

**EGI-Engage**

Report on Data Accounting

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Abstract

This report looks at the current state of dataset accounting within EGI-Engage, a new feature of the EGI accounting system that will enable storing information on dataset usage such as who accesses datasets, how often a dataset is accessed, the data transfers, etc. This feature should enable Resource Centre and research community administrators to make decisions about the location and storage of data sets to make more efficient use of the infrastructure, to report on data usage to the data owners, data providers and funding agencies, and to assist scientists in assessing the impact of their work. The design of this new feature has been led by the users’ requirements collected in the first part of the project, shortly summarised in this document, along with the accounting metrics that were derived from those requirements. In the first experiments, which culminated with the release of the first data accounting prototype, the EGI Accounting Repository has been integrated with the data provider Onedata, the underlying technology powering the EGI Open Data platform and DataHub, as exemplar of a generic data provider.

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**TERMINOLOGY**

A complete project glossary and acronyms are provided at the following pages:

* <https://wiki.egi.eu/wiki/Glossary>
* <https://wiki.egi.eu/wiki/Acronyms>

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**Executive summary**

This report looks at the current state of dataset accounting within EGI-Engage, a new feature of the EGI accounting system that will enable storing information on data set usage such as who has accessed a dataset, how often it is accessed, the data transfers, etc. A dataset is defined as a logical set of files which may exist in several places at once and to which it is possible to assign some form of persistent unique identifier and to perform dataset accounting it is assumed that this unique identifier is available. This differs from storage accounting which accounts for disk allocation and usage without concern over what data is stored or who uses it and how often. Dataset accounting should enable site and experiment administrators to make decisions about the location and storage of datasets allowing more efficient use of the infrastructure, to report on data usage to data owners, data providers and funding agencies, and to assist scientists in assessing the impact of their work.

The design of this new feature has been led by user requirements collected in the first part of the project. From an initial survey[[1]](#footnote-1), it was shown that some sites already use digital object identifiers (DOI). It identified the most important attributes needed for meaningful dataset accounting as how often a dataset is accessed, who accessed it, and what data transfers occurred. Following the survey, a proposal (detailed in this report) was created for the metrics that could be extracted to perform dataset usage accounting.

In the first experiments, which culminated in the release of the first data accounting prototype, the EGI Accounting Repository has been integrated with the data provider Onedata, the underlying technology powering the EGI Open Data platform and DataHub[[2]](#footnote-2), as an example of a generic data provider. Onedata is a global data management system, providing easy access to distributed storage resources, supporting a wide range of use cases. It provides a REST API which can be used to extract space and user metrics. Currently, it is not possible to extract metrics based on persistent identifiers (PIDs) such as DOIs, but this is a feature that is being added to support the Open Data Platform. To account for the usage of datasets, the prototype uses software from the APEL[[3]](#footnote-3) project, the underlying technology of the EGI Accounting Repository which collects accounting data from sites participating in EGI and other infrastructures. The APEL software has been modified to support fetching dataset usage records from the REST API that Onedata provides.

Future work includes ironing out any problems with the integration and making use of unique dataset identifiers once they are available in Onedata so that a second prototype could be produced, and improving the definition of the dataset usage metrics so that they could be standardised. Furthermore, other systems outside EGI are also being looked at and may lead to some fruitful developments in the future.

# Introduction

This report looks at the current state of dataset usage accounting within EGI-Engage. Here, a dataset is defined as a logical set of files which may exist in several places at once and to which it is possible to assign some form of persistent unique identifier, and to perform dataset accounting it is assumed that this unique identifier is available. This differs from storage accounting which accounts for disk allocation and usage without concern over what data is stored or who uses it and how often. Storage accounting is supported by a separate part of the Accounting Repository and is almost at the production level.

Accounting for dataset usage should enable site and experiment administrators to make decisions about the location and storage of datasets to make more efficient use of the infrastructure and to assist scientists in assessing the impact of their work.

After a first phase of the activity focused on requirements gathering and on the definition of a data accounting usage record, a prototype dataset accounting system was created using software from the APEL project. APEL is an accounting tool that collects accounting data from sites participating in the EGI and WLCG infrastructures as well as from sites belonging to other Grid organisations that are collaborating with EGI, including OSG and NorduGrid. The accounting information is gathered from different sensors into a central accounting repository where it is processed to generate statistical summaries that are available through the EGI Accounting Portal. Statistics are available for view in different detail by users, Virtual Organisation (VO) managers, site administrators and anonymous users according to well-defined access rights.

