Exploring NCAR's Campaign Store with Elasticsearch

How much can we know about 120 PiB in a summer?

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Background

- **NCAR Campaign Store:**
  - Resource for medium-term storage of project data, typically for three to five years, by NCAR labs and universities
  - **Large volume**:
    - ~120 pebibyte capacity (1 PiB ~ 1 million GB)
    - 90% currently used (~4 billion files)

- **Central question:**
  - How do we facilitate data searching within Campaign Store for NCAR scientists?

Background

- **Application:**
    - Java-based web application that interfaces with Elasticsearch to index files and directories
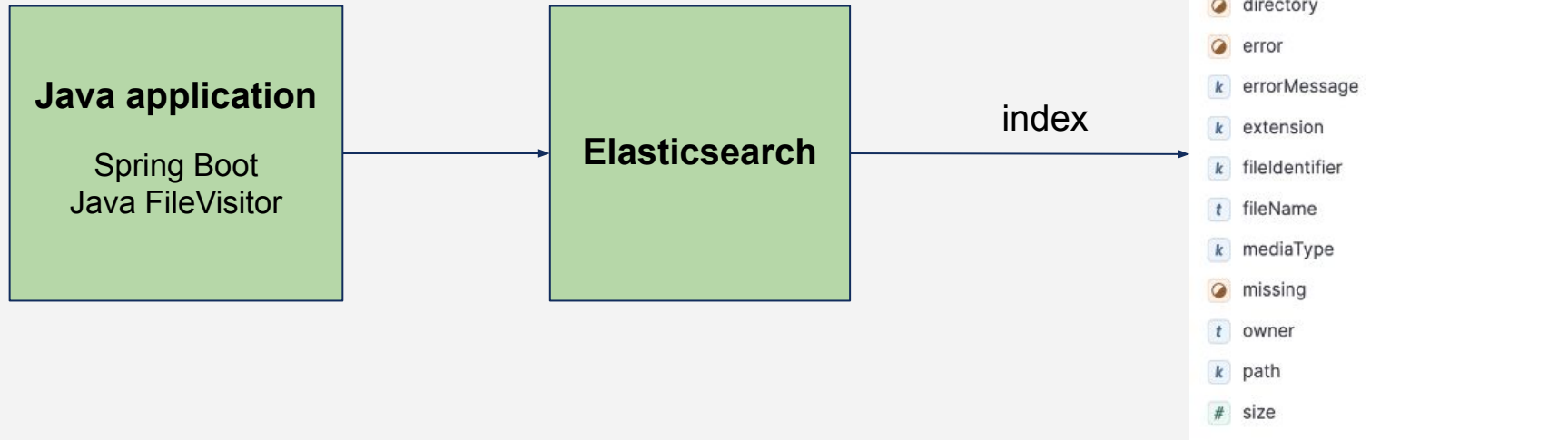
File Walkers State

Start Directory	Ignored Directories	Start Time	Total Time (ms)	Files	Errored Files	Directories	Errored Directories	Other Errors	Running
/glade/campaign/cesm	[/glade/campaign/cesm/development/espwg/SMYLE/archive/]	Mon Jul 22 13:20:23 MDT 2024	596828045	2,622,994	0	360,399	214	1,246	true
/glade/campaign/collections	[/glade/campaign/collections/cdg/data/CMIP6/, /glade/campaign/collections/cdg/data/cmip5/]	Mon Jul 22 13:20:23 MDT 2024	596828046	58,616,412	0	1,303,766	582	344	true
/glade/campaign/mmm	[]	Mon Jul 22 13:20:23 MDT 2024	596828046	196,677,980	0	2,415,254	1,653	2,954	true
/glade/campaign/acom	[]	Mon Jul 22 13:20:23 MDT 2024	596828045	6,176,839	0	162,112	0	0	true

Refresh

Run File Walkers

The challenge of time and volume

- Current number of files on campaign store: 4,088,158,704

Name	Health	Status	Primaries	Replicas	Docs count	Storage size
file-walker-files	● green	open	7	0	499,936,380	140.17gb

