

UNICORE, EUROGRID and GRIP

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Outline

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

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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
 - AHPARC TeraWeb
 - Mississippi State DMEFS
 - EnginFrame from NICE
 - ...

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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

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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

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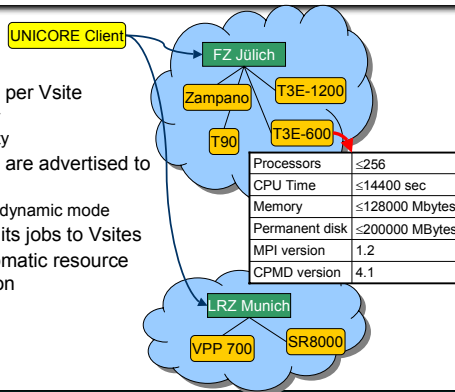
UNICORE Approach

- 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

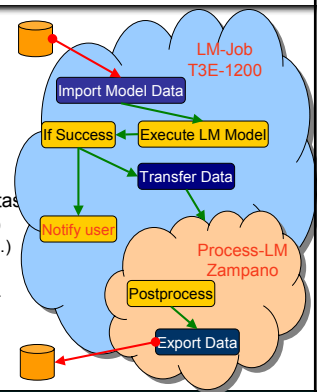
- Usite
- Vsite
- Resources per Vsite
 - capacity
 - capability
- Resources are advertised to the client
 - pseudo-dynamic mode
- User submits jobs to Vsites
- Soon: automatic resource identification



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UNICORE Job Model

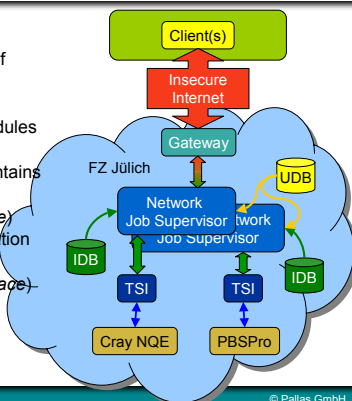
- Directed acyclic graph of
 - tasks (computational or data transfer)
 - sub-jobs (to be executed at another Vsite)
 - temporal dependencies
- Attach *resource requests* to tasks
 - capacity (CPU time, disk, ...)
 - capability (MPI-2, profiling, ...)
 - can do static tests of jobs
 - can do resource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



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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



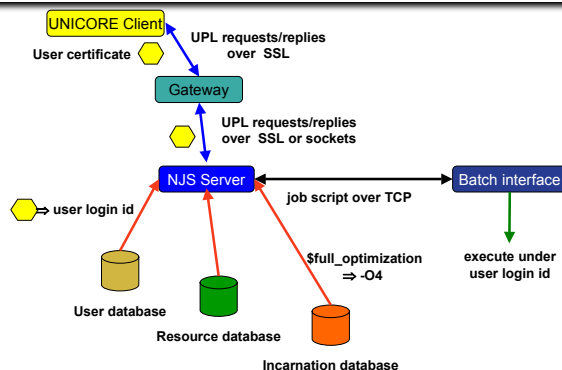
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UNICORE Security Model

- 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

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UNICORE – Job Submission and Execution



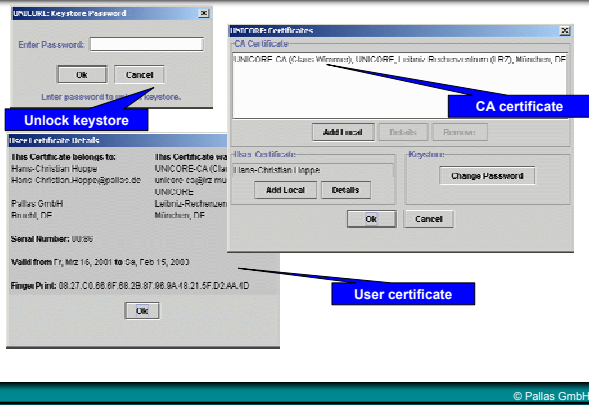
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UNICORE Technology

