

**Final report on alternative tape usage**

**Deliverable D4.4**



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**About this document**

**Work package in charge:** WP4 Exploitability

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**Dissemination level**: *PU = the general public*

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# 1. Abstract /publishable summary

Storage systems at data centres are becoming increasingly heterogeneous, with the proliferation of new storage technology, often coexisting with older, more established technology. This can lead to a number of problems for the users of these data centres. Firstly, there can be a number of user interfaces and different programs available to access the storage systems, leading to user confusion and requiring a large commitment to training. Secondly, the time for writing or reading data from these storage systems may be very disparate between the different systems. Thirdly, a system may block until a user operation is executed (synchronous) or it may execute the operation in the backend (asynchronous). This can cause inconsistencies leading to user errors, such as dropping a connection on an initiated synchronous transfer may lead to abort of the operation.

To counteract these problems, we have developed a multi-tiered storage library which provides a single API to users. Regardless of the available storage system and behaviour, it allows to move data, to query the data that is stored on those systems, and to retrieve the data. These interactions are carried out using a single user interface, which is a command line tool to be used interactively, and a HTTP API to be used programmatically. The command line tool essentially provides a wrapper for calls to the HTTP API.

# 2. Conclusion & Results

This deliverable gives an overview of the design, implementation and deployment of a multi-tiered storage library, to achieve the goal of exploiting data within the project, to support the end-to-end workflow and to improve the usability of the existing computing and data-handling infrastructure.

A multi-tiered storage library has been designed, implemented, deployed and tested, with users from NCAS-CMS partaking in the beta-testing. Three different storage technologies are catered for: tape (via CASTOR), object-stores (via Amazon S3) and FTP. The library has been constructed so that the support for storage is pluggable, and extensions can be written for other storage systems. The unified interface to the three different storage technologies has been well received by the beta-testers, with the improvement in monitoring transfers to and from the storage being particularly liked.

Development of the library will continue after ESiWACE has completed, as it has become part of the future roadmap for storage services offered to users of JASMIN at STFC.

# 3. Project objectives

This deliverable contributes directly and indirectly to the achievement of all the macro-objectives and specific goals indicated in section 1.1 of the Description of the Action:

|  |  |
| --- | --- |
| **Macro-objectives** | **Contribution of this deliverable?** |
| Improve the efficiency and productivity of numerical weather and climate simulation on high-performance computing platforms | No |
| Support the end-to-end workflow of global Earth system modelling for weather and climate simulation in high performance computing environments | Yes |
| The European weather and climate science community will drive the governance structure that defines the services to be provided by ESiWACE | No |
| Foster the interaction between industry and the weather and climate community on the exploitation of high-end computing systems, application codes and services. | Yes |
| Increase competitiveness and growth of the European HPC industry | Yes |

|  |  |
| --- | --- |
| **Specific goals in the workplan** | **Contribution of this deliverable?** |
| Provide **services** to the user community that will impact beyond the lifetime of the project. | Yes |
| Improve **scalability** and shorten the time-to-solution for climate and operational weather forecasts at increased resolution and complexity to be run on future extreme-scale HPC systems. | No |
| Foster **usability** of the available tools, software, computing and data handling infrastructures. | Yes |
| Pursue **exploitability** of climate and weather model results. | Yes |
| Establish governance of common software management to avoid unnecessary and redundant development and to deliver the best available solutions to the user community. | Yes |
| Provide **open access** to research results and **open source** software at international level. | Yes |
| Exploit **synergies** with other relevant activities and projects and also with the global weather and climate community | Yes |

# 4. Detailed report on the deliverable

See the Annex 1.

