Supporting Large-Scale Data-Intensive Computation for Seismology in VERCE

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Overall Objectives

- VERCE: **V**irtual **E**arthquake and Seismology **R**esearch **C**ommunity in **E**urope
- Unified, Europe-wide computing infrastructure
- Support common ***data***- and CPU-intensive tasks
- Exploit local and remote processing and storage resources
- Use-case driven:
  - Ambient noise cross-correlation

Data-Intensive Requirements

- "Data-intensive": when data management and processing is the bottleneck due to volume or algorithmic reasons.
- Data staging, pre-processing and cross-correlation
  - mainly on private or (in the future) high-throughput resources
- Arbitrarily many continuous waveforms (typically 24h records from local, regional, global networks)
- Over arbitrarily long periods of time
- Unified view of data sources (files, online feeds)
  - Through metadata (e.g. station, channel, time, etc.)

VERCE Technical Goals

- Transparent parallelism and maximum utilisation of local resources
  - Fine-grained *Dispel* workflows
- Data management
  - Preemptive and reactive movement/replication
  - Extensive use of science-specific metadata
- Customisation of workflows
  - Use of community oriented library tools, e.g. ObsPy

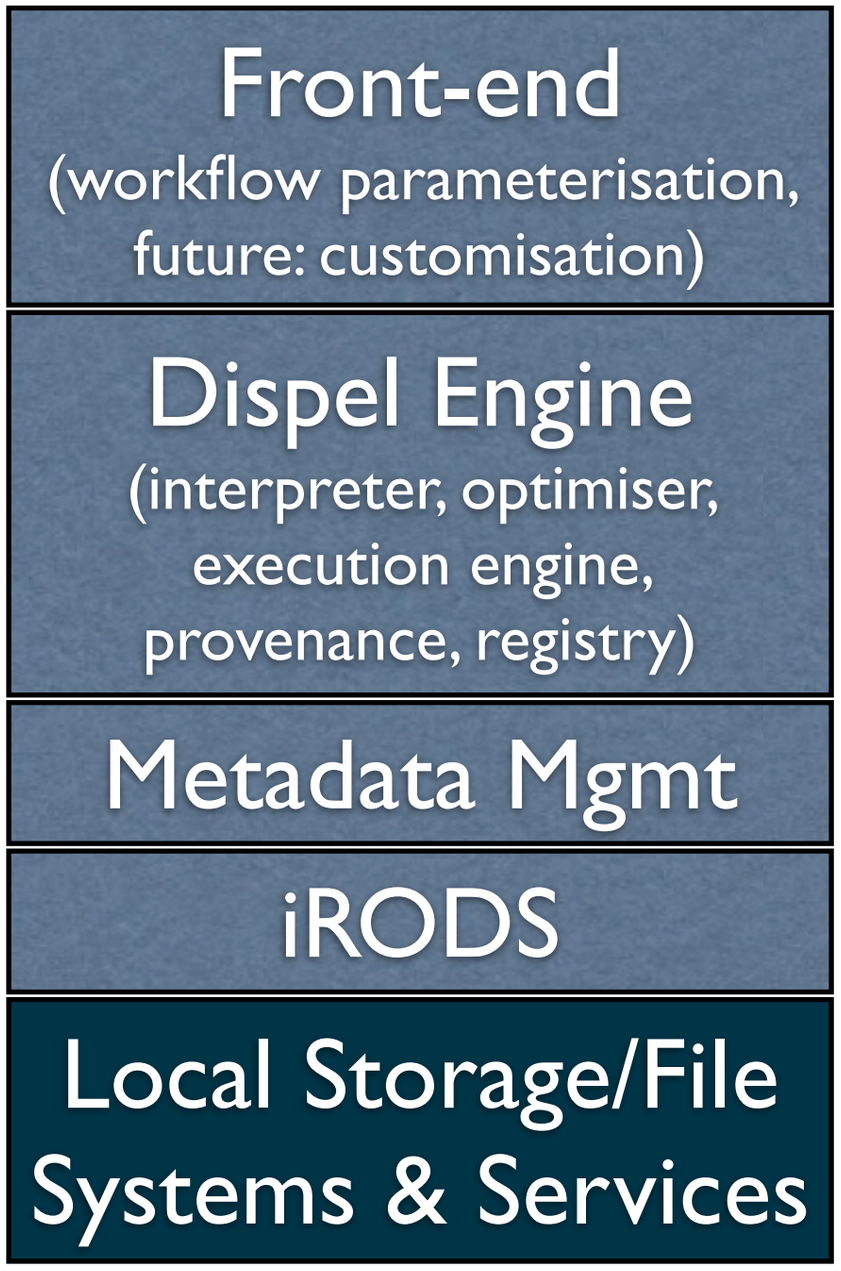
Dispel: Fine-Grained Scientific Workflows

- Composition of arbitrarily fine-grained workflows through *processing elements* and *functions/constructors*
- Stream-oriented / online processing:
  - Keeping 'threads' of workflows busy
  - Decoupling from lower-level, technical details
- An example seismology processing element may have
  - High-level specification in Dispel - typed I/O streams and parameters
  - Lower-level implementation in ObsPy, or other libraries
  - Tweaking parameters alters behaviour

VERCE Data Management

- Main components, currently under consideration:
  - iRODS network in participating sites
  - MonetDB-based metadata manager
- iRODS offers support for decentralised policies
  - different scientific sites have different requirements
- MonetDB component
  - indexes scientific metadata available (through iRODS) at each site
  - unifies data access to VERCE components (e.g. Dispel engines)

Architectural Stack



- D-I workflows are defined in terms of stream-based PEs
  - Executed initially on Dispel-aware, local resources
- Scientific codes and scripts provide the basis for Dispel PEs
  - Forming a shared, distributed library of components
- Data are queried and retrieved, in principle, via scientific metadata

Current Actions

- Evaluation of individual components
  - iRODS, MonetDB, Dispel execution engines
- Enrichment and refinement of the PEs library to meet scientific requirements
  - Currently Python-based, ObsPy
- Collaborating with other projects and initiatives
  - SCI-BUS: support for meta-workflows, potential support for SHIWA for VERCE, etc.
  - EUDAT: archiving of products
  - ERC Whisper for additional data-intensive seismic noise correlation methods and tools

Roadmap and Conclusions

- 6 Months - Alpha testing large-scale cross-correlation
  - VERCE data layer and integration with Dispel engine
  - Basic interaction through a Science Gateway
  - Continuous deployment on VERCE Dispel-aware sites
- 12 Months - VERCE test platform open to public
  - Better integration with archiving services (e.g. EUDAT)
  - High-throughput computing support (EGI), alternative execution engines and optimisation
  - Workflow parameterisation through the front-end
- Combination of 'in-house' development and reaching out
  - maximising impact and sustainability