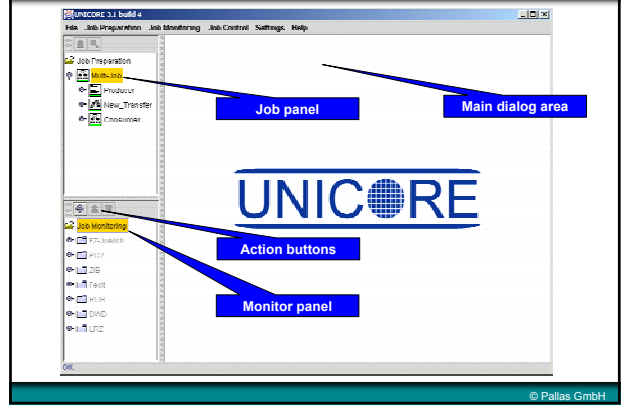
- Client and server components implemented in Java-2
- Authentication using X.509 certificates
 - UNICORE Plus project uses own public key infrastructure (PKI)
 - software can work with any other PKI
- Coexistence with firewalls
 - gateway as single point of entry
 - can run outside firewall, in DMZ 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)

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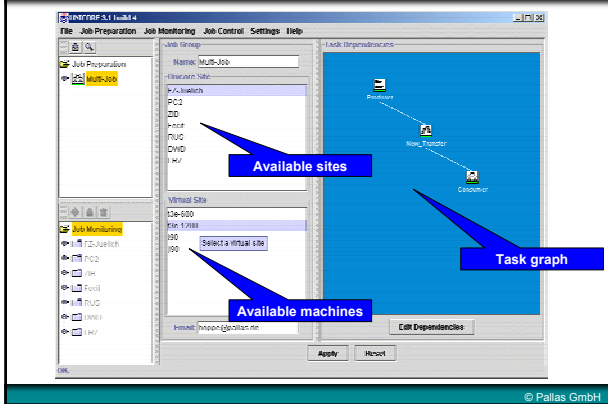
UNICORE GUI – Authentication



