A European Grid Technology

http://www.unicore.eu

Shiraz Memon
Forschungszentrum Jülich GmbH
History Lesson

- **UNiform Interface to COmputing Resources**
  - seamless, secure, and intuitive

- Initial development started in two German projects funded by the German ministry of education and research (BMBF)
  - 08/1997 – 12/1999: UNICORE project
    - Results: well defined security architecture with X.509 certificates, intuitive GUI, central job supervisor based on Codine from Genias
    - Results: implementation enhancements (e.g. replacement of Codine by custom NJS), extended job control (workflows), application specific interfaces (plugins)

- Continuous development since 2002 in several EU projects
- Open Source community development since Summer 2004

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More than a decade of German and European research & development and infrastructure projects

Any many others, e.g.

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UNICORE – Grid driving HPC

- Used in
  - DEISA (European Distributed Supercomputing Infrastructure)
  - National German Supercomputing Center NIC
  - Gauss Center for Supercomputing (Alliance of the three German HPC centers)
  - PRACE (European PetaFlop HPC Infrastructure) – starting-up
  - But also in non-HPC-focused infrastructures (i.e. D-Grid)

- Taking up major requirements from i.e.
  - HPC users
  - HPC user support teams
  - HPC operations teams

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Open source (BSD license)
  - Open developer community on SourceForge
  - Contribution with your own developments easily possible

Guiding principles and implementation strategies
  - Standards-based: OGSA-conform, WS-RF 1.2 compliant
  - Open, extensible, interoperable
  - End-to-End, seamless, secure and intuitive
  - Security: X.509, proxy and VO support
  - Workflow and application support tightly integrated
  - Variety of clients: graphical, command-line, portal, etc.
  - Quick and simple installation and configuration
  - Support for many operating and batch systems
  - Implemented in Java for platform-independence

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UNICORE 6 Architecture

Portal client, e.g. GridSphere
command-line client
Eclipse-based client
Programming API

Gateway

UNICORE Atomic Services
OGSA

Gateway

UNICORE Atomic Services
OGSA

Target System Interface
Local RMS (e.g. Torque, LL, LSF, etc.)

Target System Interface
Local RMS (e.g. Torque, LL, LSF, etc.)

scientific clients and applications
authentication
emerging standard interfaces
Grid services hosting
job incarnation & authorization
parallel scientific jobs of multiple end-users on target systems

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Standards in **UNICORE 6**

- **Security**
  - Full **X.509** certificates as base line, **XACML** based access control
  - Support for **SAML**-based VOMS & **X.509** proxies
- **Information system, monitoring, accounting**
  - **GLUE 2.0** information service in development
  - **OGSA-RUS** for accounting in development (incl. **UR** for storing)
- **Job management**
  - **OGSA-BES, HPC-P**: creation, monitoring and control of jobs
  - job definition compliant with **JSDL** (+ **JSDL HPC ext.**)
  - **DRMAA** communication to local resource manager for job scheduling
- **Data management**
  - Fully **OGSA-ByteIO** compliant for site-to-site transfers
  - Web-Services (**WS-RF 1.2, SOAP, WS-I**) stack!

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UNICORE 6 Architecture: Focus on Workflow

- **Portal client**, e.g. GridSphere
- **command-line client**
- **Eclipse-based client**

**Gateway**

- **UNICORE Workflow Engine**
- **UNICORE Tracing Service**
- **UNICORE Service Orchestrator**
- **Resource Information Service**

**UNICORE Atomic Services**
- **OGSA-**
- **XNJS + TSI**

**UNICORE hosting env.**

**service and applications**
- **authentication**
- **workflow execution**
- **brokering and job management**
- **job execution and data storage**
- **parallel scientific jobs of multiple end-users on target systems**

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UNICORE 6 Workflow

- Two layer architecture for scalability
- Workflow engine
  - Based on Shark open-source XPDL engine
  - Pluggable, domain-specific workflow languages
- Service orchestrator
  - Brokering based on pluggable strategies
  - Job execution and monitoring
  - Callback to workflow engine
- Clients
  - GUI client based on Eclipse
  - Commandline submission of workflows is also possible
- 6.1 release includes first release of the workflow engine

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<table>
<thead>
<tr>
<th>Version</th>
<th>Release Date</th>
<th>Changes</th>
</tr>
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<tbody>
<tr>
<td>6.0</td>
<td>August 10, 2007</td>
<td>- Web services/WS-RF core, basic services (registry, jobs, files)</td>
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<tr>
<td></td>
<td></td>
<td>- XNJS job execution management engine</td>
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<tr>
<td></td>
<td></td>
<td>- Graphical GPE Application client, command-line client, scripting tools</td>
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<tr>
<td></td>
<td></td>
<td>- Flexible security framework using X.509, SAML, XACML</td>
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<tr>
<td></td>
<td></td>
<td>- Standards: WS-RF 1.2, JSDL 1.0, OGSA ByteIO</td>
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<tr>
<td>6.0.1</td>
<td>December 23, 2007</td>
<td>- Fast https-based file transfer, bug fixes</td>
</tr>
<tr>
<td>6.1</td>
<td>March 20, 2008</td>
<td>- Interoperability components, basic workflow support</td>
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<tr>
<td>6.1.1</td>
<td>June 18, 2008</td>
<td>- Enhanced workflow support, rich client based on Eclipse</td>
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<tr>
<td>6.1.2</td>
<td>August 4, 2008</td>
<td>- Various enhancements and improvements in all areas</td>
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<td>6.1.3</td>
<td>October 23, 2008</td>
<td>- Java 6 support for servers, improvements of UCC</td>
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<tr>
<td>6.2.0</td>
<td>March 09, 2009</td>
<td>- Improved logging, application metadata support, shell based UCC</td>
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</table>
Using **UNICORE 6**

