

# EUROPEAN MIDDLEWARE INITIATIVE

## **MJRA1.18 - TRANSPARENT USE OF OPEN STANDARDS IN THE EMI COMPONENT ECOSYSTEM**

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## I. DELIVERY SLIP

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## II. DOCUMENT LOG

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## III. DOCUMENT CHANGE RECORD

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1		
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## IV. DOCUMENT AMENDMENT PROCEDURE

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## V. GLOSSARY

Acronym	Long Name
EMI-ES	EMI Execution Service
A-REX	ARC Remote Execution Service
CREAM	Computing Resource Execution And Management
UNICORE	Uniform Interface to Computing Resources
VOMS	Virtual Organization Membership Service
DPM	gLite Disk Pool Manager
FTS	gLite File Transfer Service
WMS	gLite Workload Management System
StoRM	Grid Storage Resource Manager
Argus	Argus Authorization Service
STS	EMI Security Token Service
ARIS	ARC Information System
GLUE	Grid Laboratory Uniform Environment
GridFTP	Grid Security Infrastructure File Transfer Protocol
HTTPs	Hypertext Transfer Protocol Secure
JSDL	Job Submission Description Language
NFS	Network File System
pNFS	Parallel Network File Service
OGSA-BES	OGSA – Basic Execution Service
POSIX	Portable Operating System Interface [for Unix]
SAGA-ISN	Simple API for Grid Applications - Information System Navigator
SAGA-SD	Simple API for Grid Applications - Service Discovery
SAML	Security Assertion Markup Language

SRM	Storage Resource Manager
CAR	EMI compute accounting record
StAR	EMI storage accounting record
WebDAV	Web-based Distributed Authoring and Versioning
WSRF	Web Services Resource Framework
XACML	eXtensible Access Control Markup Language
WMS	Workload Management System
Delegation (GridSite)	GridSite delegation protocol
WS-Trust	Web Services Trust Language
OCCI	Open Cloud Computing Interface
EGI	European Grid Infrastructure

The complete EMI glossary is available at <https://twiki.cern.ch/twiki/bin/view/EMI/EmiGlossary> .

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## MILESTONE REPORT

This milestone report describes the open standard specifications supported in the EMI component ecosystem. The areas covered include: computing, information, data access/transferring, job description/submission, accounting, authorization, authentication, etc.

### 1. BACKGROUND

The development and implementation of open standards is a critical task for grid middleware. The adoption of open standards can enable grid components that have been developed by various scientific communities to shift from community-specific mechanisms/protocols/support to global, community-independent mechanisms/protocol/support. The use of open standards in the EMI component ecosystem promotes larger scale integration of computational and storage capabilities and wider customer coverage.

### 2. RESULTS

The use of open standards in the EMI components is according to the standard matrix [1] agreed by each Product Team. A short description on the standard adoption status until EMI 3 is provided for each standard specification. For a more detailed description of the results, consult the corresponding references for each standard.

#### 2.1. EMI-ES

ARC Remote EXecution service (A-REX) along with the ARC client has fully adopted and is supporting the latest EMI execution service (EMI-ES) [2] agreement jointly defined by ARC, CREAM and UNICORE. Interoperability test has been done for each component.

ARC Information System's component (ARIS) and ARC Monitor are able to present EMI-ES's GLUE2 information both in LDIF and XML format. The LDIF format allows an LDAP server to publish such information for a Top-BDII to use, while the XML format is needed for EMI-ES operations. ARC Monitor is capable of presenting EMI-ES GLUE2 endpoints. See also Section 2.2 about GLUE2.

CREAM has been enhanced to support the latest EMI-ES specification (v.1.16) [2] including the new GridSite delegation interface.

A prototype implementation of the EMI-ES v1.16 [2] is available as a UNICORE service.

