FUJITSU THE POSSIBILITIES ARE INFINITE

UNICORE

Unicore Technology

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Grid School
July 17, 2003

History

- **History**
  - Conceived in 1997
  - UNICORE and UNICORE Plus BMBF Projects
  - EuroGrid and GRIP EC Projects
  - RealityGrid UK e-Science Project
  - Supported Service from Pallas (UnicorePro)
- **Focus on Seamless Computing**
- **Open Source and Online Demo Site**
  - www.unicore.org
- **OGSA Compliant Demonstrator**
  - June 7th 2002: First release.
  - September 4th 2002: Application Steering Deployment
    - Fast Track project in RealtyGrid (UK e-Sciecnce).

      www.sve.man.ac.uk/Research/AtoZ/RealityGrid/AHM2002/
  - Official OGSI based development under way.

Unicore Implementation

- **Unicore Architecture**
  - Open Protocol, Abstract Job Object
  - Reference Implementation (one server, two clients)
- **Fujitsu Developed Components**
  - Security Gateway
  - Network Job Superisor (NJS)

    Authorization translation, AJO Incarnation, workflow scheduling, file management, ...
  - Target System Interfaces (TSI)

    Fujitsu, IBM, NEC, Hitachi, SGI, Sun, Mac, Sony (PS2), ...
  - Client Tool Kit
- **Pallas Developed Component**
  - Production Ready GUI Based Client

Important Unicore Functions

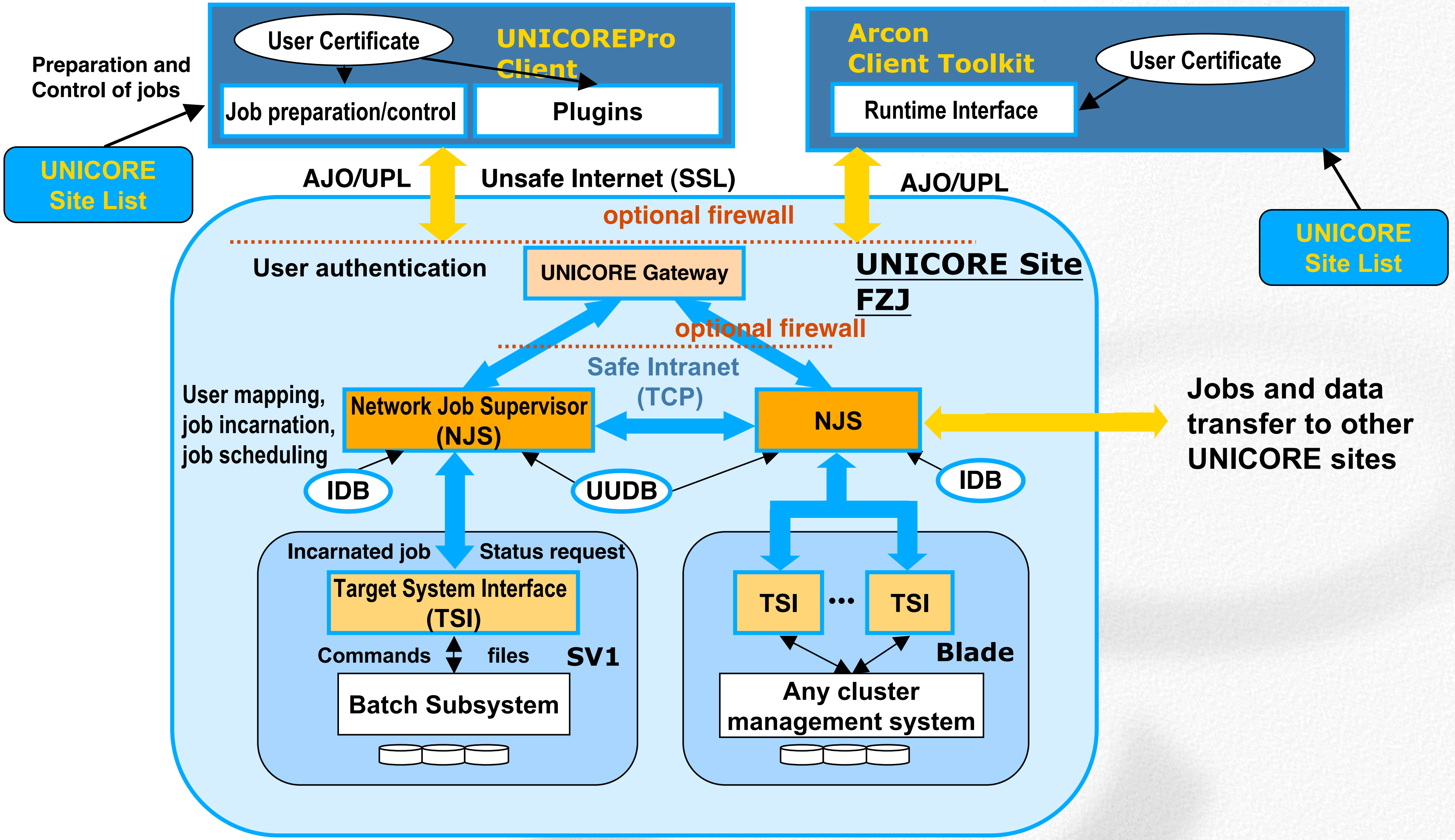
- **Security**
  - Certificate/PKI Based Security Model
  - Interoperable with Globus Certificates
  - Support for stronger trust model than Globus
    - or Globus Trust Model using proxies.
- **Workflow**
  - Local, remote, and nested task graphs
  - File management, transfer, and streaming
  - If and loop constructs
  - Flow control based on task status, time events, and file-state events
- **GRID Management**
  - Hard/soft fail recovery.
  - System administrator’s control interface.
  - Extensive logging support
  - Built in certificate management in the GUI client.