The restart problem

- How do we keep track of the file walker's progress to continue where we stopped?
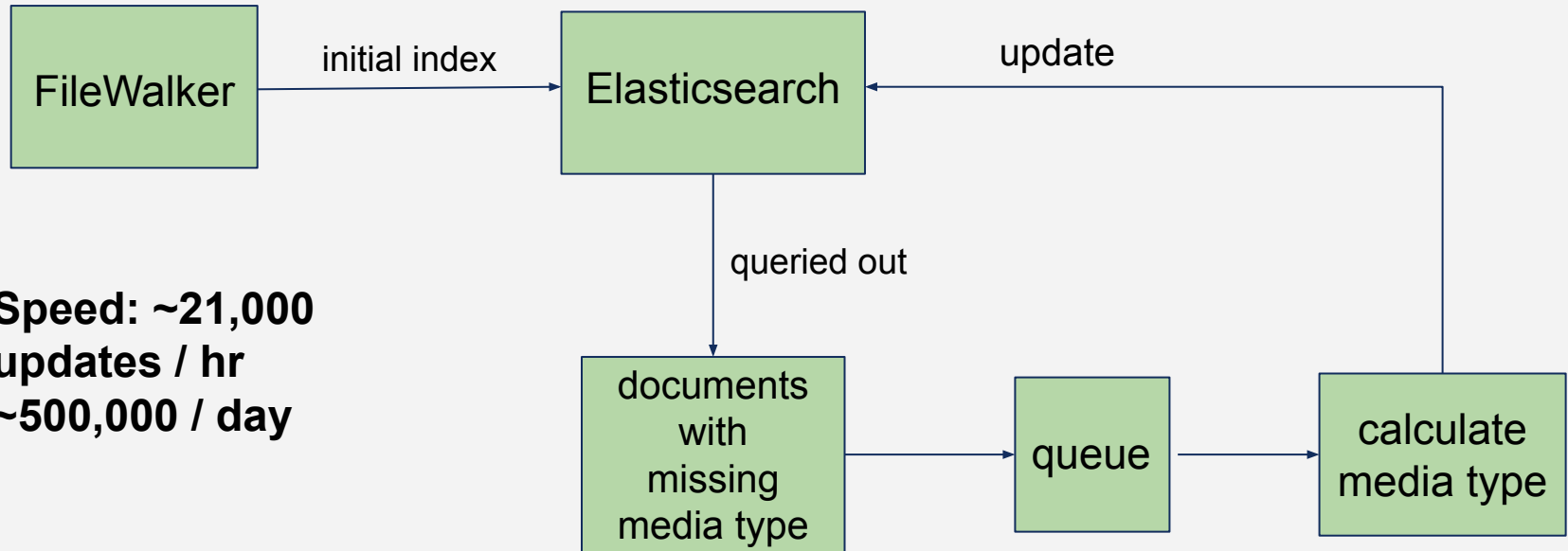
The metadata calculation problem

