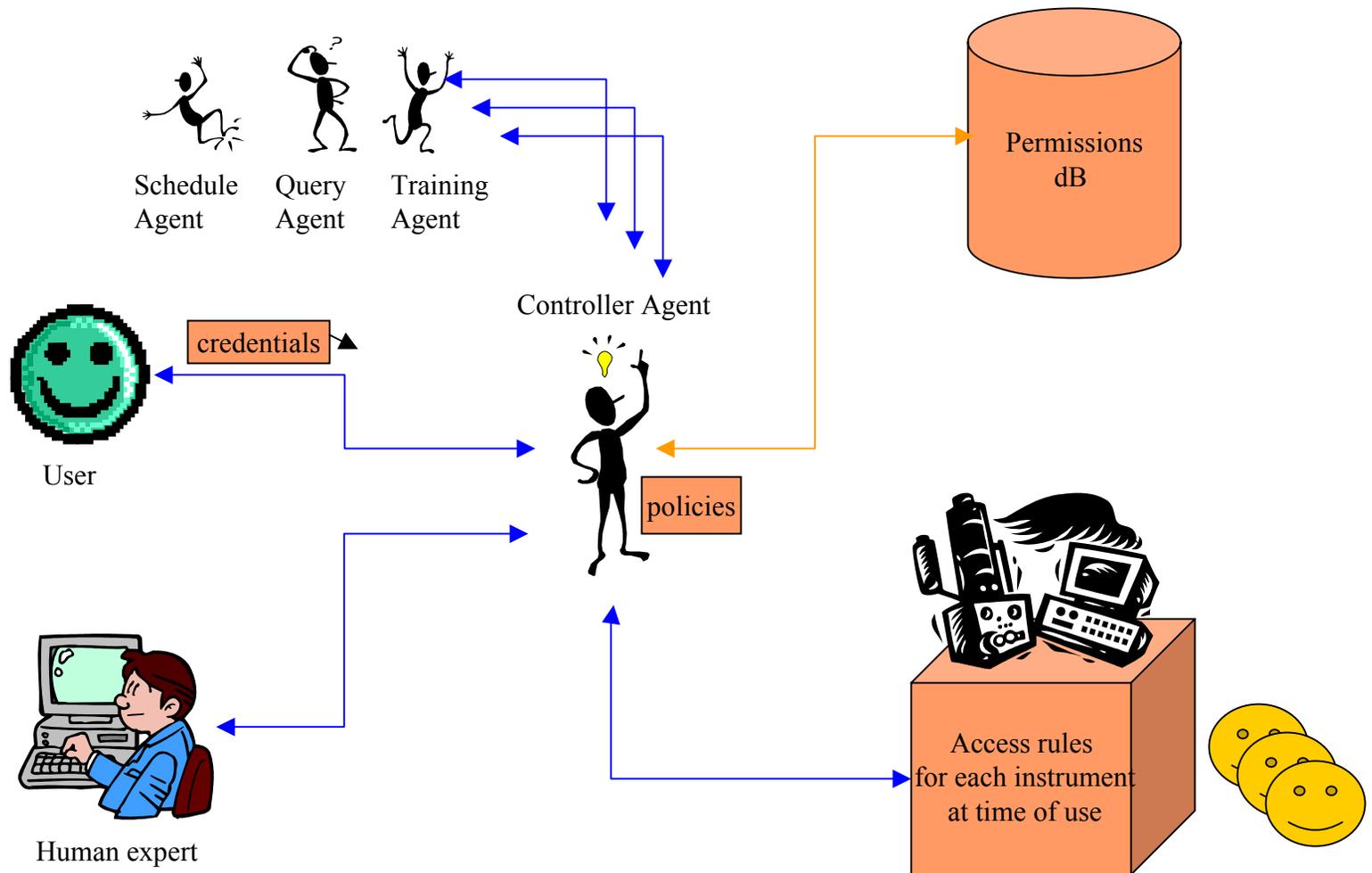
Interaction for Scheduling Agent



Interaction for Training Agent



Interaction for Controller Agent



The Controller Agent



⌘ Use of certificates

- ◆ X 509.3 user identity certificates
- ◆ RBAC user attributes — based on user profile
- ◆ use conditions for instruments

⌘ Requires a policy engine

Scalability issues

⌘ 5 main agents (CA, QA, TA, SA, UA)

- ◆ QAs, TAs, and UAs running on user client
- ◆ subtypes of QAs, TAs, and SAs on instruments for verification at run time

⌘ Total number of agents vary according to:

- ◆ users (up to 100, in practice ??)
- ◆ instruments (up to 50, in practice a dozen)

⌘ Adding new users is simple

⌘ Adding a new role is possible

Future work

- ⌘ A multi-agent system for supporting users in a scientific environment (real-world problem)
- ⌘ Can be applied to other collaboratories and collaborative problem-solving
- ⌘ Integrate intelligence in agents for helping scientists with domain problems (image recognition and feature extraction)
 - ◆ present alternative solutions
 - ◆ execute alternative solutions

Government Disclaimer

The submitted manuscript has been authored by a contractor of the U.S. Government under Contract No. DE-AC05-00OR22725. Accordingly, the U.S. Government retains a non-exclusive, royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for U.S. Government purposes.

ARGONNE
National Laboratory



NIST

ornl

University of **Illinois**
Urbana-Champaign