Functions Continued

- **Resource Broker**
  - Multi-site resource check prior to submit.
  - Estimate of time until execution.
  - Ticket generation and checking.
  - Dynamic brokering at execution time.
- **Interactive Access Extension**
  - Allows standard terminal style interaction.
  - Unicore Single Sign-on

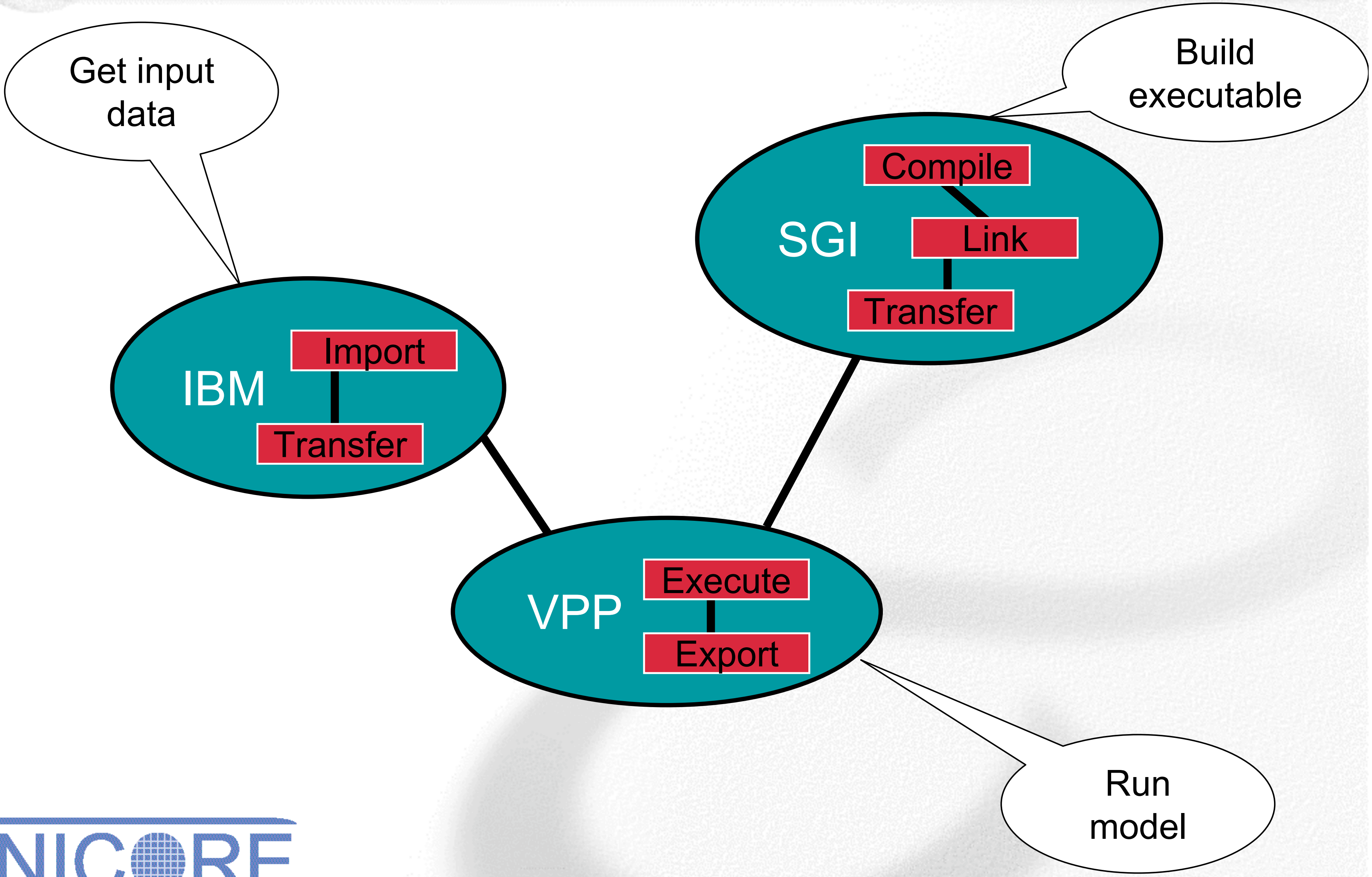
    Complete multi-site authentication & authorization.
  - Includes “Interactive Batch”.

Architecture



Jobs and data transfer to other UNICORE sites

Distributed Jobs



AJO: Unicore Programming

FUJITSU

- **Abstract Job Object**
  - Collection of classes representing Grid functions
  - Encoded as Java objects (XML encoding possible)
- **Where to build AJOs**
  - Pallas client GUI - The user's view
  - Client plugins - Grid deployer (You)
  - Arcon client tool kit - Hard core (Some of you)
- **What can't the AJO do**
  - Application level Meta-computing
  - ???