#### 2.2. GLUE2

ARC middleware has been enhanced to support the GLUE2 [3] standard. In particular, the ARC CE (A-REX) publishes itself and its Endpoints as *ComputingService* and *ComputingEndpoints*. The concept of *AdminDomain* has been integrated as well. A-REX's infoproviders are capable of generating LDAP and XML renderings of GLUE2 schema. ARC client did already before the beginning of the EMI project support the early GLUE2 XML rendering. However during EMI the GLUE2 support in the ARC client has improved to also cover the LDAP rendering. A-REX is now capable of sending GLUE2-like records to EMI Registry (EMIR), by using *emir-serp*, whose data is based on the GLUE2 LDAP rendering. The ARC Monitor has been extended to access and present LDAP GLUE2 data directly from CEs. By leveraging an EMI-reviewed version of the GLUE2 LDAP DIT, ARC CEs will be able to show in top-level BDII GLUE2 rendering.

EMI-ES Information Documents, Resource and Activity, have been modeled over GLUE2. In particular, EMI-ES Resource Document is a fully compliant GLUE2 XML document, while EMI-ES Activity Document is an XML document that uses the GLUE2 jargon. It has been designed to become a fully compliant GLUE2 document in the future, leveraging latest XML schema developments from the GLUE2 Working Group.

Argus services (PAP, PDP and PEP Server) publish GLUE2 [3] information.

DPM, LFC and FTS publish GLUE2 [3] information.

dCache publishes GLUE2 [3] information.

Both the gLite WMS and CREAM CE fully describe their capabilities and resources characteristics by adopting the GLUE2 [3] information model, rendered in LDIF format and published through the BDII information system. Moreover the implementation of the EMI-ES specification has even required the support of the XML. The XML document produces is accessible by the user through the specific EMI-ES Web Service interface. Furthermore, the gLite WMS is able to consume GLUE2 information as published by the various EMI compute elements, so as to enable resource selection (read match-making) based on GLUE attributes. Examples can be found at <https://wiki.italiangrid.it/twiki/bin/view/WMS/WMS34ExtendedReleaseNotes>.

The UNICORE GLUE2 info provider has been enhanced to support the latest version of the GLUE2 [3] XML rendering. An XSLT script can be used to transform the XML rendering into LDIF, so UNICORE sites can now be included in BDII.

SAGA-SD fully supports GLUE2 [3] for service discovery. StoRM publishes GLUE2 [3] information.

Although it has been planned that VOMS and STS will support the publishing of GLUE2 [3] information, there is no feedback about whether they have support GLUE2 yet.

### 2.3. GRIDFTP

DPM is accessible via GridFTP [4].

FTS can manage transfers between GridFTP [4] endpoints.

gLite WMS can manage file transfers between UI, server, CE and WN through GridFTP [4].

dCache provides GridFTP [4] endpoints to be used for data transfer.

StoRM provides GridFTP [4] endpoints to be used for data transfer.

UNICORE and CREAM support GridFTP [4] for data staging.

Both A-REX and the ARC client support GridFTP [4] data staging and transfers.

### 2.4. HTTPS

DPM and LFC are accessible via HTTPS [5].

gLite WMS can manage file transfers between UI, server, CE and WN through HTTPS [5].

FTS3 will support HTTP for transfers, conditional on their supporting extensions for 3rd party copy.

dCache provides HTTPS [5] accessibility.

StoRM clients can use HTTP(s) [5] as data transfer protocol.

Argus services (PAP, PDP and PEP Server), and the Argus client libraries use HTTPS [5] with client authentication for their communication.

STS uses HTTPS [5] for transporting SOAP messages.

The CREAM functionalities exposed through Web Service interfaces are accessible by the client via HTTPS [5] connections.

UNICORE supports HTTPS [5] for data staging. All communication between clients and services is via HTTPS (SOAP messages).

Both A-REX and ARC client use HTTPS [5] when using the EMI ES interface, and also when using the OGSA-BES interface with ARC proprietary extensions. And for data staging and transfers the HTTPS protocol is also supported by both components.

## 2.5. JSDL

gLite WMS, A-Rex and the ARC client supports JSDL [6], all with some extensions to the specification to achieve more sophisticated description of jobs. The extensions details can be found in chapter 4 of ARC xRSL documentation [7].

UNICORE supports basic JSDL [6] as well as several standardized extensions such as SPMD [8] and the HPC basic profile [9]. Some UNICORE-specific extensions to JSDL provide a more flexible resource model, execution environments and application metadata.