- GPE Application Client
- Rich Client for Workflows (based on Eclipse)
- UCC command-line client
- Programming API

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Rich Client based on Eclipse

http://www.unicore.eu
UCC – Commandline Client

http://www.unicore.eu
Accessing UCC through emacs

---

execute

---

83x199

Accessing UCC through emacs

---

execute

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HiLA – High Level API for Grid Applications

- Simple development of clients
  - Few lines for otherwise complex functionality
- Single interface, multiple implementations
  - UNICORE 5 & 6, OGSA-BES
- URI Scheme naming resources of the Grid
  - uncore6:/sites/FZJ_JUGGLE/storages/home
  - ogsa:/sites/GROW/tasks/910c9b56-d497-46f8-960f-eaee43e1af37
  - Object navigation based on ‘container/item’ model
- Security, sites, registries, etc. via configuration

Location l = new Location("uncore6:/sites/GROW/tasks/910c9b56-d97-46af37");
Task t = HiLAFactory.getInstance().locate(l);
assertTrue(TaskStatus.RUNNING, t.status());
List<File> fl = t.getOutcomeFiles();

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CIS: A UNICORE Common Information Service

- Information Service for UNICORE based Grids
- Aggregate information from multiple UNICORE Sites
- OGSA GLUE 2 compliant
- Implemented on WSRF- Lite, Spring and Native XML Databases
- Authorised access via XACML and XUUDB
- XPath & XQuery
- Clients: Google Maps and UCC
- Publish records as ATOM feeds
Seamless installation of server components

tar.gz based installer is also available

http://www.unicore.eu
... and even runs under Windows XP

http://www.unicore.eu
UNICORE in use
some examples

http://www.unicore.eu
Core D-Grid sites committing parts of their existing resources to D-Grid:
- Approx. 700 CPUs
- Approx. 1 PByte of storage
- UNICORE is installed and used

Additional Sites received extra money from the BMBF for buying compute clusters and data storage:
- Approx. 2000 CPUs
- Approx. 2 PByte of storage
- UNICORE (as well as Globus and gLite) is installed as soon as systems are in place
- **Workflow Engine for Grid Service Orchestration**
  - Executes workflows that orchestrate Web as well as WSRF Grid Services
  - Provides workflows as WSRF Grid Services
  - Supports Grid and IS Security (RBAC, Certificates, Access Policies)
  - Provides simple monitoring functions

- Realized as UNICORE 6 Services
- Uses WS-BPEL and an arbitrary WS-BPEL engine for orchestration
- **WS-BPEL Engine is exchangeable**
- **No proprietary WS-BPEL**
  - language extensions or modifications
  - engine extensions or modifications
- **Open Source**
- **More Information and outcomes on** [www.bisgrid.de](http://www.bisgrid.de)

**Slide courtesy of André Höing (TU Berlin)**
Distributed European Infrastructure for Supercomputing Applications

- Consortium of leading national HPC centers in Europe
- Deploy and operate a persistent, production quality, distributed, heterogeneous HPC environment
- UNICORE as Grid Middleware
  - On top of DEISA’s core services:
    - Dedicated network
    - Shared file system
    - Common production environment at all sites
  - Used e.g. for workflow applications

www.deisa.eu

http://www.unicore.eu

IDRIS – CNRS (Paris, France), FZJ (Jülich, Germany), RZG (Garching, Germany), CINECA (Bologna, Italy), EPCC (Edinburgh, UK), CSC (Helsinki, Finland), SARA (Amsterdam, NL), HLRS (Stuttgart, Germany), BSC (Barcelona, Spain), LRZ (Munich, Germany), ECMWF (Reading, UK)
Interoperability and Usability of Grid Infrastructures

- Focus on providing common interfaces and integration of major Grid software infrastructures
  - OGSA-DAI, VOMS, GridSphere, OGSA-BES, OGSA-RUS
  - UNICORE, gLite, Globus Toolkit, CROWN

- Apply interoperability components in application use-cases

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Grid Services based Environment to enable Innovative Research

- Provide an integrated Grid solution for workflow-centric, complex applications with a focus on data, semantics and knowledge
  - Provide decision support services for risk assessment, toxicity prediction, and drug design
  - End user focus
    - ease of use
    - domain specific tools
    - “hidden Grid”
  - Based on UNICORE 6

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Data Management System

- Handle large volumes of data
- Annotate data with **extensible** metadata (workflow, applications, …)
- Automatic extraction of additional metadata from files (e.g. chemical structures used, image thumbnails)
- Transparent access to external data sources (e.g. chemical databases)
- Comfortable client API and GUI client

http://www.chemomentum.org

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Phosphorus – Research Networking Test-bed

- Demonstrate on demand service delivery across multi-domain/multi-vendor research network test-beds
- Integration between application, middleware and transport networks (here: KoDaVIS + UNICORE 6)

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Usage in the National German HPC center NIC

- About 450 users in 200 research projects
  - ¼ of them uses UNICORE
- Access via UNICORE to
  - IBM p690 eSeries Cluster (1312 CPUs, 8.9 TFlops)
  - JUGENE (65536 CPUs, 223 TFlops)
  - SoftComp Cluster (264 CPUs, 1 TFlops)
  - JUGGLE (176 cores, 845 GFLops)

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Embedding in Industrial and Research Environments: Access to C²A²S²E-HPC

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UNICORE

join the developer community, software, source code, documentation, tutorials, mailing lists, community links, and more:

http://www.unicore.eu