UNICORE

Unicore Can Dos

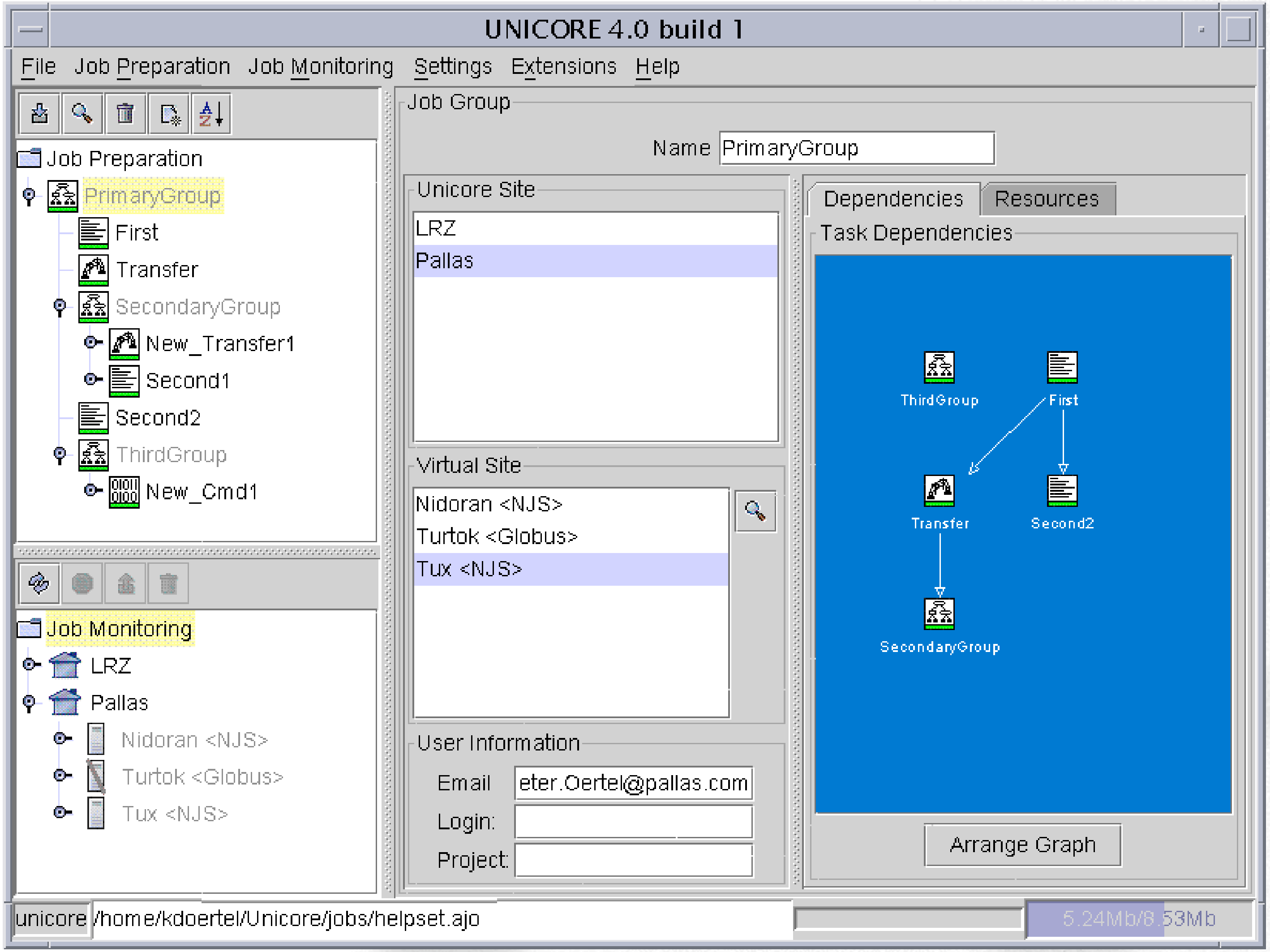
- **Run & control remote**
  - Shell scripts
  - Applications (without modifications)
- **Files**
  - Transfer client <-> servers
  - Transfer servers <-> servers
  - Remote management
- **Simple VO's**
- **Resource**
  - Discovery
  - Brokering
  - Reservation
- **Provide site autonomy**
- **Data archive access**
- **Integration with local admin.**
- **Workflow**
  - Nested remote jobs
  - Nested local jobs
  - Loops &Conditionals
  - Time based events
  - File state events
  - Rerun on failure
- **Seamless Computing**
- **Filer streaming**
  - Application to application
  - Application to Client
- **CORBA Integration**
- **Built in cert. management**
- **Grid administration**
  - Tools
  - Failsafe restart
  - Dynamic hosting

AJO Tour

Interfaces

- **Client Plugins**
  - Application specific support (CPMD, Gausian, NASTRAN, ...)
- **Unicore Protocol Layer**
  - Resource discovery, job submission, job management
- **Incarnation Data Base and TSI Interface**
  - Incarnation support
- **Unicore User Data Base**
  - User mapping and authorization
- **Broker/Scheduler Interface**
  - Interface defined and implemented in NJS.
- **Independent File Transfer Interface**
  - Interface defined

The Unicore Client



UNICORE 4.0 build 1

Job Preparation
- PrimaryGroup
  - First
  - Transfer
  - SecondaryGroup
    - New_Transfer1
    - Second1
  - Second2
  - ThirdGroup
    - New_Cmd1

Job Monitoring
- LRZ
- Pallas
  - Nidoran <NJS>
  - Turtok <Globus>
  - Tux <NJS>

Job Group

Name: PrimaryGroup

Unicore Site
- LRZ
- Pallas

Virtual Site
- Nidoran <NJS>
- Turtok <Globus>
- Tux <NJS>

User Information

Email: eter.Oertel@pallas.com

Login:

Project:

Dependencies | Resources

Task Dependencies

unicore /home/kdoertel/Unicore/jobs/helpset.ajo

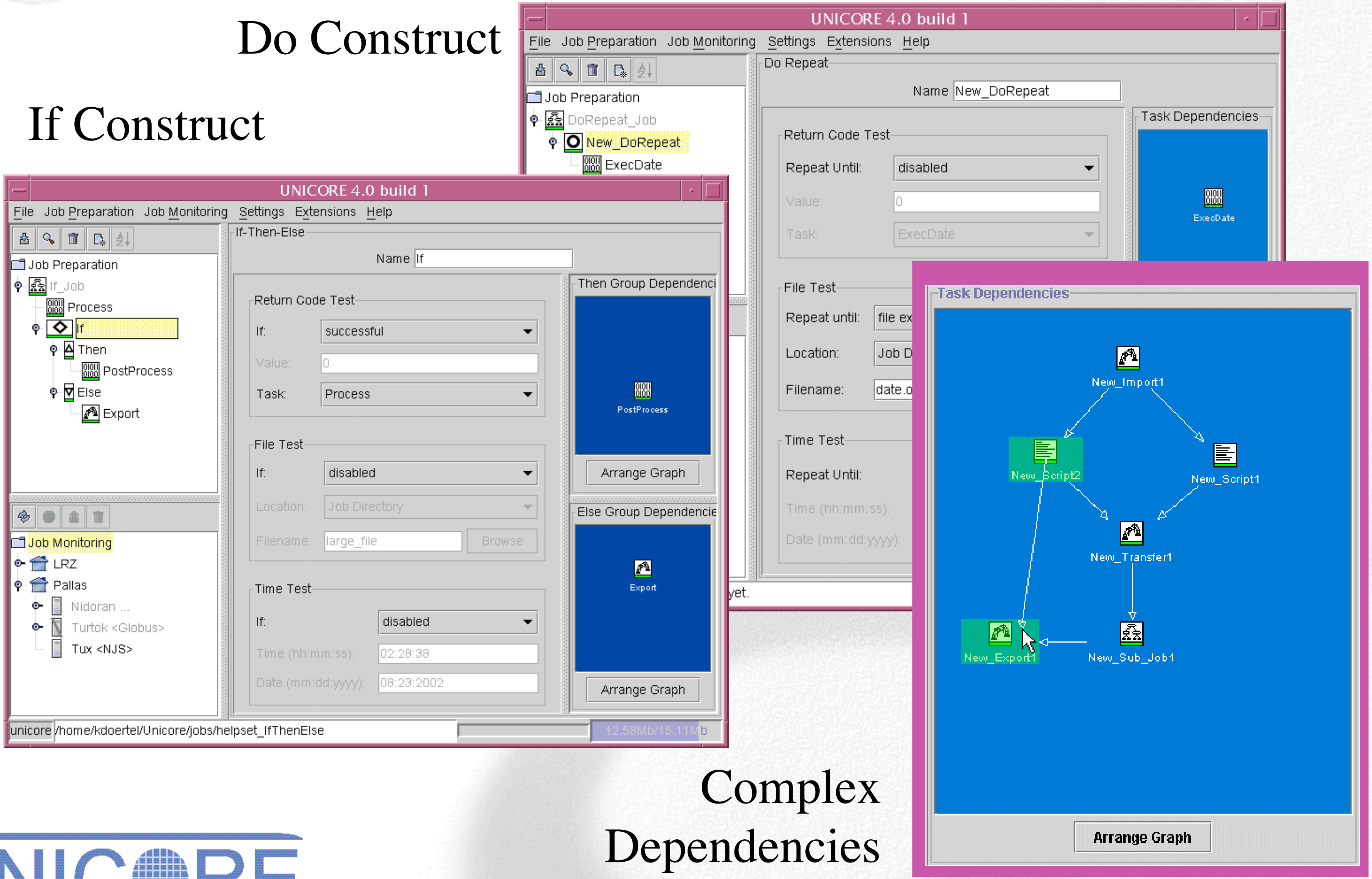
5.24Mb/8.53Mb

Fujitsu Laboratories of Europe © 2003

WorkFlow

Do Construct

If Construct



Do Repeat

Name: New_DoRepeat

Return Code Test

Repeat Until: disabled

Value: 0

Task: ExecDate

File Test

Repeat until: file ex

Location: Job D

Filename: date.o

Time Test

Repeat Until:

Time (hh:mm:ss):

Date (mm:dd:yyyy):

If-Then-Else

Name: If

Return Code Test

If: successful

Value: 0

Task: Process

File Test

If: disabled

Location: Job Directory

Filename: large_file

Time Test

If: disabled

Time (hh:mm:ss): 02:28:38

Date (mm:dd:yyyy): 08:23:2002

unicore /home/kdoertel/Unicore/jobs/helpset_IfThenElse 12.58Mb/15.11Mb

Complex Dependencies

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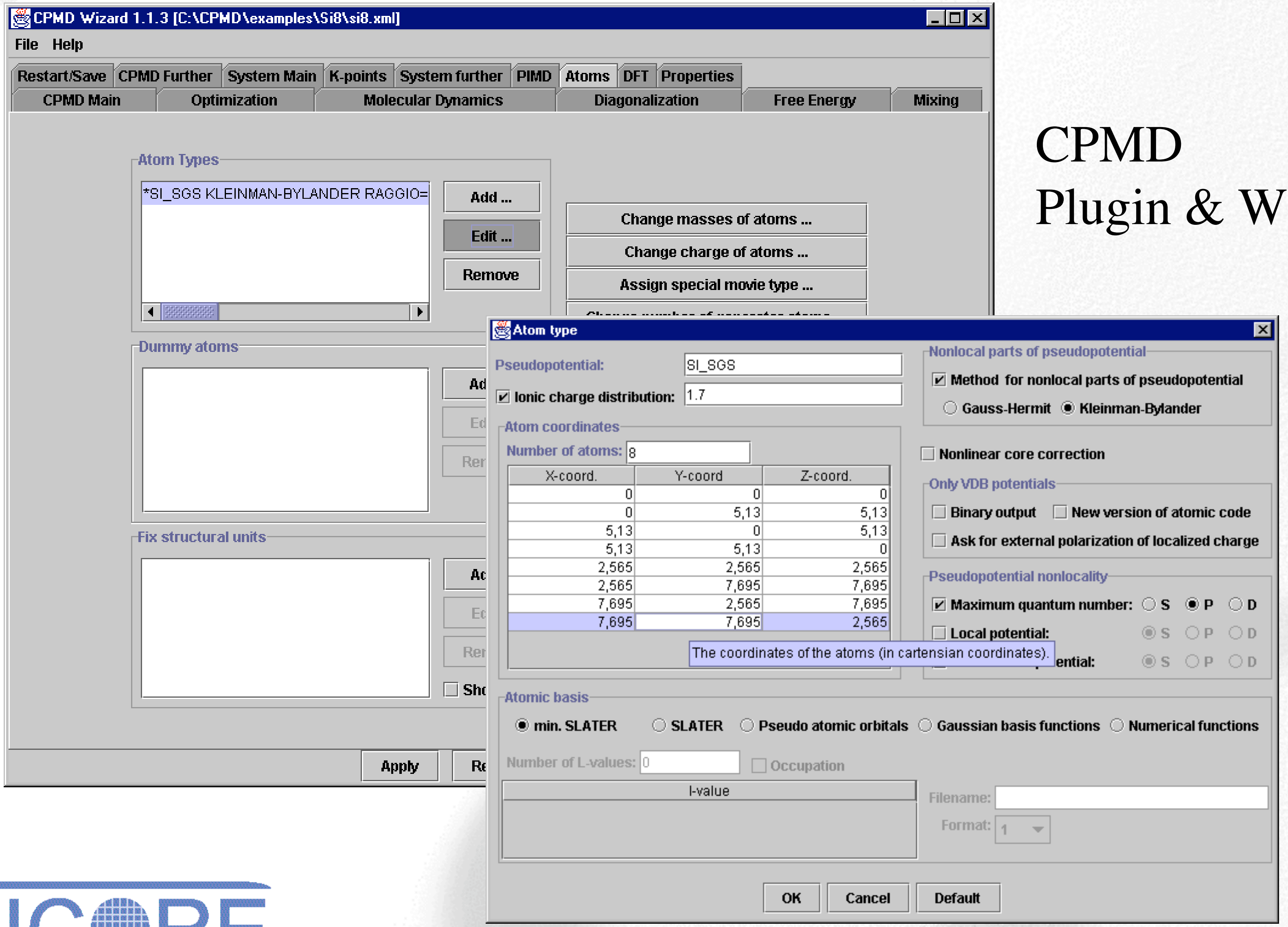
Plugins