CREAM doesn't support the JSDL [6] because in the past we encountered some limitations and issues on such specification. For example an issue is that the BES requires conformant services to reject activities whose JSDL contains elements which are not supported by the receiving entity. This raises important interoperability problems: a client has no way of knowing in advance which JSDL elements are supported by a BES service. So this implies that non-trivial JSDL has significant probabilities of being rejected by most of the BES services it is submitted to, because each one would complain on a different unsupported element. Moreover the extension mechanism used by the JSDL specification makes things worse. It is not possible to insert service-specific hints into a JSDL because BES implementations not recognizing the extension elements will reject the request. At the current time CREAM adopts the ADL defined in the EMI-ES specification [2] which represents an improvement of the JSDL.

## 2.6. NFS 4.1/PNFS

DPM in EMI2 supports NFS v4.1 [10] read only. The EMI3 release will support writing.

dCache provides NFS v4.1 [10] read/write.

StoRM can provide NFS 4.1/pNFS [10] if installed on top of a storage backend file system posix compliant providing this functionality.

## 2.7. OGSA-BES

UNICORE supports the OGSA Basic Execution Service (OGSA-BES) [11].

A-REX and the ARC client support OGSA-BES [11].

## 2.8. POSIX/IO

To achieve POSIX [12] compatibility, different storage systems have chosen different technological solutions. DPM in EMI2 supports NFS v4.1 read only. The EMI3 release support NFS v4.1 write. dCache provides NFS v4.1 read/write. StoRM supports posix/IO by means of its underlying posix compliant file system.

## 2.9. SAGA-ISN

SAGA-ISN is a complete implementation of the OGF standard defined in [13].

## 2.10. SAGA-SD

SAGA-SD is a complete implementation of the OGF standard defined in [14].

## 2.11. SAML

STS supports SAML 2.0 assertions as an incoming token format, as defined in [15]. STS also supports initiation of the SAML 2.0 ECP profile, sections 2.3.1 and 2.3.2 in [16].

UNICORE uses SAML 2.0 assertions for expressing various security statements (trust delegation, user attributes, SSL certificate information when the UNICORE Gateway is deployed).

Argus uses XACML, which is build on top of SAML to carry the assertion attributes [17]. The specifications that Argus have adopted/specified can be found at [18].

## 2.12. SRM

DPM, dCache and StoRM all support SRM [19]. FTS supports data transfer between SRM [19] endpoints, both via gridftp and srmcopy.

Starting with the EMI-3 release, UNICORE has prototype level support for SRM as a storage backend. This means that data staging from/to SRM is possible, as well as operations like file rename, delete, mkdir, etc.

## 2.13. CAR (COMPUTE ACCOUNTING RECORD)

CAR 1.0 [20] and CAR 1.1 [21] in A-REX is completely supported in A-REX.

UNICORE generates records in OGF Usage record format, which can be exported in CAR [20][21] format from the UNICORE accounting system.

CREAM doesn't handle by itself accounting records, but it relies on APEL and DGAS external components.

## 2.14. STAR

The DPM release in EMI3 supports StAR [22].

dCache is providing a standard compliant StAR [22] record. It will be available post EMI-3. The code has been finished during EMI.

StoRM team is working on a StAR [22] record provider. Development has been started within EMI and will be released post EMI-3.

## 2.15. WEBDAV

DPM and LFC are accessible via WebDAV [23]. StoRM provides a WebDAV interface on its resources as Class 1 WebDAV [23] compliant resources. dCache supports WebDAV [23] access (read/write). FTS3 will support WebDAV [23] endpoints.

## 2.16. WSRF

The UNICORE Services Environment (USE) provides a full implementation of the OASIS WSRF 1.1 standard [24]. Native UNICORE services leverage WSRF for a standardized, resource-oriented access to service instance data, lifecycle management, and access control.

In A-REX, WSRF [24] is used along with the OGSA-BES interface and ARC proprietary extensions for providing information about resources, which is likewise supported on the client side by the ARC client.

