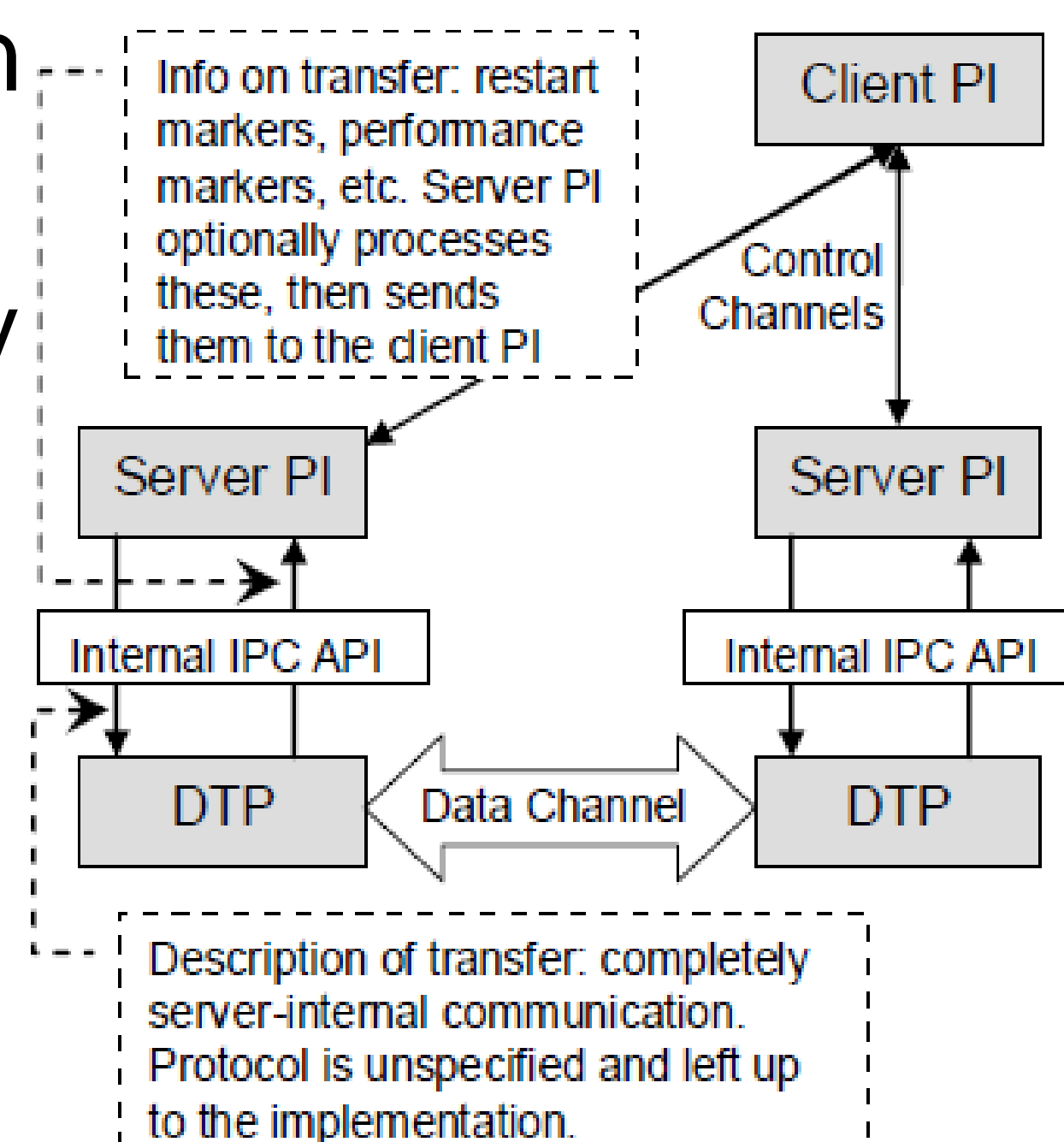


Motivation

- Science becomes increasingly data driven
- **“Big Data” Challenge**
 - Fast semi structured data generation speed
 - Slow disk IO and network speed
 - Distributed and Spread Data
- Wide-Area Data Transfer Protocols (Globus GridFTP)
 - Efficient data transfer over wide-area network
 - Data Transfer Volume? - File level (GB or TB in size)
 - Strong needs for data subsets transfer
- Goal: Integrate core data management functionality with wide-area data transfer protocols

