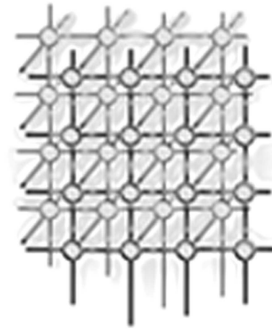


# Interoperation of World-Wide Production e-Science Infrastructures



M. Riedel<sup>\*,†</sup>, E. Laure, Th. Soddemann, L. Field, J. Casey, M. Litmaath, J.Ph.Baud, B. Koblitiz, C. Catlett, D. Skow, JP Navarro, C. Zheng, P.M. Papadopoulos, M. Katz, N. Sharma, O. Smirnova, B. Kónya, P. Arzberger, F. Würthwein, A.S. Rana, T. Martin, M. Wan, V. Welch, T. Rimovsky, S. Newhouse, A. Vanni, Y. Tanaka, Y. Tanimura, T. Ikegami, D. Abramson, C. Enticott, G. Jenkins, R. Pordes, N. Sharma, S. Timm, N. Sharma, G. Moont, M. Aggarwal, D. Colling, O. van der Aa, A. Sim, V. Natarajan, A. Shoshani, J. Gu, S. Chen, G. Galang, R. Zappi, L. Magnoni, V. Ciaschini, M. Pace, V. Venturi, M. Marzolla, P. Andreetto, B. Cowles, S. Wang, Y. Saeki, H. Sato, S. Matsuoka, P. Uthayopas, S. Sriprayoonsakul, O. Koeroo, M. Viljoen, L. Pearlman, S. Pickles, M. Jones, G. Moloney, J. Lauret, J. Marsteller, P. Sheldon, S. Pathak, S. De Witt, J. Mencák, J. Jensen, M. Hodges, D. Ross, S. Phatanapherom, G. Netzer, A.R. Gregersen, M. Jones, S. Chen, P. Kacsuk, A. Streit, D. Mallmann, F. Wolf, Th. Lippert

*Open Grid Forum - Grid Interoperation Now (GIN) - Community Group (CG)*

<sup>\*</sup>Correspondence to: Morris Riedel, Forschungszentrum Juelich (FZJ), Juelich Supercomputing Centre (JSC), Distributed Systems and Grid Computing Division, Wilhelm-Johnen-Str. 1, D-52425 Juelich, Germany

<sup>†</sup>E-Mail: m.riedel@fz-juelich.de



## SUMMARY

Many production Grid and e-Science infrastructures have begun to offer services to end-users during the past several years with an increasing number of scientific applications that require access to a wide variety of resources and services in multiple Grids. Therefore, the Grid Interoperation Now (GIN) - Community Group (CG) of the Open Grid Forum (OGF) organizes and manages interoperation efforts among those production Grid infrastructures to reach the goal of a world-wide Grid vision on a technical level in the near future. This contribution highlights fundamental approaches of the group and discusses open standards in the context of production e-Science infrastructures.

KEY WORDS: Interoperation, Interoperability, Grid Infrastructures, Open Standards, GIN

## ACKNOWLEDGEMENTS

The work presented here is conducted by many talented computer scientists and e-Scientists that are funded by various public funding organizations that we thank and acknowledge, because this work would not have been possible without their continuous and sustainable support.

## REFERENCES

1. OGF - Grid Interoperation Now Community Group (GIN-CG), <http://forge.ogf.org/sf/projects/gin>
2. T. Sandholm et al., *A service-oriented approach to enforce grid resource allocation*, Int. Journal of Cooperative Inf. Systems, Vol.15, 2006
3. European BRIDGE Project, <http://www.bridge-grid.eu>
4. Dillaway B., Humphrey M., Smith C., Theimer M., Wasson G., *HPC Basic Profile, Version 1.0*, GFD.114, <http://www.ogf.org/documents/GFD.114.pdf>
5. German National Grid D-Grid, <http://www.d-grid.org>
6. Foster I., Grimshaw A., Lane P., Lee W., Morgan M., Newhouse S., Pickles S., Pulsipher D., Smith C., Theimer M., *OGSA Basic Execution Service Version 1.0*, GFD.108, <http://www.ogf.org/documents/GFD.108.pdf>
7. Mandrichenko I., Allcock W., Perelmutov T., *GridFTP v2 Protocol Description*, GFD.47, <http://www.ogf.org/documents/GFD.47.pdf>
8. German IVOM Project, <http://dgi.d-grid.de/index.php?id=314>
9. TeraGrid, <http://www.teragrid.org/index.php>
10. Venturi V., Stagni F., Gianoli A., Ceccanti A., Ciaschini V., *Virtual Organization Management Across Middleware Boundaries*, In Proc. of International Interoperation and Interoperability Workshop (IGIIW) 2007, Workshop at e-Science 2007, Bangalore, India
11. China National Grid, <http://www.cngrid.org/web/guest/home>
12. Nadalin A., Kaler C., Monzillo R., Hallam-Baker Ph., *OASIS WS-Security Username Token Profile 1.1*, <http://www.oasis-open.org/committees/download.php/16782/wss-v1.1-spec-os-UsernameTokenProfile.pdf>
13. India's National Grid Computing Initiative, <http://www.garudaIndia.in>
14. Delaite T., Kiss T., Goyeneche A., Terstynszky G., Winter S., Kacsuk P., *GEMLCA: Running Legacy Code Applications as Grid Services*, Journal of Grid Computing Vol. 3. No. 1-2. June 2005, Springer Science + Business Media B.V., Formerly Kluwer Academic Publishers B.V., ISSN 1570-7873 pp 75-90
15. OGF - OGSA - Data Movement Interface Working Group (OGSA-DMI), <https://forge.gridforum.org/sf/projects/ogsa-dmi-wg>