*SI_SGS KLEINMAN-BYLANDER RAGGIO=

Pseudopotential: SI_SGS

☑ Ionic charge distribution: 1.7

Atom coordinates

Number of atoms: 8

X-coord.	Y-coord	Z-coord.
0	0	0
0	5,13	5,13
5,13	0	5,13
5,13	5,13	0
2,565	2,565	2,565
2,565	7,695	7,695
7,695	2,565	7,695
7,695	7,695	2,565

The coordinates of the atoms (in cartensian coordinates).

Nonlocal parts of pseudopotential

☑ Method for nonlocal parts of pseudopotential

○ Gauss-Hermit ● Kleinman-Bylander

□ Nonlinear core correction

Only VDB potentials

□ Binary output □ New version of atomic code

□ Ask for external polarization of localized charge

Pseudopotential nonlocality

☑ Maximum quantum number: ○ S ● P ○ D

□ Local potential: ● S ○ P ○ D

ential: ● S ○ P ○ D

Atomic basis

● min. SLATER ○ SLATER ○ Pseudo atomic orbitals ○ Gaussian basis functions ○ Numerical functions

Number of L-values: 0 □ Occupation

l-value

Filename:

Format: 1

CPMD
Plugin & Wizard

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Plugin Development

Very Seamful: Scripts

- Different for every system

Seamful: Command Task

- Path to command
- Environment variables

Seamless: Appl. Resource

- Fully abstracted
- No system/site differences
- Application metadata

Ideal: Plugin

- User's view of application
- Not a computation,
  but a solution

Client Development

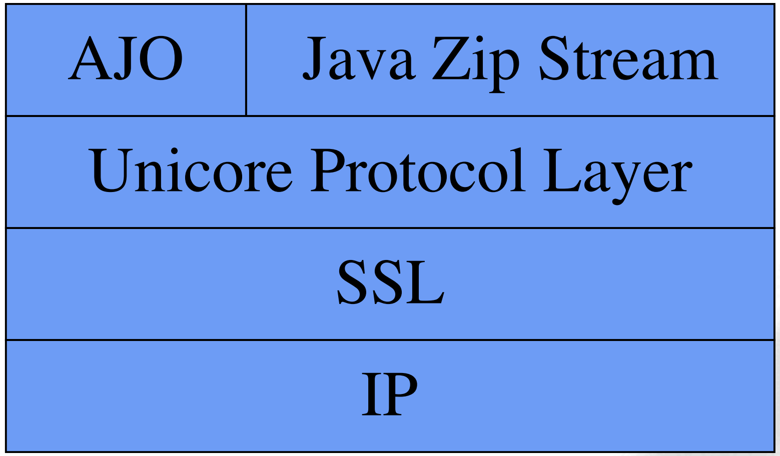
- A few Java classes
  - GUI
  - Plugin start/stop
  - Data container
- Use Client Functions
  - Job management
  - Resource editor
- Examples available

System Development

- Install application
- Edit server data base (IDB)
  - Application location
  - Environment variables
  - Libraries and data files

Protocol Layering

- Abstract Job Object
- Java Zip Stream (File Transfer Only)
- Unicore Protocol Layer
- SSL
- IP



AJO | Java Zip Stream

Unicore Protocol Layer

SSL

IP

Structure, Integrity, & Compression

Authorization, Packetizing, & Control

Authentication, Integrity, & Encryption

Underlined functions can be turned off.

IDB and TSI Interfaces

Incarnation Data Base

- Maps abstract representation to concrete
- Includes resource description
  - Prototype auto-generation from MDS

Target System Interface

- Perl interface to host platform
- Very small system specific module for easy porting
- Current: NQS (several versions), PBS, Loadleveler, UNICOS, Linux, Solaris, MacOSX, PlayStation-2
- Condor: Under development .