Globus GridFTP

- Support efficient data transfer in grid community
 - 3500+ server, 1PB+ transfer/day
- Parallel, Streaming Transfer
- Reliable, Restartable Transfer
- Data Storage Interface (DSI)
 - Compatible with different file systems and platforms
 - Dynamic loading, small overhead



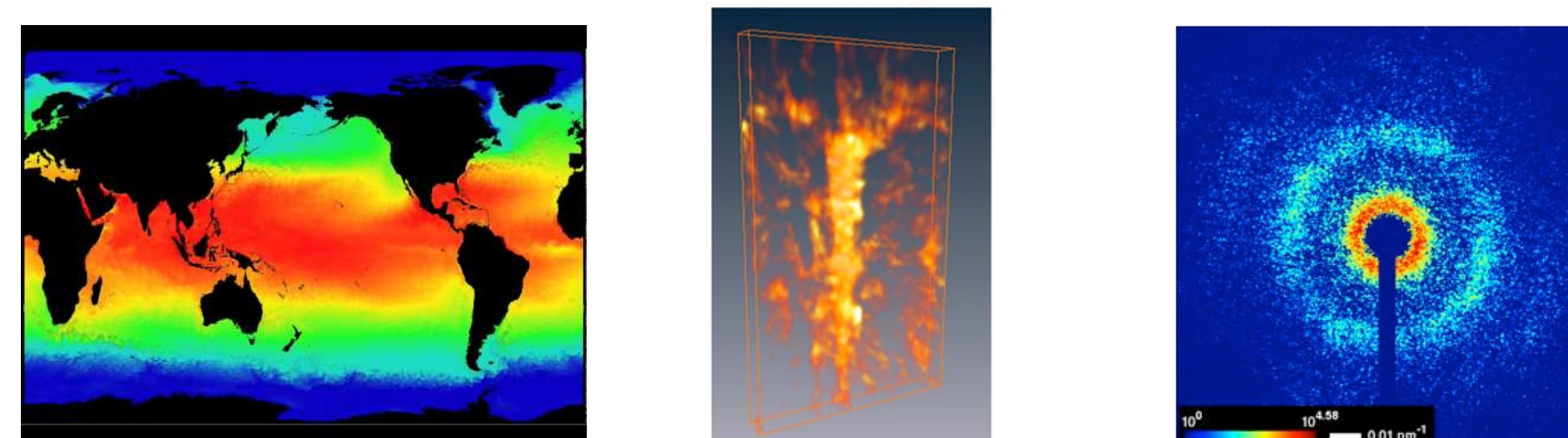
Challenges

- Flexible Data Management:
 - Standard interface to describe subsetting requests
 - Dimension or Coordinates-based subsetting
 - Value-based subsetting
- Challenges:
 - How to locate the relevant data source / file?
 - How can users view a combination of remote files and conveniently specify data subsets that is of interest to them?
 - How to support efficient data retrieval with different subsetting scenarios across multiple data sources / files?
 - How to combine the result set to a relevant data source that can be used by the data requestor?