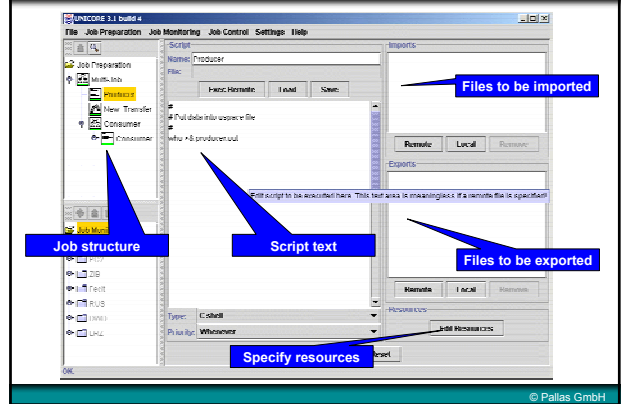
UNICORE GUI – Main Screen



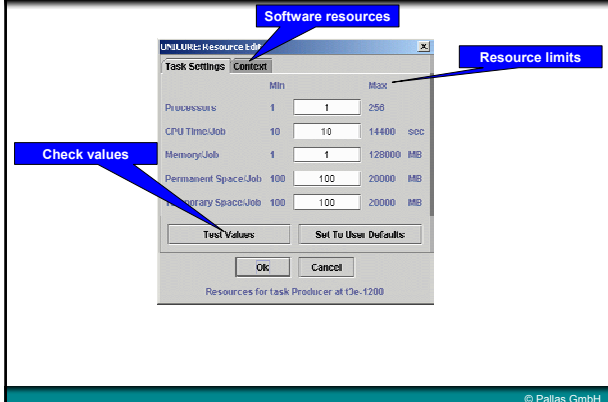
UNICORE GUI – Job Construction



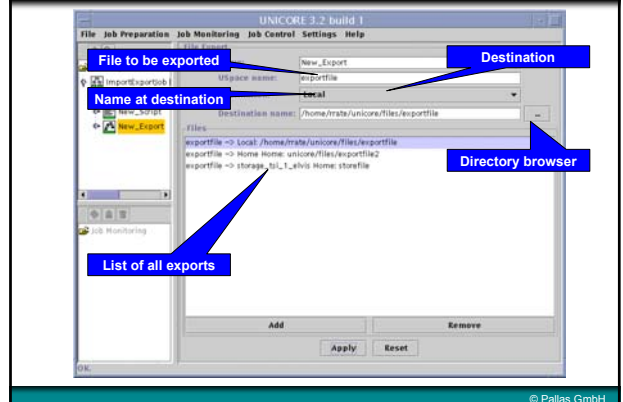
UNICORE GUI – Task Definition



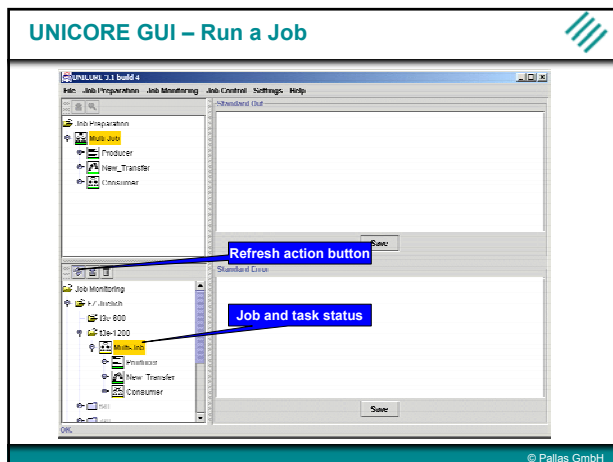
UNICORE GUI – Specify Resources



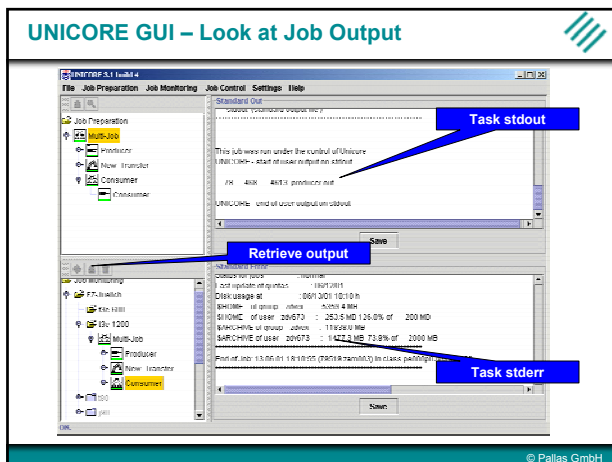
UNICORE GUI – Export Files



UNICORE GUI – Run a Job



UNICORE GUI – Look at Job Output



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, ...

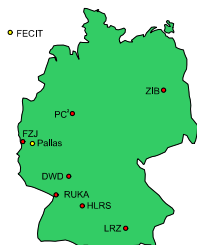
Projects Around UNICORE

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

Project	Goals	Duration	Funded by
UNICORE Plus	Product, Deployment at HPC Centers	01/2000-12/2002	German govt. (BMBF)
EUROGRID	European HPC centers, scientific applications, industrial involvement	11/2000 – 10/2003	EU FP5
GRIP	Interoperability UNICORE and GLOBUS	01/2002 – 12/2003	EU FP5
Various new projects	Applications, tools, deployment, ...	≥ 2002	EU FP6

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
 - PC² Paderborn
 - HLRS Stuttgart
 - RZ Karlsruhe
 - DWD
- Involvement of vendors
 - Cray/SGI
 - Hitachi
 - IBM
 - Siemens
 - Fujitsu
 - HP
 - 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
 - DWD
 - Parallab
 - CSCS
 - CNRS-IDRIS
 - University of Manchester
 - 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