## 2.17. XACML

The Argus Authorization Service is main EMI component to handle XACML [25] authorization. Argus is composed of three main components:

- The Policy Administration Point (PAP) provides the tools to author XACML authorization policies, organize them in the local repository and configure policy distribution among remote PAPs.
- The Policy Decision Point (PDP) implements the XACML authorization engine, and is responsible for the evaluation of the authorization requests against the XACML policies retrieved from the PAP.
- The Policy Enforcement Point Server (PEP Server) ensures the integrity and consistency of the authorization requests received from the PEP clients. Lightweight PEP client libraries are also provided to ease the integration and interoperability with other EMI services or components.

ARC partially supports XACML [25] with the XACML client (PEP) functionality, through a plugin to ARC services (including A-REX service) to compose XACML request, and contact Argus PDP server

to get XACML response. The XACML authorization profiles [25][26] can be interpreted by this ARC plugin. The request-response payload that carries XACML request and XACML response is according to the definition of "SOAP Profiles for XACML-SAML" [27].

The CREAM authorization framework is realized by the ARGUS service. The decision concerning whether the user has the rights to access services and resources is taken on the basis of policies that can be either local or defined at VO level. Such policies are described and expressed by adopting the XACML notation. In particular the CREAM service makes use of Argus PEP java client in order to communicate with the Argus PEP daemon [28]. The client is embedded into the authorization framework and it is configured by CREAM common configuration system. The CREAM service doesn't contact directly the Argus PDP service: XACML requests and responses are managed by the Argus PEP daemon. Moreover the CREAM authorization framework allows site administrators to select the correct plugin for dealing with one of the supported profiles [25][26]. Any plugin implements a mapping between web service operations and XACML profile actions, the same plugin is responsible for checking and handling XACML obligations.

The UNICORE Services Environment leverages XACML for access control, using an open source XACML 2.0 engine and local policy files. Additionally, policies can be downloaded from Argus PAP to support typical use cases like banning of users and VOs.

For dCache "argus" and "xacml" (for GUMS) plugins in gPlazma both support XACML [25]. IIRC, the "argus" gPlazma plugin uses the Argus PEP client library to query the PDP; this communication is XACML. The "xacml" plugin uses another client library to query the GUMS server using XACML.

## 2.18. GRIDSITE DELEGATION

A-REX and the ARC client have adopted the GridSite Delegation protocols [29] for credential delegation.

DPM supports GridSite [29] delegation in order to enable 3rd party copy. An htcopy client is supplied which handles this.

FTS supports delegation as it performs transfers on behalf of users.

gLite WMS supports GridSite delegation protocols [29], version 1.0 and 2.0.

CREAM fully supports the GridSite [29] delegation Web Service Interface.

UNICORE partially implements the GridSite [29] delegation web service as part of the EMI-ES implementation.

## 2.19. WS-TRUST

EMI STS is a partial implementation of the STS defined in the WS-Trust 1.3 specifications [30]. It follows the interoperability profile specified in [31]. Initial STS version 1.0 implements the base protocol requirements (section 2) and the issuance operation (section 3) of WS-Trust 1.3 [30].

For the incoming security token formats, STS supports Username/Password [32] and SAML assertion [33]. For the outgoing formats, X.509 certificate [34] and X.509 proxy certificate are supported.

## 2.20. OCCI INTERFACE

OCCI (Open Cloud Computing Interface) is a protocol and API for serving many cloud models in addition to IaaS, including PaaS and SaaS [35]. WNoDeS supports interaction with user requests through traditional batch or Grid jobs and also via the OCCI standard, allowing users to access compute, storage and network resources on a pay-as-you go basis.

### 3. SUMMARY

To facilitate integration of computational and storage capabilities, the EMI component ecosystem has adopted a number of opens standards.

EMI has worked with the opens standards that have been defined by different SDOs (standardization development organisation), including the following:

- Open Grid Forum (OGF)  
e.g. GLUE2, SRM, GridFTP, OGSA-BES, JSDL, SAGA-ISN, SAGA-SD, etc.
- Organization for the Advancement of Structured Information Standards (OASIS)  
e.g. SAML, XACML, WS-Trust, WSRF, etc.
- Internet Engineering Task Force (IETF)  
e.g. X.509-based Public Key Infrastructure (PKI), NFS 4.1/pNFS, HTTPS, WebDAV, etc.