Distributed Scientific Data Query Data Storage Interface

Motivation Applications

- Climate Simulation, Tomography
- X-ray Photon Correlation Spectroscopy



GridFTP SDQuery DSI

- Efficient data transfer over flexible file subset
 - Queries embedded in data download request
 - Dynamic loading/uploading with small overhead
 - Multiple query types and data formats
 - Bitmap Indexing: efficient value-based subsetting
 - Metadata View
- Performance model based hybrid subsetting
- Parallel streaming data reading and transfer

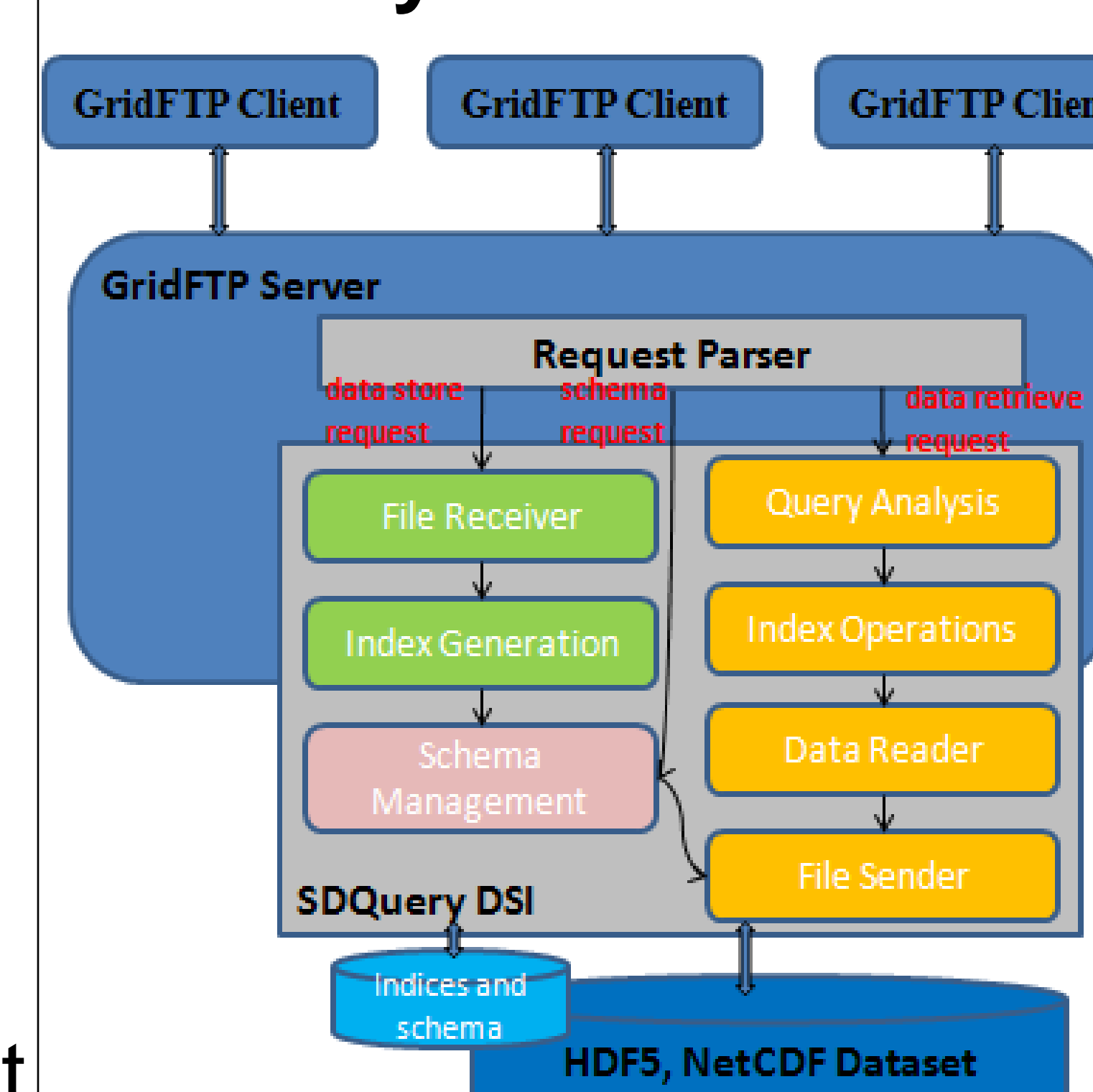
GridFTP DSDQuery DSI

- Database is being formed by the query.
- Uses SDQuery for data collection, preserves the advantages of SDQuery.
- Automatic Meta-Data extraction - Bridger
 - Detects new data sources, scans it, recognizes and extracts its structure automatically.
- Automatic data source relevancy detector
 - context is being referred from the query.
- Output - constructs a data source in a convenient structured format (NetCDF for scientific data)