This report summarises the status of the activities, presenting: the user requirements that were captured from an initial questionnaire and interviews with relevant communities, the dataset metrics that were developed from those requirements, and the currently supported storage systems and how support is integrated into APEL and the EGI infrastructure. Finally exploitation, dissemination and future plans are shown.

# User requirements

The accounting team published a questionnaire to gather feedback from stakeholders on how best to implement a prototype system. In addition, communities that expressed great interest in this activity were selected for interviews to clarify their needs. In general, the needs for this new feature for the EGI accounting system clearly emerged from the communities. In addition, none of the available systems was applicable across the whole infrastructure. Such an outcome was considered a good motivation to develop the data accounting prototype. More details on such analysis are available in M3.2[[4]](#footnote-4).

From this initial questionnaire, it was shown that some sites already use digital object identifiers (DOI) from DataCite[[5]](#footnote-5), ePIC, and Handle, as well as Uniform Resource Identifiers (URI) and persistent Uniform Resource Locators (URL). The need for a persistent identifier (PID) management system to implement a data accounting feature was identified from this analysis. The survey identified the most important attributes needed for meaningful dataset accounting as

* how often a dataset is accessed,
* who accessed them, and
* what transfers of the dataset occurred.

Other high priority data fields that should be included are: the different forms of user identification (such as an x.509 certificate Distinguished Name (DN), an eduPersonPrincipleName (ePPN) attribute from a security realm, or the EGI unique identifier (UID) released by the CheckIn service); user groupings such as VO, or home-site; number of store and retrieve operations; number of files transferred; success or failure of the transfer; and the dataset identifier.

Other, medium priority data fields which should probably be accounted for include: storage system implementation, i.e. the type of storage system this data was extracted from; transfer start time and end time or duration; the source and destination IP address; and the volume of data transferred.

# Dataset usage metrics

Following the questionnaire, a proposal was created for the metrics that could be extracted to perform dataset usage accounting. They are intended as an extension to the Open Grid Forum (OGF) Usage Record version 2 (UR-2.0)[[6]](#footnote-6), but the final implementation for dataset usage accounting may need to be quite different once more feedback is received and use cases developed. For example, the format of the “DataSet” field should probably not be mandated in the accounting record, and should just provide optional fields to specify which replica the record refers to. Additionally there is currently no agreed way for the individual records to be aggregated into larger summaries and these metrics will need to be refined as dataset accounting is developed though the prototypes and integrations with storage systems.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Key** | **Type** | **Description** |
| **Record Identity Block** | Resource provider | string | Resource provider at which the resource is located (e.g. GOCDB sitename) |
| **Subject Identity Block** | GlobalUserID | string | e.g. X.509 certificate DN / EGI unique ID (from Checkin service) |
| GlobalGroupId | string | e.g. VO |
| GlobalGroupAttribute | string | e.g. VO Group and/or Role |
| ORCID | string | ORCID iD of the user |
| **Dataset Usage Block** | DataSet | string | unique identifier such as a PID / DOI |
| AccessEvents | integer | Number of read and write operations |
| Source | IP address / other | Source of transfer at resource provider |
| Destination | IP address / other | Destination of transfer |
| StartTime | ISO 8601 timestamp | Start time of transfer |
| Duration | ISO 8601 duration | Duration of transfer |
| EndTime | ISO 8601 timestamp | End time of transfer |
| TransferSize | integer | Bytes transferred |
| HostType | string | Storage system Type |
| FileCount | integer | Number of files accessed |
| Status | string | Success / failure / partial transfer |

# Supported storage solutions

## Onedata

Onedata[[7]](#footnote-7) is a global data management system, providing easy access to distributed storage resources, supporting a wide range of use cases from personal data management to data-intensive scientific computations. With Onedata, users can access, store, process and publish data using global data storage backed by computing centres and storage providers worldwide.

Onedata provides a REST API which can be used to extract space and user metrics. At the moment, it is not possible to extract metrics based on persistent identifiers (PIDs) such as DOIs, but this is a feature that is being added to support the EGI Open Data Platform and will be available shortly.