16. Dierks T. et al., *The Transport Layer Security (TLS) Protocol Version 1.1*, <http://tools.ietf.org/html/rfc4346>
17. *Nordic DataGrid Facility (NDGF)*, <http://www.ndgf.org/ndgfweb/home.html>
18. Foster I. et al., *The Anatomy of the Grid - Enable Scalable Virtual Organizations*, Grid Computing - Making the Global Infrastructure a Reality, pages 171–198, 2003
19. *Pacific Rim Applications and Grid Middleware Assembly (PRAGMA)*, <http://www.pragma-grid.net/>
20. Rajasekar A., Wan M., Moore R., Schroeder W., *A Prototype Rule-based Distributed Data Management System*, Proceedings of the HPDC Workshop on Next Generation Distributed Data Management, 2006
21. *National Grid Service (NGS)*, <http://www.grid-support.ac.uk/>
22. Shoshani A., Sim A., Gu J., *Storage Resource Managers - Essential Components on the Grid*, Grid Resource Management, Kluwer Academic Publishers, 2003
23. *DMTF: Common Information Model (CIM) Standards*, <http://www.dmtf.org/standards/cim/>
24. *OASIS - Extensible Access Control Markup Language (XACML) Technical Committee*, <http://www.oasis-open.org/committees/xacml>
25. *Open Science Grid*, <http://www.opensciencegrid.org/>
26. Kacsuk P., Kiss T., Sipos G., *Solving the Grid Interoperability Problem by P-GRADE Portal at Workflow Level*, Proc. of the GELA Workshop at the 15th IEEE International Symposium on High Performance Distributed Computing (HPDC-15), Paris, France, 2006
27. *OASIS - Security Services Technical Committee, Security Assertion Markup Language (SAML)*, <http://www.oasis-open.org/committees/security>
28. Schopf J.M. et al., *Monitoring and Discovery in a Web Services Framework: Functionality and Performance of the Globus Toolkit's MDS4*, Argonne National Laboratory Technical Report ANL/MCS-P1248-0405, 2004
29. *Wide In Silico Docking On Malaria (WISDOM)*, <http://wisdom.eu-eggee.fr/>
30. *GridToday: Striving for Grid Interoperability Now*, <http://www.gridtoday.com/grid/1918361.html>
31. *OGF GLUE 2.0 Working Group*, <https://forge.gridforum.org/sf/projects/glue-wg>
32. Foster I., *Globus Toolkit version 4: Software for Service-Oriented Science*, Proceedings of IFIP International Conference on Network and Parallel Computing, LNCS 3779, pages 213–223, Springer-Verlag, 2005
33. *Tunisian Grid (GTRS)*, <http://www.esstt.rnu.tn/utic/gtrs/>
34. Streit A. et al., *UNICORE - From Project Results to Production Grids*, Grid Computing: The New Frontiers of High Performance Processing, Advances in Parallel Computing 14, pages 357–376, Elsevier, 2005
35. *Grid Storage Management (GSM) Working Group*, <https://forge.gridforum.org/projects/gsm-wg/>
36. Bitonti L., Kiss T., Terstynszky G., Delaite T., Winter S., Kacsuk P., *Dynamic Testing of Legacy Code Resources on the Grid*, in Proceedings of the ACM International conference on Computing Frontiers. Ischia, Italy, May 2–5, 2006, pp 261–268
37. *OGF - OGSA - Resource Usage Service Working Group (OGSA-RUS)*, <https://forge.gridforum.org/projects/rus-wg>
38. Alfieri R., Cechini R., Ciaschini V., dell'Agnello L., Frohner A., L'orentey K., Spataro F., *From gridmap-file to voms: managing authorization in a grid environment*, Future Generation Comp. Syst., 21(4), 549–558, 2005
39. *Berkeley Database Information Index (BDII)*, <https://twiki.cern.ch/twiki/bin/view/EGEE/BDII>
40. Mach R., Lepro-Metz R., Jackson S., McGinnis L., *Usage Record - Format Recommendation*, GFD98, <http://www.ogf.org/documents/GFD.98.pdf>
41. *Enabling Grid for e-Science (EGEE)*, <http://public.eu-eggee.org/>
42. Riedel M., Schuller B., Mallmann D., Menday R., Streit A., Tweddell A., Memon M.S., Memon A.S., Demuth B., Lippert Th., Snelling D., van den Berghe D., Li V., Drescher M., Geiger A., Ohme G., Benedyczak K., Bala P., Ratering R., Lukichev A., *Web Services Interfaces and Open Standards Integration into the European UNICORE 6 Grid Middleware*, Proceedings of 2007 Middleware for Web Services (MWS 2007), Workshop at 11th International IEEE EDOC Conference "The Enterprise Computing Conference", 2007, Annapolis, Maryland, USA
43. *Open Middleware Infrastructure Institute for Europe (OMII-Europe)*, <http://www.omii-europe.org>
44. Antonioletti M., Collins B., Krause A., Laws S., Magowan J., Malaika S., Paton N., *Web Services Data Access and Integration - The Relational Realisation (WS-DAIR) Specification, Version 1.0*, GFD.76, <http://www.ogf.org/documents/GFD.76.pdf>
45. *NAMD Scalable Molecular Dynamics*, <http://www.ks.uiuc.edu/Research/namd/>