- **Tika: used to calculate media type**

- **Current Workflow:**
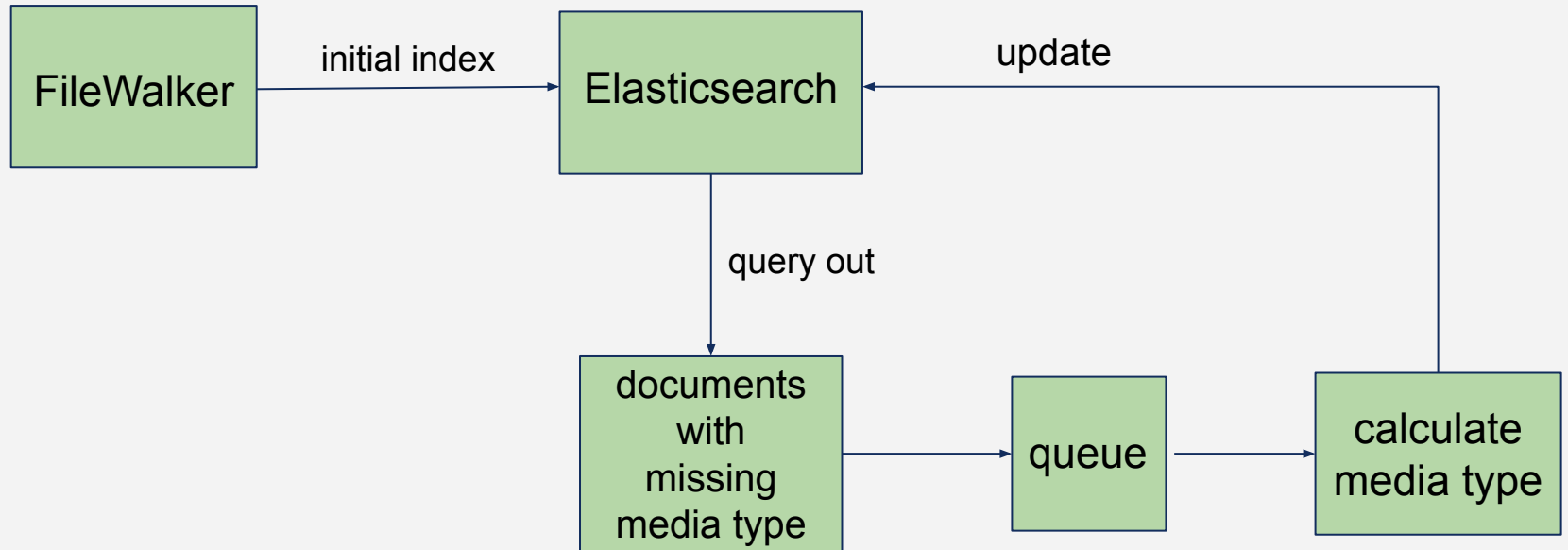
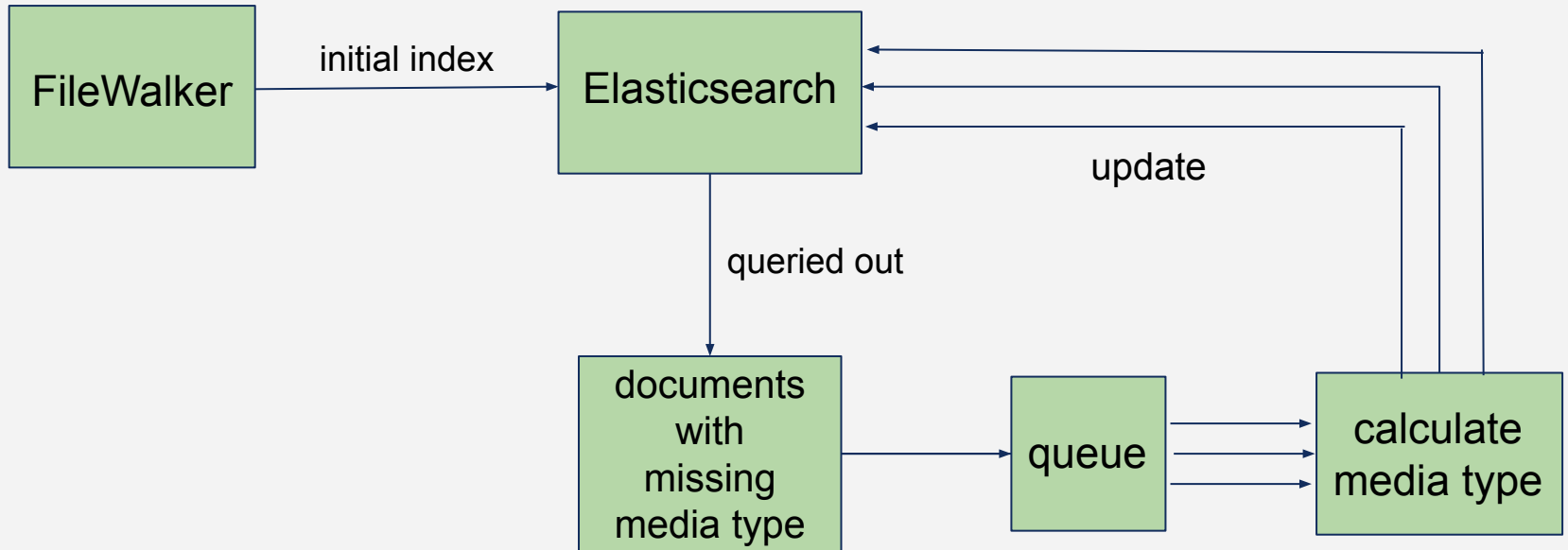# The metadata calculation problem