Additionally, the Onedata REST API provides metrics in a format that does not directly map onto the proposed metrics present in the previous section so some compromise will need to be found between the two. Also, since a single dataset can be divided between several storage providers, consideration should be made about how the metrics for a dataset can be collated from the data retrieved from disparate providers.

### Onedata integration with the Accounting Repository

The APEL software was modified to support the loading of dataset usage records into a specifically designed database schema, and the APEL Secure Stomp Messenger (SSM) component was modified to support fetching dataset usage records from a REST interface (as opposed to sending messages via the EGI Message Brokers), which is the method that Onedata provides access to monitoring data. Currently, the prototype uses a simple REST “puller”, similar to the receiver used to retrieve messages from the EGI Message Brokers. However, the updated SSM with REST support is being developed with the new the ARGO Messaging Service (AMS) in mind, as that service will also make use of HTTP interfaces. Although AMS can certainly be used to communicate with the Accounting Portal in the future, it is still not clear whether the messaging infrastructure can be used for communication with Onedata.

The prototype works by using the Python urllib2 library to query the REST interface. The returned data is then parsed into the new message format based on the OGF Usage Record. This message is then saved for future loading, as currently happens with all other messages received via the message broker.

The APEL software has been modified to support loading of this new format into a database by starting a separate loader process with its own configuration file. This means that the prototype is capable of extracting the space metrics of the test space, parsing them into the OGF message format then loading the data into the database.

A lot of the metrics proposed are available in Onedata, although with different keys, and some are not yet available (mainly DOI, ORCID, and specific metrics about transfers). Additional modifications are thus required to convert the data retrieved from the Onedata API into a format suitable for ingestion by the Accounting Repository. This will be achieved in the coming months during the development of the second data accounting prototype.

## Other data management systems

### B2SHARE

B2SHARE[[8]](#footnote-8) is the service in the [EUDAT](https://eudat.eu/) Collaborative Data Infrastructure[[9]](#footnote-9) which appears to be appropriate for dataset accounting. B2SHARE can receive requests for a digital object’s PID and use another service called B2HANDLE[[10]](#footnote-10) to look up the replicas that exist in the data resources B2SAFE[[11]](#footnote-11) or iRODS (described later), and then deliver the data from one of those sources to the user. B2SHARE currently only logs storage accounting information but they see the need for dataset accounting and have plans to work on usage statistics.

There is potential for a future collaboration with APEL to ensure that what they develop meets the requirements of APEL and the EGI user communities.

### ICAT

ICAT[[12]](#footnote-12) is a metadata catalogue, originally developed by the STFC, but now used at a number of neutron and photon sources in Europe and the US through the Photon and Neutron data infrastructure initiative[[13]](#footnote-13) (PANdata) FP7 project. It keeps information on an ‘investigation’ which is typically a series of measurements by a team on one instrument at a large facility. It tracks the investigation from project submission, approval, and data-taking, through to scientific publications. The relevant part for dataset accounting is its knowledge of the raw and derived data stored as part of the investigation. This is not only of use by the participating scientists but is also used by publications to point to the data for subsequent use.

In the ISIS[[14]](#footnote-14) neutron source, the investigation itself has a single DOI in DataCite. Other models are available; for example the Diamond Light Source[[15]](#footnote-15) has a DOI for each individual dataset. Both models could benefit from dataset accounting. ICAT and its associated web interface TopCat look worthy of further investigation.

### iRODS

The integrated Rule-Oriented Data System[[16]](#footnote-16) (iRODS) is open source data management software, provided by the iRODS Consortium, used by many scientific sites and collaborations. Although it is a stand-alone system with its own catalogues, metadata, collections, and data transfer mechanisms, it is also integrated into EUDAT services.

It is worth further investigation, both in terms of usage within the EGI communities and technically that it keeps sufficient logging to report what dataset accounting needs.