EMI has also worked with standards that have commonly been recognized and proposed by EMI partners, including EMI-ES, CAR, StAR, GridSite delegation. EMI has also adopted the OCCI Interface standard, which is an open standard from cloud community.

## REFERENCES

ID	Description	Link
1	EMI standardization matrix	<a href="http://www.eu-emi.eu/standardization-matrix">http://www.eu-emi.eu/standardization-matrix</a>
2	EMI execution service (EMI-ES) specification	<a href="https://twiki.cern.ch/twiki/pub/EMI/EmiExecutionService/EMI-ES-Specification_v1.16.odt">https://twiki.cern.ch/twiki/pub/EMI/EmiExecutionService/EMI-ES-Specification_v1.16.odt</a>
3	GLUE Specification v. 2.0	<a href="http://www.ogf.org/documents/GFD.147.pdf">http://www.ogf.org/documents/GFD.147.pdf</a>
4	GridFTP v2 Protocol Description	<a href="http://www.ogf.org/documents/GFD.47.pdf">www.ogf.org/documents/GFD.47.pdf</a>
5	HTTP over TLS	<a href="https://tools.ietf.org/html/rfc2818">https://tools.ietf.org/html/rfc2818</a>
6	Job Submission Description Language (JSDL) Specification, Version 1.0	<a href="http://www.ogf.org/documents/GFD.136.pdf">http://www.ogf.org/documents/GFD.136.pdf</a>
7	Extended Resource Specification Language (xRSL)	<a href="http://www.nordugrid.org/documents/xrsl.pdf">www.nordugrid.org/documents/xrsl.pdf</a>
8	JSDL SPMD extension	<a href="http://www.ogf.org/documents/GFD.115.pdf">http://www.ogf.org/documents/GFD.115.pdf</a>
9	JSDL HPC basic profile	<a href="http://www.ogf.org/documents/GFD.111.pdf">http://www.ogf.org/documents/GFD.111.pdf</a>
10	NFS version 4 minor version one	<a href="http://tools.ietf.org/html/rfc5661">http://tools.ietf.org/html/rfc5661</a>
11	OGSA BES	<a href="http://www.ogf.org/documents/GFD.108.pdf">http://www.ogf.org/documents/GFD.108.pdf</a>
12	POSIX	<a href="http://en.wikipedia.org/wiki/POSIX">http://en.wikipedia.org/wiki/POSIX</a>
13	SAGA API Extension: Information System Navigator API	<a href="http://www.gridforum.org/documents/GFD.195.pdf">http://www.gridforum.org/documents/GFD.195.pdf</a>
14	SAGA API Extension: Service Discovery API	<a href="http://www.ogf.org/documents/GFD.144.pdf">http://www.ogf.org/documents/GFD.144.pdf</a>
15	WS-Trust 1.3 Interoperability Profile: SAML 2.0 Token Profile	<a href="http://www.switch.ch/grid/support/documents/wst-saml-wd01.pdf">http://www.switch.ch/grid/support/documents/wst-saml-wd01.pdf</a>
16	SAML V2.0 Enhanced Client or Proxy Profile Version 2.0	<a href="https://www.oasis-open.org/committees/download.php/41209/sstc-saml-ecp-v2.0-wd02.pdf">https://www.oasis-open.org/committees/download.php/41209/sstc-saml-ecp-v2.0-wd02.pdf</a>
17	SOAP Profile for XACML-SAML	<a href="http://www.switch.ch/grid/support/documents/xacmlsaml.pdf">http://www.switch.ch/grid/support/documents/xacmlsaml.pdf</a>
18	The specifications of Argus authorization service	<a href="https://twiki.cern.ch/twiki/bin/view/EGEE/AuthorizationFramework#Specifications">https://twiki.cern.ch/twiki/bin/view/EGEE/AuthorizationFramework#Specifications</a>
19	The Storage Resource Manager Interface Specification Version 2.2	<a href="http://www.ggf.org/documents/GFD.129.pdf">www.ggf.org/documents/GFD.129.pdf</a>
20	Definition of the Compute Accounting Record version 1.0	<a href="https://twiki.cern.ch/twiki/pub/EMI/ComputeAccounting/CAR-EMI-tech-doc-1.0.doc">https://twiki.cern.ch/twiki/pub/EMI/ComputeAccounting/CAR-EMI-tech-doc-1.0.doc</a>
21	Definition of the Compute Accounting Record version 1.1	<a href="https://twiki.cern.ch/twiki/pub/EMI/ComputeAccounting/CAR-EMI-tech-doc-1.1.doc">https://twiki.cern.ch/twiki/pub/EMI/ComputeAccounting/CAR-EMI-tech-doc-1.1.doc</a>
22	EMI StAR – Definition of a Storage Accounting Record	<a href="http://www.ggf.org/Public_Comment_Docs/Documents/2012-02/EMI-StAR-OGF-info-doc-v2.pdf">http://www.ggf.org/Public_Comment_Docs/Documents/2012-02/EMI-StAR-OGF-info-doc-v2.pdf</a>
23	HTTP Extensions for Web Distributed Authoring and	<a href="http://tools.ietf.org/html/rfc4918#section-18">http://tools.ietf.org/html/rfc4918#section-18</a>