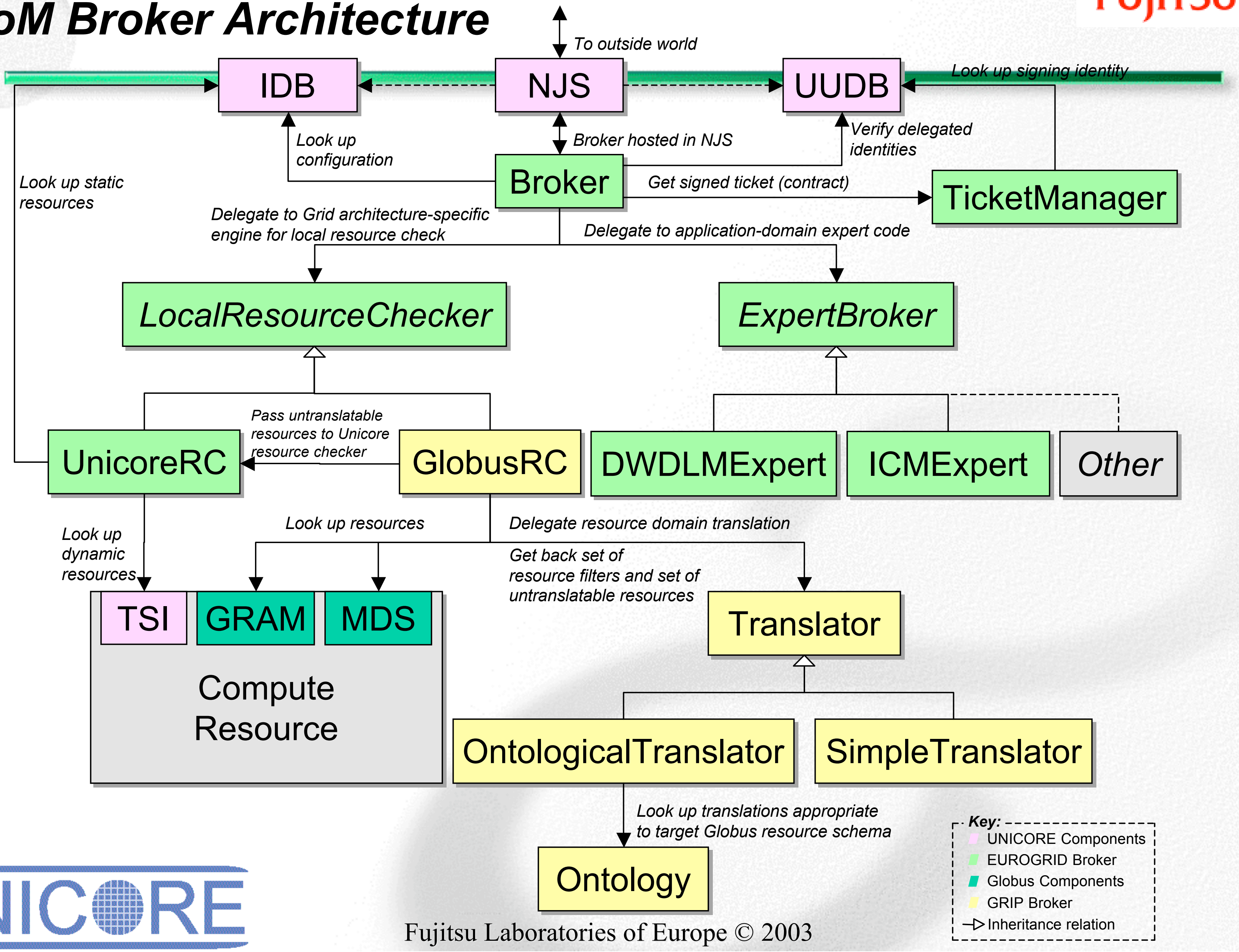
UUDB

- **Maps user certificate to local login**
  - Support for limited roles.
- **Support for multiple logins per user**
  - User name or project based selection
- **Simple VO support**
  - Multiple users to a single account
    - Selection on user, local account, or project
  - All users under a CA
- **Extensible**
  - External interface
  - Two example UUDB implementations available.
  - Can be integrated into existing user management

Resource Broker

- **Support for simple QoS bids**
  - Turnaround time and price
- **Ticket based**
  - Sites retain control of ticket validity.
  - Ticket checking at execution time
  - Advanced reservation possible (if site supported)
- **Planned for 2003**
  - Dynamic site selection support
  - Interoperable across Unicore and Globus resources

UoM Broker Architecture



To outside world

IDB

NJS

UUDB

Look up signing identity

Look up configuration

Broker hosted in NJS

Verify delegated identities

Look up static resources

Broker

Get signed ticket (contract)

