UNICORE, EUROGRID and GRIP

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Outline

- UNICORE approach
- UNICORE architecture and implementation
- Projects
  - UNICORE Plus
  - EUROGRID
  - GRIP
- Availability and outlook

UNICORE Approach

- Provide a uniform work environment for users
  - access mechanism (browser, dedicated client, ...)
  - authentication mechanisms (certificates, ...)
  - hide system details (commands, data archives, batch systems, ...)
  - define user-level resource and job model (task graph, ...)
  - allow job monitoring and steering

- Lots of projects worldwide
  - SDSC Hotpage
  - AHPCRC TeraWeb
  - Mississippi State DMEFS
  - EnginFrame from NICE
  - ...

UNICORE Approach

- Intended UNICORE users
  - end-users in a specific domain
  - general HPC end-users
  - NOT application developers

- Intended usage modes
  - batch execution
  - interactive steering
  - NOT general purpose interactive

- Degree of "transparency"
  - access and monitoring part
  - uniform job model
  - uniform resource model
  - NOT YET a uniform data model
  - NOT YET automatic brokering amongst resources

UNICORE Approach

- System architecture
  - multiple entry points, one per resource
  - cooperation between resources
  - allow for distributed computing

- Security mechanisms
  - user authentication by X.509 certificates
  - authorization handled per site
  - data integrity and confidentiality by reliance on SSL/https

- Implementation technique
  - emphasize portability, rely on standards
  - use Java for client and server components
  - build protocols on top of SSL/https
  - some (limited) use of XML

UNICORE Approach

- System integration and deployment
  - fit into common firewall setups
  - integrate into existing system administration procedures
  - preserve site autonomy (authorization, quotas, billing, ...)

- Extensibility
  - provide GUIs for particular applications (plugin mechanism)
  - extend set of supported resources, incarnation rules
  - configure third-party file transfers
  - ...

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**UNICORE Resource Model**

- Usite
- Vsite
- Resources per Vsite
  - capacity
  - capability
- Resources are advertised to the client
  - pseudo-dynamic mode
- User submits jobs to Vsites
- Soon: automatic resource identification

**UNICORE Job Model**

- Directed acyclic graph of
  - tasks (computational or data transfer)
  - sub-jobs (to be executed at another Vsite)
  - temporal dependencies
- Attach resource requests to tasks
  - capacity (CPU time, disk, ...)
  - capability (MPI-2, profiling, ...)
  - can do static tests of jobs
  - can do resource brokering ...

**UNICORE Architecture**

- Client can run anywhere
- Gateway as single point of entry
- NJS incarnates and schedules jobs
- UDB (User Database) contains user login information
- IDB (Incarnation Database) contains resource information and job incarnation rules
- TSI (Target System Interface), interfaces to local batch system

**UNICORE Security Model**

- User authentication
  - Gateway requires user certificate to initiate SSL communication
  - pass (permanent) user certificate along with job description
  - can pass site-specific authentication information (e.g. SecurID passcode)
- User authorization
  - Vsite maps certificate to local userid
  - authorization based on local userid
- Job and request integrity
  - each DAG is signed with the private key
  - the Vsite executing a sub-job can check the sign
- Required trust
  - the user protects his/her private key
  - the CA is not compromised

**UNICORE Technology**

- Client and server components implemented in Java–2
- Authentication using X.509 certificates
  - UNICORE Plus project uses own public key infrastructure (PKI)
  - software can work with any other PKI
- Coexistence with firewalls
  - gateway as single point of entry
  - can run outside firewall, in DMZ or inside firewall
  - user authentication at that point: rogue users can’t go further
- Secure data transmission using SSL
  - additional data encryption considered in EUROGRID
- Modeling of computational jobs and resources as Java objects (AJO)
Application Frontends

- Create GUIs that support important applications
  - UNICORE client has a plugin interface
  - GUI simplifies data entry for application
  - GUI can support application-specific resources
  - GUI constructs (complicated) job chains automatically

- GUI will use UNICORE client to
  - submit the application job
  - monitor and control the application job

- Helpful features
  - end-users concentrate on applications
  - extended consistency checks

- Existing frontends
  - CPMD molecular dynamics code
  - Fluent, Gaussian, ...

Projects Around UNICORE

### UNICORE = GRID system for seamless access to (High Performance) Computing Systems

<table>
<thead>
<tr>
<th>Project</th>
<th>Goals</th>
<th>Duration</th>
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<tr>
<td>UNICORE Plus</td>
<td>Product, Deployment at HPC Centers</td>
<td>01/2003-12/2002</td>
<td>German gov. (BMBF)</td>
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<tr>
<td>EUROGRID</td>
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<td>GRIP</td>
<td>Interoperability UNICORE and GLOBUS</td>
<td>01/2002 – 12/2003</td>
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<td>Various new projects</td>
<td>Applications, tools, deployment, ...</td>
<td>≥ 2002</td>
<td>EU FP5</td>
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</table>

UNICORE Plus Project

- German national R&D project
- First production version (3.0) available since end of 2000
- Current phase: deployment and end-user evaluation

- Involvement of major German HPC centers
  - FZ Jülich
  - LRZ München
  - ZIB Berlin
  - Paderborn
  - HLRS Stuttgart
  - RZ Karlsruhe
  - DWD

- Involvement of vendors
  - Cray/SGI
  - Hitachi
  - IBM
  - NEC
  - Sun

- Involvement of ISVs
  - Pallas (FECIT)