46. Kacsuk P., Sipos G., *Multi-Grid, Multi-User Workflows in the P-GRADE Portal*, Journal of Grid Computing, Vol. 3, No. 3-4, Kluwer Academic Publishers, pp. 221-238, 2006
47. Farrell S. et al., *An Internet Attribute Certificate Profile for Authorization*, <http://www.ietf.org/rfc/rfc3281.txt>
48. Laure E. et al., *Programming The Grid with gLite*, Computational Methods in Science and Technology, pages 33-46, Scientific Publishers OWN, 2006
49. *Distributed Infrastructure for Supercomputing Applications (DEISA)*, <http://www.deisa.org>
50. R. Piro et al., *An Economy-based Accounting Infrastructure for the DataGrid*, Proc. of the 4th Int. Workshop on Grid Comp., Phoenix, 2003
51. *dCache*, <http://www.dcache.org/>
52. Stamou K., Hedman F., Iliopoulos A., *Extending UNICORE 5 Authentication Model by Supporting Proxy Certificate Profile Extensions*, UNICORE Summit 2007 in conjunction with the European Conference on Parallel Computing 2007 (Euro-Par 2007), Rennes, France
53. *The Monitoring Software for Large Scale Grid System*, <http://www.opensce.org/components/SCMSWeb>
54. *Australian Partnership for advanced computing (APAC)*, <http://www.apac.edu.au/>
55. Anjomshoaa A., Brisard F., Drescher M., Fellows D., Ly A., McGough S., Pulsipher D., Savva A., *Job Submission Description Language (JSDL) Specification v1.0*, GFD.56, <http://www.ogf.org/documents/GFD.56.pdf>
56. *Time-dependent density functional theory*, <http://www.tddft.org/>
57. Santos N., Koblitiz B., *Distributed Metadata with the AMGA Metadata Catalog*, in Workshop on Next-Generation Distributed Data Management, HPDC-15, Paris, France, June 2006
58. *Open LDAP*, <http://www.openldap.org>
59. Frings W., Riedel M., Streit A., Mallmann D., van den Berghe S., Snelling D., Li V., *LLview: User-Level Monitoring in Computational Grids and e-Science Infrastructures*, In Proc. of German e-Science Conference 2007, Baden-Baden, Germany
60. *National Research Grid Initiative (NAREGI)*, <http://www.naregi.org>
61. Foster I., Kesselman C., Tsudik G., Tuecke S., *A security architecture for computational grids*, 5th ACM Conference on Computer and Communications Security, pages 83-91, Assoc. Comput. Mach Press, New York, 1998
62. Good G., *The LDAP Data Interchange Format (LDIF) - Technical Specification*, <http://www.ietf.org/rfc/rfc2849.txt>
63. *International Grid Trust Federation (IGTF)*, <http://www.gridpma.org/>