- **Current Workflow:**

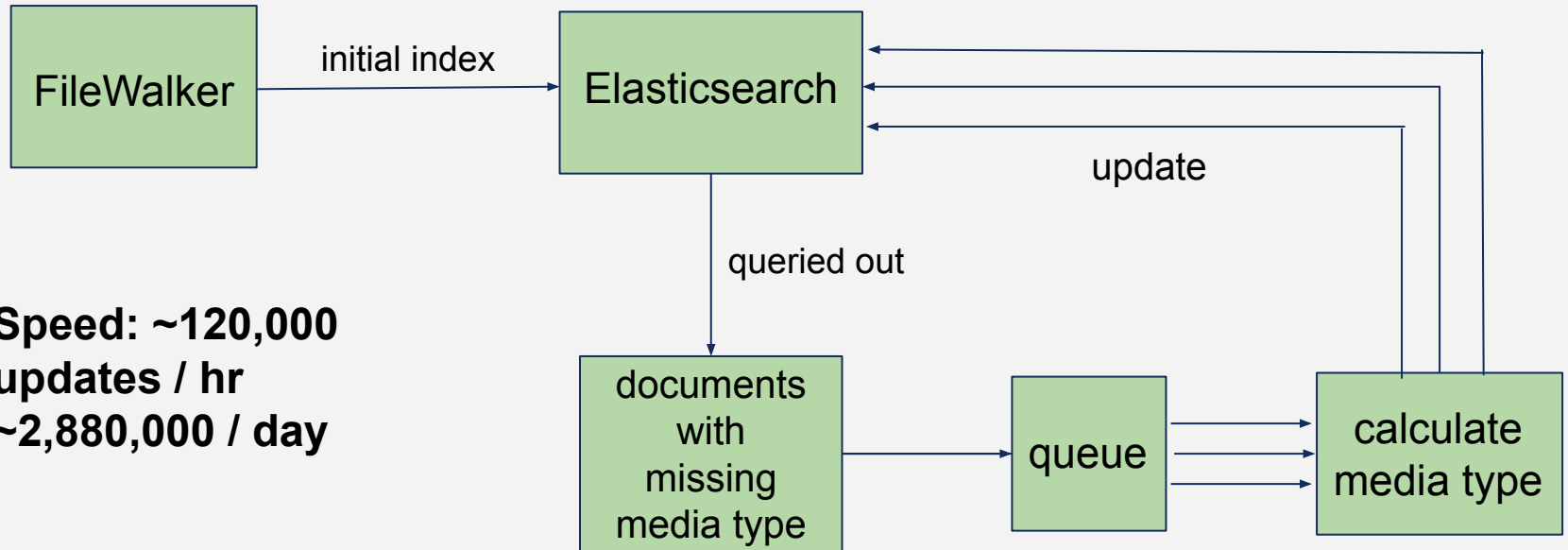- **Speed: ~21,000 updates / hr**
- **~500,000 / day**