TicketManager

Delegate to Grid architecture-specific engine for local resource check

Delegate to application-domain expert code

LocalResourceChecker

ExpertBroker

Pass untranslatable resources to Unicore resource checker

UnicoreRC

GlobusRC

DWDLMExpert

ICMExpert

Other

Look up dynamic resources

Look up resources

Delegate resource domain translation

Get back set of resource filters and set of untranslatable resources

TSI

GRAM

MDS

Compute Resource

Translator

OntologicalTranslator

SimpleTranslator

Look up translations appropriate to target Globus resource schema

Ontology

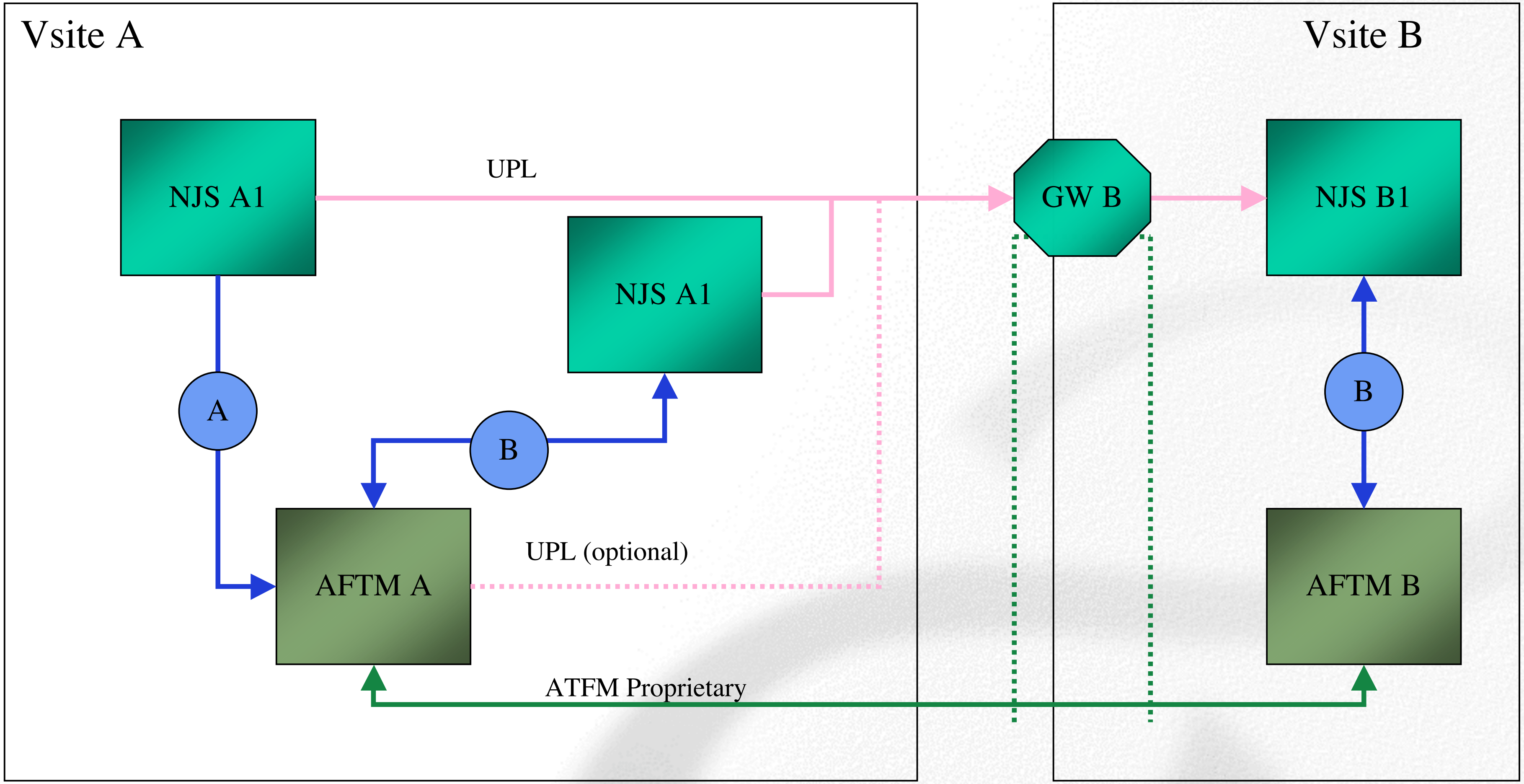
Key:

- 🟪 UNICORE Components
- 🟩 EUROGRID Broker
- 🟩 Globus Components
- 🟨 GRIP Broker
- —▷ Inheritance relation

Alternate File Transfer

- **Uses independent FTP mechanisms**
  - “rcp” or “scp” within an Intranet
  - GridFTP for sites with relaxed firewall rules
  - Point to point leased line support
- **Alternative FTP invisible to users**
- **Interface extendable to other mechanisms**
- **FTP Authentication Options**
  - Via Unicore Gateway
  - Completely independent

AFT Architecture



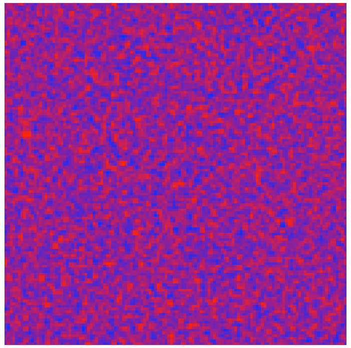
Key Technologies

FUJITSU

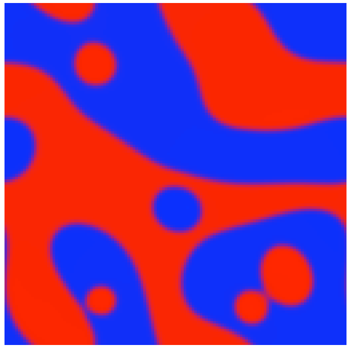
- **Seamless Computing Model**
  - Job abstraction
  - Incarnation
  - File staging, transfer, and streaming support
- **Security Model**
  - X509 certificate based security model
  - Consigner plus endorser model
  - Several CA policies used
  - Fully flexible firewall support
- **Generic Clients**
  - No changes to application needed
  - Client Tool Kit
  - Plugin Interface in GUI Client
- **Portable Server**
  - Java + Perl