# 5. References *(Bibliography)*

[1]: Django Project, <https://www.djangoproject.com/>  
[2]: GitHub, <https://www.github.com/>  
[3]: Docker, <https://www.docker.com/>  
[4]: Kubernetes, <https://kubernetes.io/>  
[5]: JASMIN, <http://jasmin.ac.uk/>  
[6]: CASTOR, <http://castor.web.cern.ch/>  
[7]: Python multiprocessing, <https://docs.python.org/3/library/multiprocessing.html>  
[8]: Amazon Simple Storage Service, https://aws.amazon.com/s3/  
[9]: What is a group workspace?, https://help.jasmin.ac.uk/article/199-introduction-to-group-workspaces  
[10]: OAuth, https://oauth.net/  
[11]: JSON, https://www.json.org/  
[12]: JDMA client, <https://github.com/cedadev/jdma_client>  
[13]: Requests: HTTP for Humans, http://docs.python-requests.org/en/master/

# 6. Dissemination and uptake

## 6.1 Uptake by the targeted audience

As indicated in the Description of the Action, the audience for this deliverable is the general public.

**6.2 This is how we are going to ensure the uptake of the deliverables by the targeted audience**

* Materials for the public and the audiences beyond the ESiWACE project have been disseminated through participation in conferences and workshops, see Section 10 below. Additionally, the source code and documentation for JDMA is freely available at:  
  <https://github.com/cedadev/django-jdma_control>  
  <https://github.com/cedadev/jdma_client>  
  <https://cedadev.github.io/jdma_client/docs/build/html/index.html>
* Confidential information, just for the partners and the European Commission Services. Not applicable, all material is freely available.

# 7. The delivery is delayed: 🞎 Yes ⌧ No

# 8. Changes made and/or difficulties encountered, if any

In the proposal, RAIT (Redundant Array of Independent Tapes) was mentioned as a possible method of using tapes in parallel, to improve performance. However, during the course of the project it became apparent that improving the interoperability of different storage systems was both a more desirable and achievable target. We therefore decided to concentrate on building what became **JDMA**, to try to offer some of the flexibility and functionality of MASS and MARS to users of JASMIN and across different storage systems.

# 9. Sustainability

## 9.1. Lessons learnt: both positive and negative that can be drawn from the experiences of the work to date

Developing a multi-tiered and flexible storage library has been quite a challenge in both the design and implementation with each of the interfaces to the storage systems having their own nuances. Although these problems have been overcome, it took longer than envisaged. This means that some key functionality, particularly moving data between storage systems, will have to be implemented after the ESiWACE project has finished.

However, the existence of **JDMA** is a huge positive and shows that libraries like this can be built and can help users of data centres work with large volumes of data stored on heterogeneous storage systems more effectively.

## 9.2 Links built with other deliverables, WPs, and synergies created with other projects

Not applicable.

**10. Full track of dissemination activities**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type of dissemination and communication activities** | **Details** | **Location , dates** | **Audience** | **Zenodo record / link to website** | **Estimated number of persons reached** |
| Participation to a conference  (presentation) | Neil Massey (STFC),  Evolving JASMIN: high performance analysis and the data deluge | Big Data from Space conference, Toulouse (FR), 30th November 2017 | Scientific Community (higher education, Research) | <https://doi.org/10.5281/zenodo.2597525> | 250 |
| Participation to a workshop  (presentation) | Neil Massey (STFC),  Semantic storage of climate data on object stores | RCUK Cloud workshop, London (UK), 8th January 2018 | Scientific Community (higher education, Research),  Commercial companies. | <https://doi.org/10.5281/zenodo.2597531> | 200 |
| Participation to a conference  (presentation) | Neil Massey (STFC),  Semantic storage of climate data on object stores | EGU conference, Vienna (AUT),  9th April 2018 | Scientific Community (higher education, Research) | <https://doi.org/10.5281/zenodo.2597522> | 100 |
| Participation to a conference  (presentation) | Neil Massey (STFC),  Semantic storage of climate data on object stores | SIG-IO UK, Reading (UK), 6th June 2018 | Scientific Community (higher education, Research),  Commercial companies. | <https://doi.org/10.5281/zenodo.2597522> (same presentation as EGU) | 50 |
| Participation to a conference  (poster) | Neil Massey (STFC),  Semantic storage of climate data on object stores | NCAS staff conference, 6th February 2018 | Scientific Community (higher education, Research). | <https://doi.org/10.5281/zenodo.2597536> | 200 |