Grid Infrastructures and Standards

Example: D-Grid

Wolfgang Gentzsch
Motivation: Towards a Global Society

Old World
Static
Silo
Physical
Manual
Application

New World
Dynamic
Shared
Virtual
Automated
Service

From Silo Oriented Architectures to Service Oriented Architectures

Courtesy Mark Linesch, OGF
A Grid Computing Timeline

- Globus, Legion, Unicore start
- CEC FP5 starts in 1998
- US, European, AP Grid Forums
- Grid Forums merge, form GGF
- CEC FP6 starts in 2002
- EDG, CrossGrid, etc start
- EGEE, DEISA start
- OGSA v1.0

Today:
- Grid solutions are common for HPC
- Grid-based business solutions are becoming common
- Technologies & standards are evolving

Source: OGF, modified
Three Generations of Grid

1. Local “metacomputers“
   - Distributed file systems
   - Site-wide single sign-on
2. "Metacenters" explore inter-organizational integration
3. Totally custom-made, top-to-bottom: proofs-of-concept

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Utilize software services and communications protocols developed by grid projects:
   - Condor, Globus, UNICORE, Legion, g-Lite, etc.

Need significant customization to deliver complete solution
Interoperability is still very difficult!

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- Common interface specifications support interoperability of discrete, independently developed services
- Competition and interoperability among applications, toolkits, and implementations of key services

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Standardization is key for third-generation grids!

Source: Charlie Catlett
Many Grid Projects:

- Grid5000
- iVD gl
- K*GRID
- ACCESS GRID
- NG SINGAPORE
- Grid3 2003
- DataTAG
- NEESgrid
- CERN
- Grid5000
- Grid Consortium Japan
- GridLab
- Egee
- Grid.Ireland
- NAREGI
- NII - The National Institute of Informatics
- Grid Applications
- Grid Middleware
- Networking
- INFN GRID
- DataGRID
- UNICORE
- D-GRID
- Open Science Grid
e-Infrastructures are complex!

1. Resources: **Networks** with computing and data nodes
2. Development/support of standard **middleware** & grid svcs
3. Internationally agreed **AAA** infrastructure
4. **Discovery services** and collaborative tools
5. **Data** provenance, curation and preservation
6. Open **access** to data and publications via interoperable **repositories**
7. Remote access to **large-scale facilities**: Telescopes, LHC, ITER, ..
8. Application- and community-specific **portals** and workflows
9. **Industrial** collaboration
10. **Service Centers**: maintenance, support, training, utility, apps

**Standards, Standards, Standards!!!**
Analysing Basic Grid Services

1. secure environment
2. discover resource
3. submit job
4. transfer data
Analysing Basic Grid Services

UNICORE

1. secure environment
2. discover resource
3. submit job
4. transfer data

Globus

1. secure environment
2. discover resource
3. submit job
4. transfer data

Data transfer

gLite

1. secure environment
2. discover resource
3. submit job
4. transfer data
Standards Bodies

- **GGF** (Global Grid Forum, 2000) => **OGF**
  - Grid Architecture: OGSA, CDDLM, WS-Agreement, …
- **ETSI** (European Telecom. Standards Institute, 1988)
  - Standardization of ICT in Europe
  - 2006: ICT GRID Interoperability Testing Framework
  - ETSI series of GRID Plugtests
- **OASIS** (Organization for the Advancement of Structured Information Standards, 1993)
  - Middleware/Web services focused
  - WSRF, WS-Notification, WSDM, WS-Security…
- **DMTF** (Distributed Management Task Force, 1992)
  - Management and Information models (CIM)
  - Server management
  - WS-CIM
- **W3C** (WWW Consortium, 1994)
  - WS-Addressing
- And IETF, Liberty Alliance, WS-I, EGA

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Source: OGF, modified
Case Study: D-Grid e-Infrastructure *)

Building a National e-Infrastructure for Research and Industry

- **01/2003**: Pre-D-Grid Working Groups ➔ Recommendation to Government
- **09/2005**: D-Grid-1: early adopters, ‘Services for Science’
- **07/2007**: D-Grid-2: new communities, ‘Service Grids’
- **…/2008 ?**: D-Grid-3: Service Grids for research and industry

- **D-Grid-1**: 25 MEuro > 100 Orgs > 200 researchers
- **D-Grid-2**: 40 MEuro > 100 addl Orgs > 200 addl researchers and industry

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**Important:**
- Sustainable production grid infrastructure after the end of the funding
- Integration of new communities
- Evaluating business models (operational models) for grid services

*) funded by the German Federal Ministry for Science and Education
D-Grid -1, -2, -3
2005 - 2011

User-friendly Access Layer, Portals

Business Services, SLAs, SOA Integration, Virtualization

Knowledge Management

Generic Grid Middleware and Grid Services

Integration Project DGI-2
D-Grid: 3 Grid Middlewares!