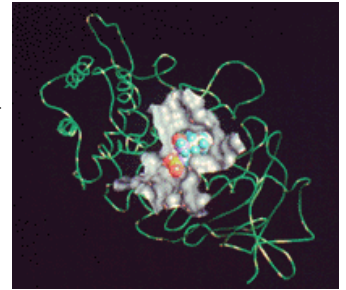
- Pallas (Project Coordinator)
- Fecit (Assistant Partner)

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

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Bio-GRID

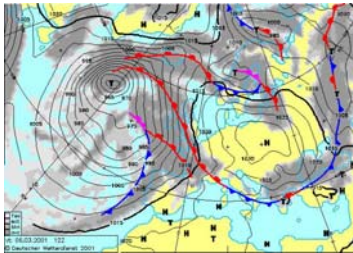
- PSE for bio-molecular applications
- Operate a GRID for bio-molecular simulations
- Develop interfaces to existing biological and chemical codes



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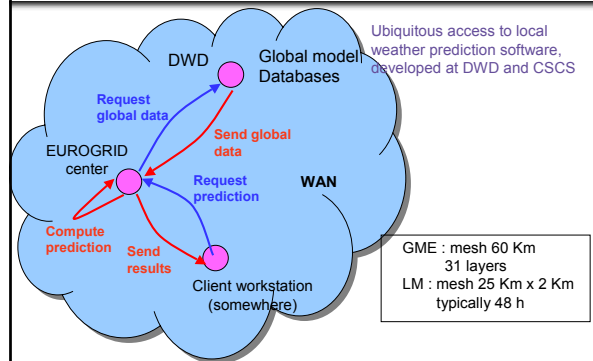
Meteo-GRID

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



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Meteo-Grid



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CAE-GRID

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



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CAE-GRID

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



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HPC-GRID



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



CRAY T3E 900 (32 PE)
NEC SX4B/2A
Linux Cluster (4 PE)



SGI O2000 (128 PE)

FZJ



Linux Intel Cluster (36 PE)
CRAY T3E - 600 (512 PE)
CRAY T3E - 1200 (512 PE)



CRAY T3E - 1200 (816 PE)
FUJITSU VPP300 (8 PE)
SGI O2000 (128 PE)
SGI O3000 (256 PE)

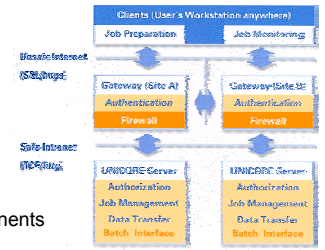
IBM SP3 (8 PE)
NEC SX5 cluster (40 PE)
IBM Power4 (256 PE, 1.3 TFLOPS)
COMPAQ Linux Cluster (24 PE)

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EUROGRID Technology



- 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

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EUROGRID Resource Broker



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EUROGRID Application Coupling



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EUROGRID Interactive Access



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GRIP - Compatibility to Globus



- 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!

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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 MEuro funding
by European Commission Grant No. IST-2001- 32257

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UNICORE vs. Globus 2.x

- Comparison of UNICORE and Globus
 - UNICORE lacks application interface
 - 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 the 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

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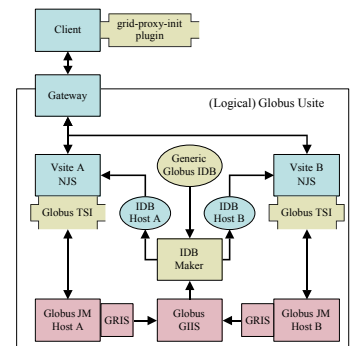
UNICORE vs. Globus 2.x

- 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
- Metacomputer directory service
 - Based on LDAP
 - Supplies static *and* dynamic information
 - UNICORE has no access to dynamic information!

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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



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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?)
 - produce an OGSA-compliant version of UNICORE
- Integrate the resource broker into OGSA

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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 ...

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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 key 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>

UNICORE Plus project
UNICORE Forum
EUROGRID project
GRIP project