The metadata calculation problem

- **Improvement: multithreading and tuning variables**

- **Workflow:**

The metadata calculation problem

- **Improvement: multithreading and tuning variables**

- **Workflow:**

```
┌──────────────┐    initial index    ┌──────────────┐ ◄────────────────────────────┐
│              │ ──────────────────► │              │ ◄─────────────────────────┐  │
│  FileWalker  │                     │ Elasticsearch│ ◄──────────────────────┐  │  │
│              │                     │              │                 update  │  │  │
└──────────────┘                     └──────┬───────┘                        │  │  │
                                            │                                │  │  │
                                            │ queried out                    │  │  │
                                            ▼                                │  │  │
                            ┌──────────────┐        ┌────────┐        ┌─────────────┐
                            │  documents   │        │        │ ─────► │  calculate  │
                            │  with        │ ─────► │ queue  │ ─────► │  media type │
                            │  missing     │        │        │ ─────► │             │
                            │  media type  │        └────────┘        └─────────────┘
                            └──────────────┘
```

- **Speed: ~120,000 updates / hr**
- **~2,880,000 / day**

Exploring scientific metadata

- **We know things about the files, what's actually in them?**

  - Harvest data inside netcdf, hdf, and grib files using Unidata NetCDF library

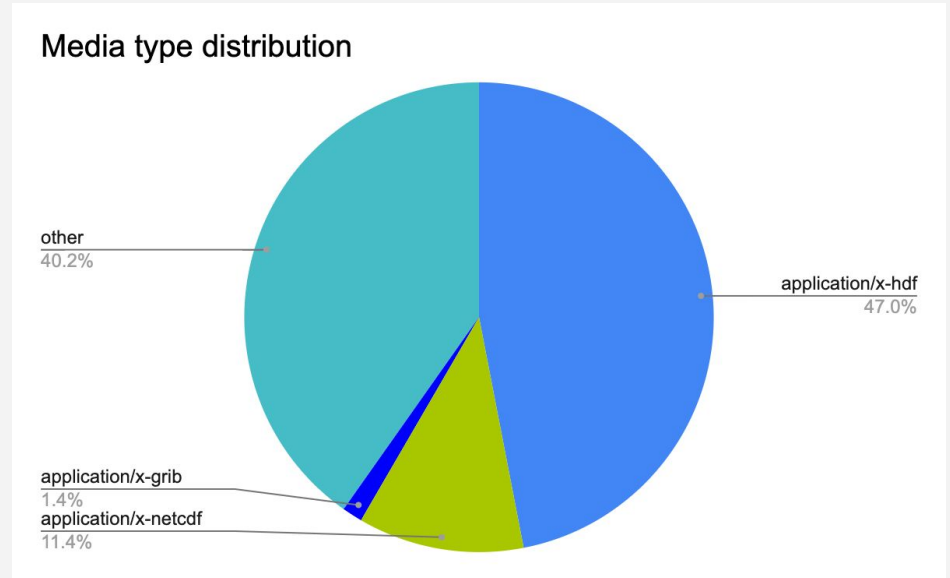 - Ex: variable names (standard_name, long_name, short_name), contact, author

Results

- Indexed **486,899,650** files and **13,075,066** directories (~**37.1** pebibytes)

- Calculated media type for **36,262,238** files

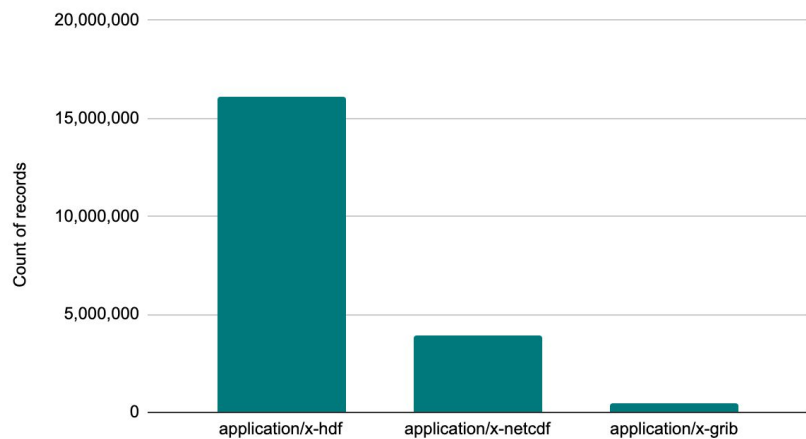- Checked **2,657,132** files for scientific metadata