	Versioning (WebDAV)	
24	OASIS Web Services Resource Framework (WSRF)	<a href="https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrf">https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrf</a>
25	Common CE XACML Authorization Profile (v.1)	<a href="https://twiki.cern.ch/twiki/bin/view/EMI/XACMLCommonCEProfileV1">https://twiki.cern.ch/twiki/bin/view/EMI/XACMLCommonCEProfileV1</a>
26	XACML Profile for the gLite CE	<a href="https://edms.cern.ch/document/1078881">https://edms.cern.ch/document/1078881</a>
27	SOAP Profile for XACML-SAML	<a href="http://www.switch.ch/grid/support/documents/xacmlsaml.pdf">http://www.switch.ch/grid/support/documents/xacmlsaml.pdf</a>
28	PEP (Policy Enforcement Point)	<a href="http://twiki.cern.ch/twiki/bin/view/EGEE/AuthorizationFramework#PEP_Policy_Enforcement_Point">http://twiki.cern.ch/twiki/bin/view/EGEE/AuthorizationFramework#PEP_Policy_Enforcement_Point</a>
29	GridSite delegation protocol	<a href="http://www.gridsite.org/wiki/Delegation_protocol">http://www.gridsite.org/wiki/Delegation_protocol</a>
30	OASIS WS-Trust 1.3	<a href="http://docs.oasis-open.org/ws-sx/ws-trust/200512/ws-trust-1.3-os.pdf">http://docs.oasis-open.org/ws-sx/ws-trust/200512/ws-trust-1.3-os.pdf</a>
31	WS-Trust 1.3 Interoperability Profile	<a href="http://www.switch.ch/grid/support/documents/wst-interop-wd01.pdf">http://www.switch.ch/grid/support/documents/wst-interop-wd01.pdf</a>
32	WS-Trust 1.3 Interoperability Profile: Username Token Profile	<a href="http://www.switch.ch/grid/support/documents/wst-utp-wd01.pdf">http://www.switch.ch/grid/support/documents/wst-utp-wd01.pdf</a>
33	WS-Trust 1.3 Interoperability Profile: SAML Token Profile	<a href="http://www.switch.ch/grid/support/documents/wst-saml-wd01.pdf">http://www.switch.ch/grid/support/documents/wst-saml-wd01.pdf</a>
34	WS-Trust 1.3 Interoperability Profile: X.509 Token Profile	<a href="http://www.switch.ch/grid/support/documents/wst-x509-wd01.pdf">http://www.switch.ch/grid/support/documents/wst-x509-wd01.pdf</a>
35	Open Cloud Computing Interface	<a href="http://occi-wg.org/">http://occi-wg.org/</a>