UNICORE Data Management: Recent Advancements

K. Benedyczak T. Rękawek J. Rybicki B. Schuller

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Data wave is coming!

The coming years will be marked by an increasing amount of data produced and processed (“wave of data”\(^1\)):

- global, diverse, valuable and complex data
- science is both producer and consumer of this data

\(^1\)“Riding the wave: How Europe can gain from the rising tide of scientific data”
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Examples:

- The Virtual Human Brain: 50 billion neurons, a neuron can possess up to 15,000 synapses

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Examples:

- The Virtual Human Brain: 50 billion neurons, a neuron can possess up to 15,000 synapses
- Medical data amounts to 30\% of the data produced
- 2.5 PB of mammograms are stored in the U. S. alone

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UNICORE

UNICORE (Uniform Interface to Computing Resources)
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Question

How UNICORE can handle large amounts of data and support data-oriented scientific processes?
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How UNICORE can handle large amounts of data and support data-oriented scientific processes?

What are the UNICORE capabilities to:

- store,
- transfer,
- and manage large amounts of data.
Data storage

Problem: The data must be stored somewhere

Somewhere is the crucial word here. The user usually doesn’t care as long as a seamless access to the data is granted.
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UNICORE solution: Distributed Storage (dSMS)

- hides the complexity from the user: well-known SMS abstraction
- single “access point” for the users
- . . . which can be replicated for redundancy and load balancing
- flexibility (in adding new resources)
Data transfer

Problem: How to move the data from one place to the other?

As usually:
- the user doesn’t care: she wants to just move the data quickly from one place to the other
- the admin doesn’t care: she doesn’t want to change anything (on firewall)
Data transfer

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UNICORE solution: **UFTP**
- dynamic firewall port opening using a pseudo FTP connection
- parallel input/output streams
Data transfer

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UNICORE solution: **UFTP**
- dynamic firewall port opening using a pseudo FTP connection
- parallel input/output streams
- new feature in UNICORE: scheduled transfers
Problem: How to organize and manage the data?

*Where are the results of my simulation from 16/05/2005? I need them quickly!*
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UNICORE solution: Flexible Framework for Metadata Management (MMF)

- integrated in the UNICORE Atomic Services
- flexible and extensible
- schemaless
- searchable
- supports automatic extraction
Architecture

UNICORE Client

- UCC
  - Web Services

UNICORE/X

- Metadata Service
  - Delegates
  - Storage Service (SMS)

Storage Access

Indexer
Model

- StorageMetadataManager
  - LuceneMetadataManager()
  - createMetadata(resourceName : String, lstMetadata : Map<String,String>)
  - updateMetadata(resourceName : String, lstMetadata : Map<String,String>)
  - searchMetadataByContent(searchString : String, isAdvancedSearch : boolean) : List<SearchResult>
  - getMetadataByName(resourceName : String) : Map<String,String>
  - removeMetadata(resourceName : String)
  - renameResource(source : String, target : String)
  - copyResourceMetadata(source : String, target : String)
  - startAutoMetadataExtraction(directory : String, depthLimit : int) : Future<ExtractionStatistics>
  - setStorageAdapter(storage : IStorageAdapter, storageID : String)

- IStorageAdapter

- JSONAdapter
  - convert(what : byte[]) : Map<String,String>
  - convert(metadata : Map<String,String>) : byte[]

- MetadataCrawler
  - call()

- LuceneIndexer
  - createMetadata(resourceName : String, metadata : Map<String,String>, contents : String)
  - removeMetadata(resourceName : String)
  - updateMetadata(resourceName : String, metadata : Map<String,String>, contents : String)
  - moveMetadata(source : String, target : String)
  - search(queryStrings : String[], numberOfRecords : int) : List<SearchResult>

- Apache.Tika.Parser
  - parse()
Demo
## Functionality I

<table>
<thead>
<tr>
<th>UNICORE MetadataService</th>
</tr>
</thead>
<tbody>
<tr>
<td>whole storage interactions via <code>IStorage</code> interface (integration)</td>
</tr>
<tr>
<td>metadata are stored both in:</td>
</tr>
<tr>
<td>1. Storage (as files with <code>.metadata</code> extension)</td>
</tr>
<tr>
<td>2. Lucene Index</td>
</tr>
<tr>
<td>JSON representation without schema</td>
</tr>
</tbody>
</table>

## Apache Lucene

- high-performance, full-featured text search engine
- advanced queries: wildcard, range, compound, proximity
Functionality II

Apache Tika

- toolkit for detecting and extracting metadata and structured text content from various documents
- supports: html/xml, doc/odt, pdf, rtf, zip, midi, mp3, tiff/jpg, flc, java, dwg, ttf
- extensible (very simple interface)
Data Management in UNICORE

- Store in dSMS
- Transfer with UFTP
- Describe and search with MMF
Data Management in UNICORE

- **Store in dSMS**
  - proper handling of sensitive data
  - keeping data close to computing resources

- **Transfer with UFTP**
  - automatic transfer protocol negotiation
  - deployments

- **Describe and search with MMF**
  - convenient ways to provide own parsers
  - URC integration
Thanks

j.rybicki@fz-juelich.de