Results

- **152** unique media types
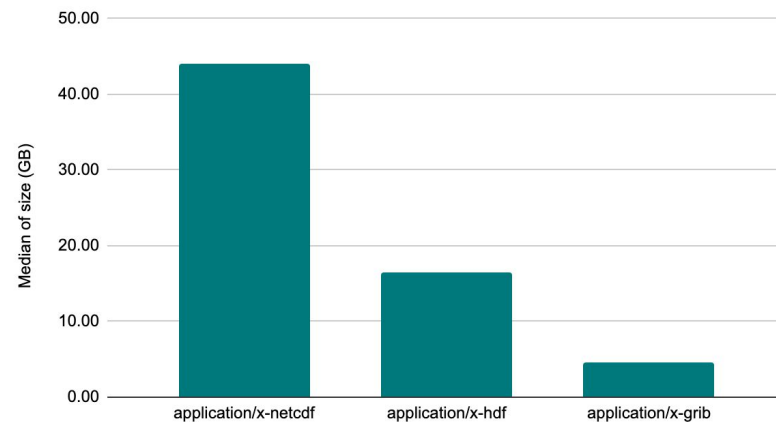
- **21,722,204 (59.8%)** are hdf, netcdf, grib

Media type distribution

other
40.2%

application/x-hdf
47.0%

application/x-grib
1.4%

application/x-netcdf
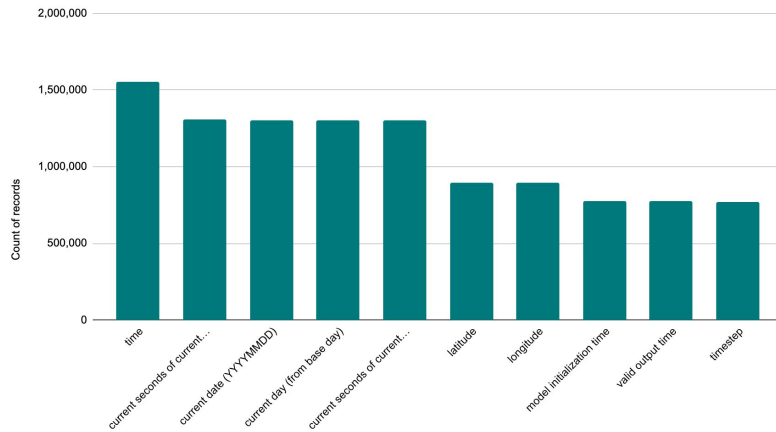11.4%

Results

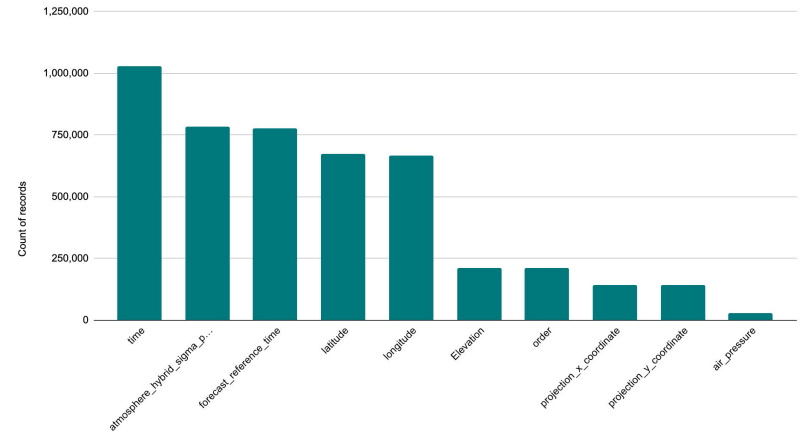Count of scientific files