UNICORE

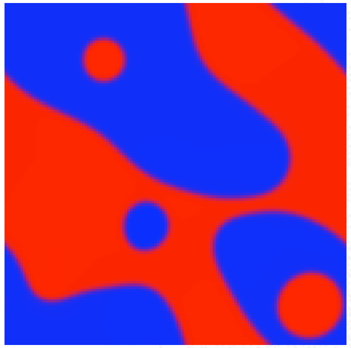
Application Steering Challenge



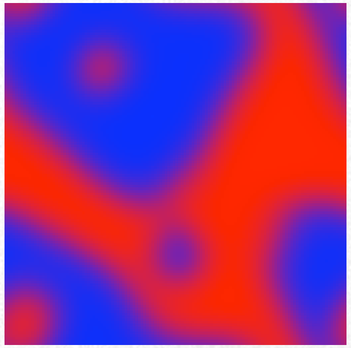
Initial State



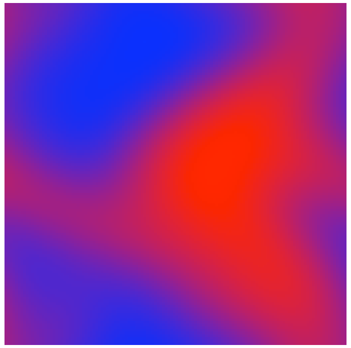
Gss = 2.0



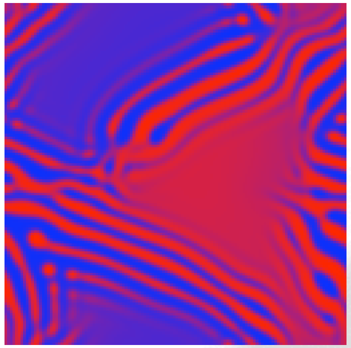
Gss = 2.0



Gss = 0.5



Gss = 0.5



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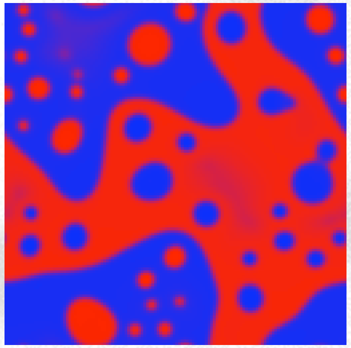
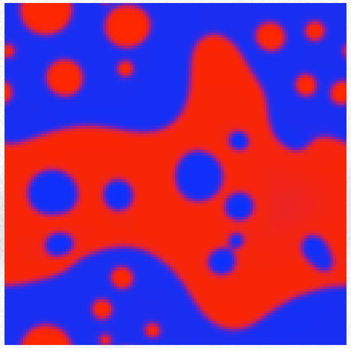


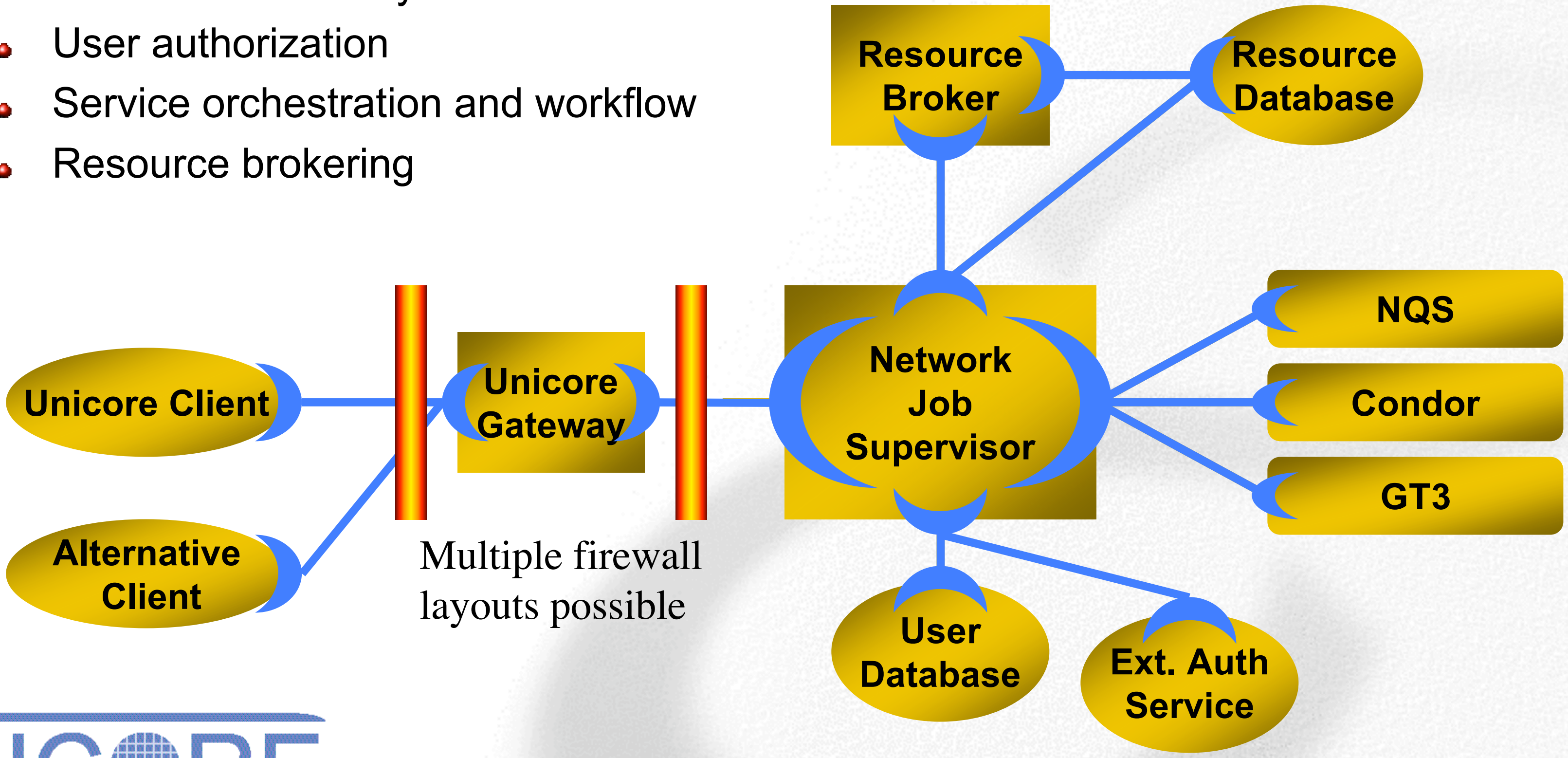
Gss = 1.8



Gss = 1.8

OGSA Roadmap

- OGSI Style Interfaces (Blue)
  - Evolve these to standards: “Push and Pull” in the GGF
- Key OGSA Services
  - Service creation and management
  - Resource discovery
  - User authorization
  - Service orchestration and workflow
  - Resource brokering


Resource Broker
Resource Database
NQS
Unicore Client
Unicore Gateway
Network Job Supervisor
Condor
GT3
Alternative Client
Multiple firewall layouts possible
User Database
Ext. Auth Service