# Plan for Exploitation and Dissemination

|  |  |
| --- | --- |
| Name of the result | Knowledge of current state of dataset accounting |
| DEFINITION | |
| Category of result | Technical input to standards and know-how |
| Description of the result | This report gives an overview of the current state of dataset accounting in EGI-Engage and looks at some of the areas that will need future development. |
| EXPLOITATION | |
| Target group(s) | Service providers, standardisation bodies |
| Needs | Knowledge of what the required metrics to perform dataset accounting are and how they might be integrated into the EGI accounting system. |
| How the target groups will use the result? | Get agreement on a standard for dataset usage accounting that is useful for users and that can be reused for other storage systems and infrastructures. |
| Benefits | Greater understanding between the service providers and accounting team. Starting point for future discussion on standardisation of dataset accounting. |
| How will you protect the results? | All software and standards released under an open source licence. |
| Actions for exploitation | Further collaboration between EGI accounting team and Onedata. Solicit feedback on prototype and proposed metrics. |
| URL to result |  |
| Success criteria | A more developed second prototype that regularly collects dataset accounting and an agreed standard for collecting dataset accounting metrics. |
| DISSEMINATION | |
| Key messages | Replicate your data sets according to real user needs. |
| Channels | EGI conferences and meetings, direct communications with collaborators. |
| Actions for dissemination | Further collaboration with Onedata, discussion with developers of other storage systems that support unique IDs (e.g. EUDAT), solicit feedback on prototype and metrics, track developments in the WLCG Data Management group. |
| Cost | N/K |
| Evaluation | Quality of feedback and discussions. |

# Future work

Having produced an initial prototype, work is needed for the second prototype to move it towards a production quality service. This includes ironing out any problems with the integration with Onedata and making use of unique dataset identifiers once they are available. Work will also be needed to modify the software to use the Onedata API to retrieve the list of space IDs and metrics programmatically. These improvements will then be integrated into the release of the second data accounting prototype (D3.15) as shown in the EGI Engage Accounting Repository roadmap[[17]](#footnote-17). Summarising the data sending it to the Accounting Portal is currently not supported, so this should be investigated for the next prototype alongside working with the Portal to define views for this data.

The initial strategy was to use the EGI DataHub and to integrate the prototype with the Onedata API hosted there as this was the EGI provided solution. However, considering that the service has not reached full maturity yet, and to develop a system that is as generic as possible, other data management systems will be analysed. A variety of other storage systems have already been already reviewed – B2SHARE, ICAT, and iRODS – although even these do not yet provide all the features required for dataset accounting. This means that work is needed to collaborate with the developers of these systems to add the required features. With this in mind, a check list of features should be produced to list what a project or storage system needs to provide to enable dataset usage accounting.

Overall, there is now a good starting point for dataset accounting in the form of a prototype schema, which may need some tweaking, and a method for storing those records. However, the more challenging problem is the lack of data tools in the EGI communities that actually store the right information to do dataset accounting. For example, WLCG is only just starting to define their requirements in this area. The Accounting Repository team can follow along with these developments, but they do not have control over them, although, having sorted out some of the basic requirements for dataset accounting, they are now in a stronger position to collaborate with, WLCG, Onedata, EUDAT, and others.

1. <https://documents.egi.eu/document/2674> [↑](#footnote-ref-1)
2. <https://datahub.egi.eu/> [↑](#footnote-ref-2)
3. <http://apel.github.io/> [↑](#footnote-ref-3)
4. <https://documents.egi.eu/document/2674> [↑](#footnote-ref-4)
5. <https://www.datacite.org/> [↑](#footnote-ref-5)
6. <https://www.ogf.org/documents/GFD.204.pdf> [↑](#footnote-ref-6)
7. <https://onedata.org/> [↑](#footnote-ref-7)
8. <https://www.eudat.eu/services/b2share> [↑](#footnote-ref-8)
9. <https://www.eudat.eu/eudat-cdi> [↑](#footnote-ref-9)
10. <https://www.eudat.eu/services/b2handle> [↑](#footnote-ref-10)
11. <https://www.eudat.eu/services/b2safe> [↑](#footnote-ref-11)
12. <https://icatproject.org/> [↑](#footnote-ref-12)
13. <http://pan-data.eu/> [↑](#footnote-ref-13)
14. <http://www.isis.stfc.ac.uk/about/aboutisis.html> [↑](#footnote-ref-14)
15. <http://www.diamond.ac.uk/Home/About.html> [↑](#footnote-ref-15)
16. <https://irods.org/> [↑](#footnote-ref-16)
17. <https://wiki.egi.eu/wiki/TASK_JRA1.3_Accounting#Accounting_Repository> [↑](#footnote-ref-17)