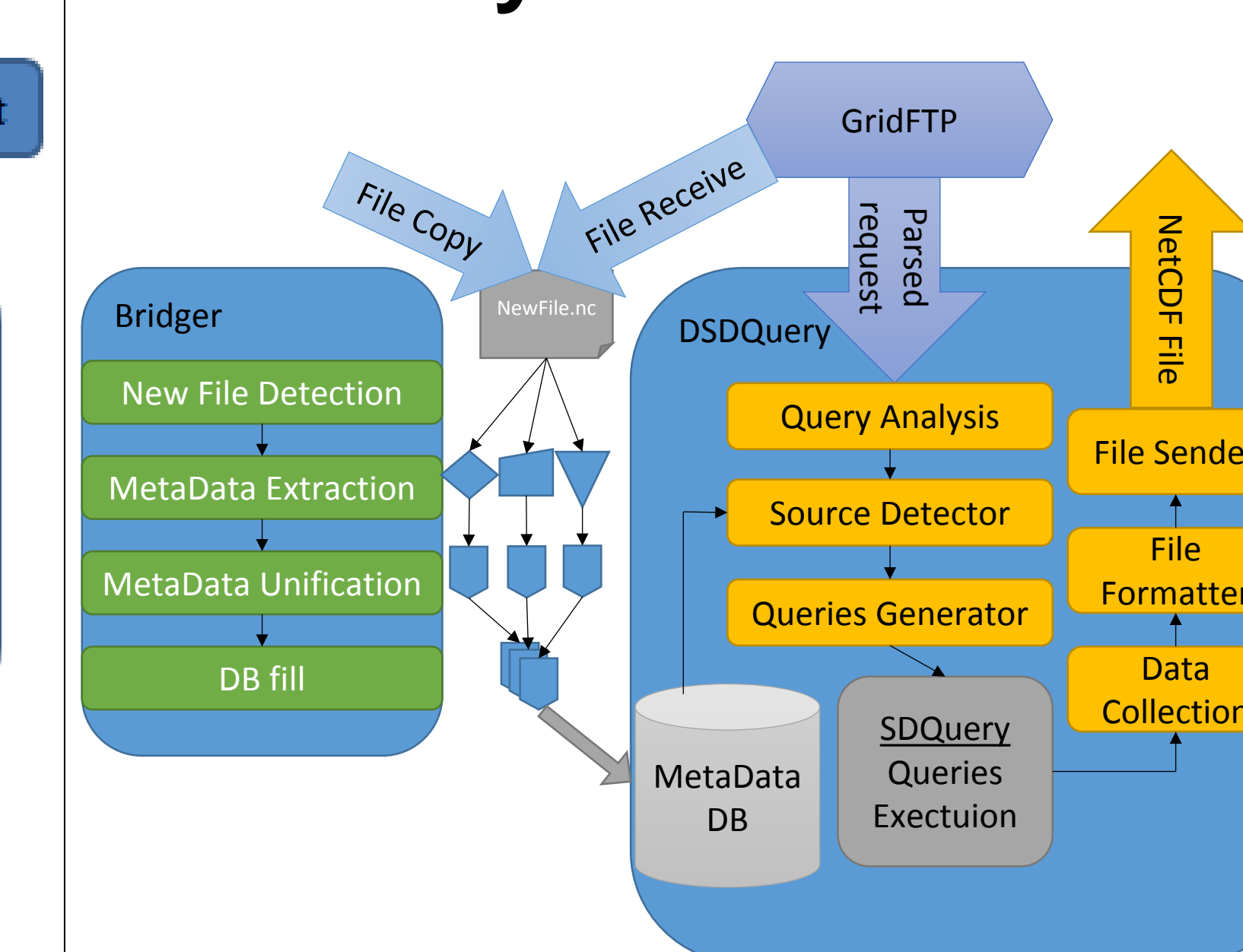
Distributed content and system

- Different aspects of distributed system
 - Distributed Files (Current implementation)
 - Different files within the system
 - Different files within the same directory / subdirectories.
 - Distributed Data – over network

SDQuery Architecture



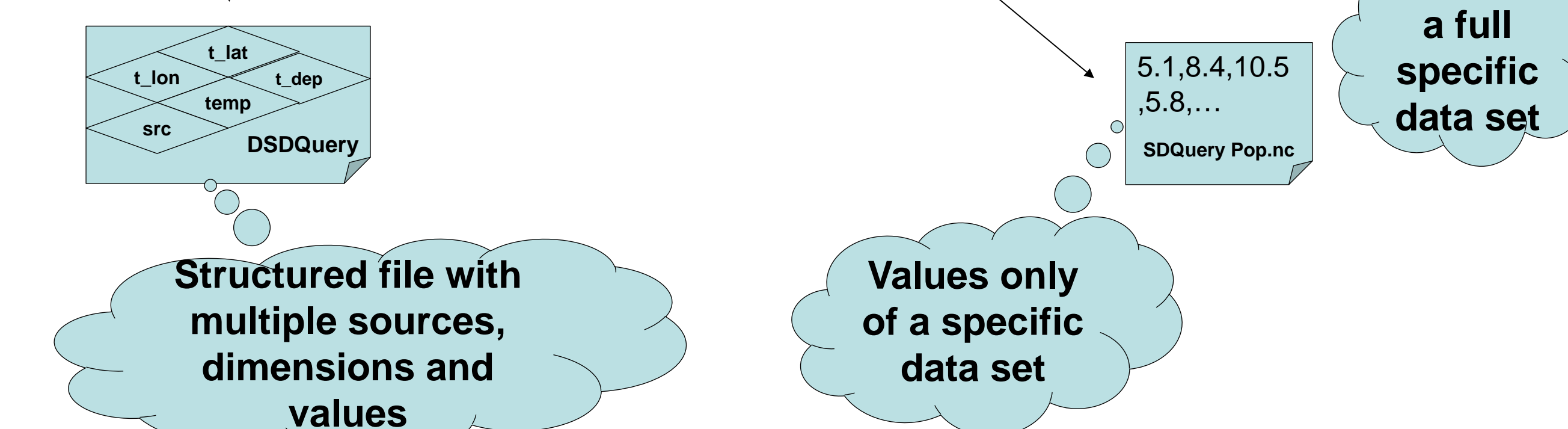
DSDQuery Architecture



User Case

- Find the data elements under the depth of 50 meters of the ocean and the temperature is larger than 5 centigrade

```
Client Side Request Examples
globus-url-copy -v "ftp://server/srcdir/POP.nc" file://tgt/
globus-url-copy -v "ftp://server/srcdir/POP.nc(SQL:SELECT TEMP FROM TEMP WHERE TEMP >= 5.0 AND depth_t < 50.0)" file://tgt/
globus-url-copy -v "ftp://server/(DSQL:SELECT TEMP FROM TEMP WHERE TEMP >= 5.0 AND depth_t < 50.0)" file://tgt/
```



Contributions

- DSDQuery DSI: a GridFTP plug-in to support flexible data subsetting over generic scientific data source (currently - HDF5 and NetCDF sources).
- Automatically extract necessary metadata.
- Automatically locates the relevant data and restructures it based on an SQL query.
- Combines multiple sources to multi-dimensional output.
- Seamless integration with GridFTP server.