Median size of scientific files

Results

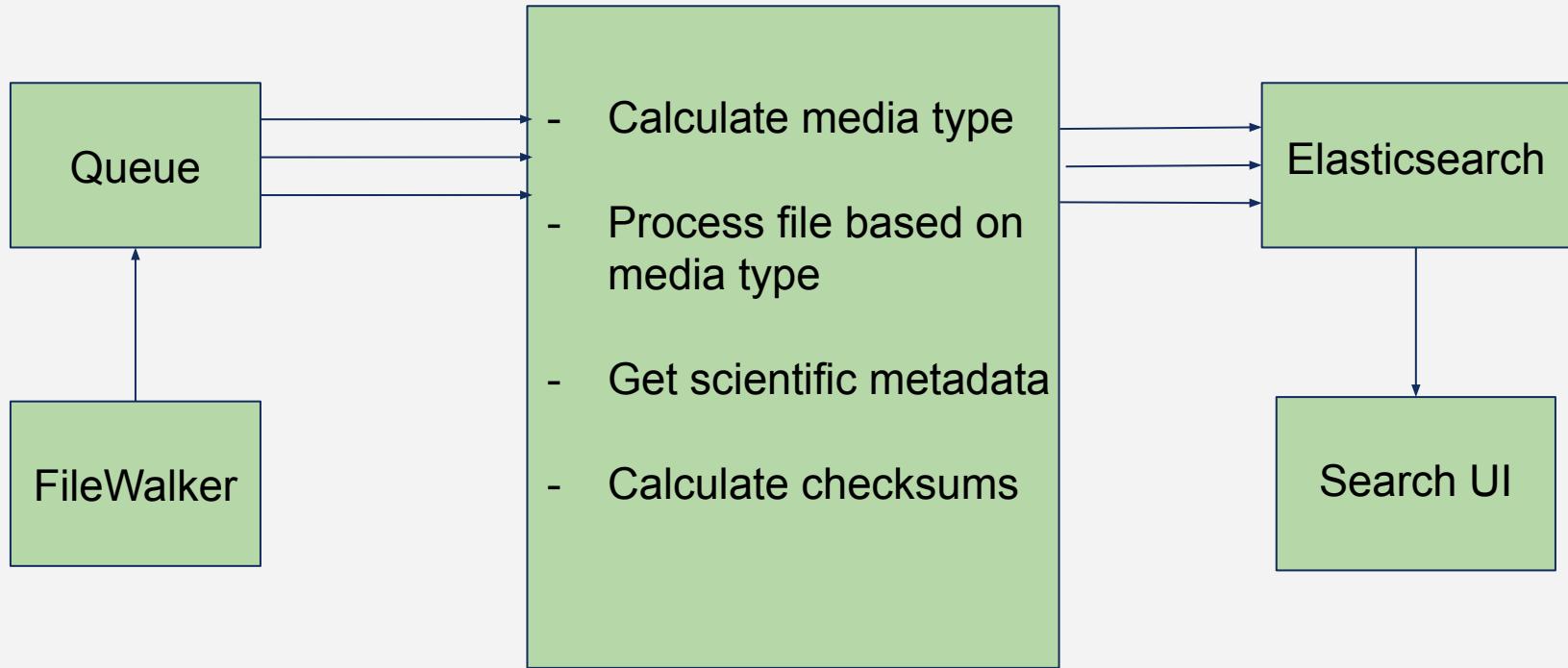- **70%** has standard_names, **9.1%** has contact, **0.1%** has author

Top 10 values of long_name

Top 10 values of standard_name

Future Work: adding functionalities and increasing efficiency

Acknowledgements

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