EUROGRID – UNICORE in Europe

- Started as IST project end of 2000
- Based on UNICORE software release 3.0
- Domain-specific extensions
  - biology, meteorology, CAE
  - General-purpose extensions
    - data transfer, resource brokering, ASP, interactive use
  - Current phase: deployment, requirements analysis

- Involvement of European HPC centers
  - FZ Jülich
  - LRZ München
  - DWD
  - University of Manchester
  - Parallax
  - CSCS
  - ICM Warsaw

- Involvement of industry
  - EADS CCR
  - Pallas
  - debis Systemhaus
  - FECIT
EUROGRID Partners

HPC Centers
- CSCS Manno (CH)
- FZ Jülich (D)
- ICM Warsaw (PL)
- IDRIS Paris (F)
- Univ Bergen (N)
- Univ Manchester (UK)

Users
- Deutscher Wetterdienst
- EADS
- debis Systemhaus (Assistant Partner)

Integration
- Pallas (Project Coordinator)
- Fecit (Assistant Partner)

Volume: 33 person years, 2 MEuro funding by European Commission Grant No. IST–1999–20247

Bio–GRID

- PSE for bio–molecular applications
- Operate a GRID for bio–molecular simulations
- Develop interfaces to existing biological and chemical codes

Meteo–GRID

- Develop a relocatable version of DWD’s local weather prediction model
- ASP solution for on demand localized weather prediction

CAE–GRID

- Coupled simulations of aircrafts (e.g. structure and electromagnetism)
- Goal: internal HPC portal for EADS engineers

CAE–GRID

- Provide HPC portal to engineers at Daimler–Chrysler and partners
- Develop GRID technology for computing cost estimates and billing
EUROGRID Interactive Access

- Demonstrate a European HPC GRID testbed
- Develop new GRID applications
- Enable sharing of competence and know-how
- Agree on security standards, certification, access policies, ...

EUROGRID Resource Broker

- Based on UNICORE system
- Develop additional GRID components
  - efficient data transfer
  - ASP infrastructure
  - resource broker
  - application coupling
  - interactive access
- Integration of new components by Pallas and Fecit

EUROGRID Application Coupling

- Started as IST project beginning of 2002
- To produce interoperability software for
  - using Globus resources from UNICORE
  - submitting UNICORE jobs from Globus
- To enhance the EUROGRID resource broker to span
  UNICORE and Globus
- To evaluate the interoperability with
  - biomolecular applications from ICM
  - on-demand weather prediction from DWD
- Current phase:
  - requirements analysis
  - architecture specification
- Argonne National Labs is participating!
GRIP Partners

- HPC Centers
  - FZ Jülich (D)
  - ICM Warsaw (PL)
  - Univ. Manchester (UK)
  - Univ. Southampton

- Users
  - Deutscher Wetterdienst

- Integration
  - Pallas (Project Coordinator)
  - Argonne National Labs

Volume: 18 person years, 1.2 M€ Euro funding by European Commission Grant No. IST–2001–32257

UNICORE vs. Globus 2.x

- Comparison of UNICORE and Globus
  - UNICORE lacks interface application
  - UNICORE lacks MDS
  - UNICORE has workflow model & interface
  - UNICORE has stricter security model

- Security
  - UNICORE uses consigner/endorser model
  - Globus jobs are not signed, use temporary certificates
  - Stealing a Globus cert seems easy, no limit to damage

- Data Transfer
  - Globus relies on GridFTP (although users can use any mechanism from within job)

- Resource modelling/handling
  - Globus uses Grid Information Services (GIS) to learn about available resources
  - Globus user Resource Specification Language (RSL) to request resources
  - UNICORE uses GetResources request and Java objects

UNICORE ⇒ Globus 2.x Architecture

- Generate Globus proxy certificate from client
- IDB maker generates incarnation databases semi-dynamically
- Globus resources become visible through the IDB maker
- Have Globus TSI control the job execution within Globus
- Map UNICORE job control commands to Globus conventions

GRIP and OGSA

- Clearly, Globus 2.x interoperability is of limited value and interest
- Introduce OGSA compatibility
  - model the UNICORE Client ↔ Gateway protocols in WSDL
  - model internal interfaces (Gateway, NJS, TSI)
- Integrate the resource broker into OGSA

Availability and Outlook

- Current version: UNICORE 3.6
  - missing functionality: control tasks (If, Repeat, …)
  - available for project partners and on request
  - starting May 2002: access to full sources

- Upcoming production version: UNICORE 4.0
  - supports control tasks
  - many improvements to the user interface
  - release in July/August timeframe
  - partners and source repository will be updated

- Results from EUROGRID and GRIP to be made available in a similar manner …
Open Issues

- Running a PKI in the real world
  - provide reasonable level of security
  - don’t offend users …

- Cope with security people
  - source IP-filtering makes access from anywhere impossible …
  - work with stricter rules for outgoing IP

- Obnoxious authentication systems
  - SecurID and skey will require pass codes for trivial operations …

- Get more user input
  - users of classic HPC centers
  - industrial users (ASP-like model)

Further Information

- Leaflets (on a desk in the lobby)

- WWW pages
  - http://www.fz-juelich.de/unicore
  - http://www.unicore.org
  - http://www.eurogrid.org
  - http://www.grid-interoperability.org

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