- gLite
- Globus
- Unicore
Standards in Globus

- **Security and client-service communication**
  - X.509, XML, WSDL, SOAP, SSL/TLS, HTTP
  - WS-RF, WS-Addressing, WS-Notification, WS-Security
  - Under adoption: SAML

- **Information System, Monitoring & Accounting**
  - XML, XML-schema, GLUE Schema

- **Job Management**
  - DRMAA; under adoption: BES, JSDL

- **Data Management**
  - GridFTP, DAIS

Courtesy Gabriel Mateescu
UNICORE 6 Architecture

Portal client
e.g. GridSphere

command-line client

Eclipse-based client

GPE application client

X.509

Gateway

UNICORE Atomic Services

OGSA

UNICORE Atomic Services

OGSA

XACML

XACML

X.509

Service Registry

UNICORE WS-RF hosting environment

UNICORE WS-RF hosting environment

ByteIO

JSDL

BES

HPC-P

RUS

UR

Gateway

ByteIO

JSDL

BES

HPC-P

RUS

UR

Target System Interface

Target System Interface

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

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

SAML

SAML

SAML

SAML

Courtesy Achim Streit

scientific clients and applications

authentication

emerging standard interfaces

Grid services hosting

job incarnation & authorization

parallel scientific jobs of multiple end-users on target systems

http://www.unicore.eu
Standards in **UNICORE 6**

- **Security**
  - Full X.509 certificates as base line, **XACML** based access control
  - Support for **SAML**-based VOMS & X.509 proxies in development

- **Information system, monitoring, accounting**
  - **GLUE 2.0** information service in development (strong interaction with the GLUE WG)
  - **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 !
gLite Grid Middleware Services

Access
- CLI
- API

Security
- Authorization
- Authentication
- Auditing

Data Management
- Metadata Catalog
- File & Replica Catalog
- Storage Element
- Data Movement

Information & Monitoring
- Information & Monitoring
- Application Monitoring

Workload Management
- Job Provenance
- Package Manager
- Workload Management

WS-I, X.509+VOMS-AC, SAML XACML
WS-I, SRM v2.2, GridFTP, DAIIR
UR, RUS
SAGA, GLUE v2.0
RGMA, GLUE v1.3
WS-I, BES, JSDL

Courtesy Claudio Grandi
Standards in gLite

- **Security**
  - Use X.509 certificates and VOMS Attribute Certificates
  - In future SAML and XACML for attribute and policy management

- **Information system, monitoring and accounting**
  - GLUE schema (1.3 now, 2.0 in future) accessed through LDAP
    - In future use a SAGA compliant interface for access
  - UR for description of accounting usage records
    - In future will adopt the RUS interface

- **Job Management**
  - Adopt BES interface in CREAM (in OMII-Europe)
    - but currently not descriptive enough
  - JSDL (with extensions) used to describe jobs

- **Data Management**
  - SRM 2.2 interface for data access and GridFTP for file transfers

- **Use a Web Service Interface wherever possible**
  - When performance allows it
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=> Standards-based Interoperability in OMII-Europe
Our Goal: Sustainability of e-Infrastructures

e-IRG Workshop in April ’07:

- **Theme 1:** Towards a European Grid Infrastructure.
  Lessons, recommendations: EGI, OMII-UK, HET, CEC, DEISA, Tony Hey

- **Theme 2:** Sustainability for e-Infrastructures.
  Sharing policies, resource provisioning, Grid economy, business models, national Grid services, e-social science, large-scale research infrastructures

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**Standards are the key towards achieving these goals !**
Last but not least: Standards are a prerequisite for an International Grid Community
Last but not least: Standards enable D-Grid to become part of the International Grid Community.
Thank You!

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