Legion Performance Analytics

Septembre 2021

Legion Performance Analytics

- **Introduction**
- Requirements
- Architecture
- Roadmap

Introduction

Definition

- `Performance` : quantified non-functional requirement
- **The test of the machine is the satisfaction it gives you.**— Robert M. Pirsig, *Zen and the Art of Motorcycle Maintenance: An Inquiry Into Values*
- Performance for software
  - Latency
    - ex.: frame time, reaction time, replication time, load time
  - Stability
    - ex.: MTBF, crashes, error logs, memory use
  - Satisfaction
    - ex.: retention, engagement, biometrics, surveys

Introduction

Stages of data storage

- **in-app**: buffered streams of structured events
- **Data Lake**
  - write-friendly format
  - shallow index
- **Data Warehouse**
  - ephemeral subset
  - deeply indexed
  - SQL

Introduction

Levels of analytics

- in-app: basic stats, adjust level of details of telemetry
- Basic stats over multiple sessions: MTBF, max memory use
- Deep inspection of a single session: Mem use of every asset, flame graphs
- Aggregates of high-frequency events over many sessions: Heat maps

Legion Performance Analytics

- Introduction
- **Requirements and implications**
- Architecture
- Roadmap

Requirements

Frequency of events

- High Frequency: thousands of events per frame
  - begin/end function call
  - begin/end asset-specific scope
  - memory alloc/free

Requirements

Frequency of events

- Frame metrics
  - frame time, engine time, render sync
  - player health, #npcs
  - process memory allocated/available
  - i.e. mostly time series

Requirements

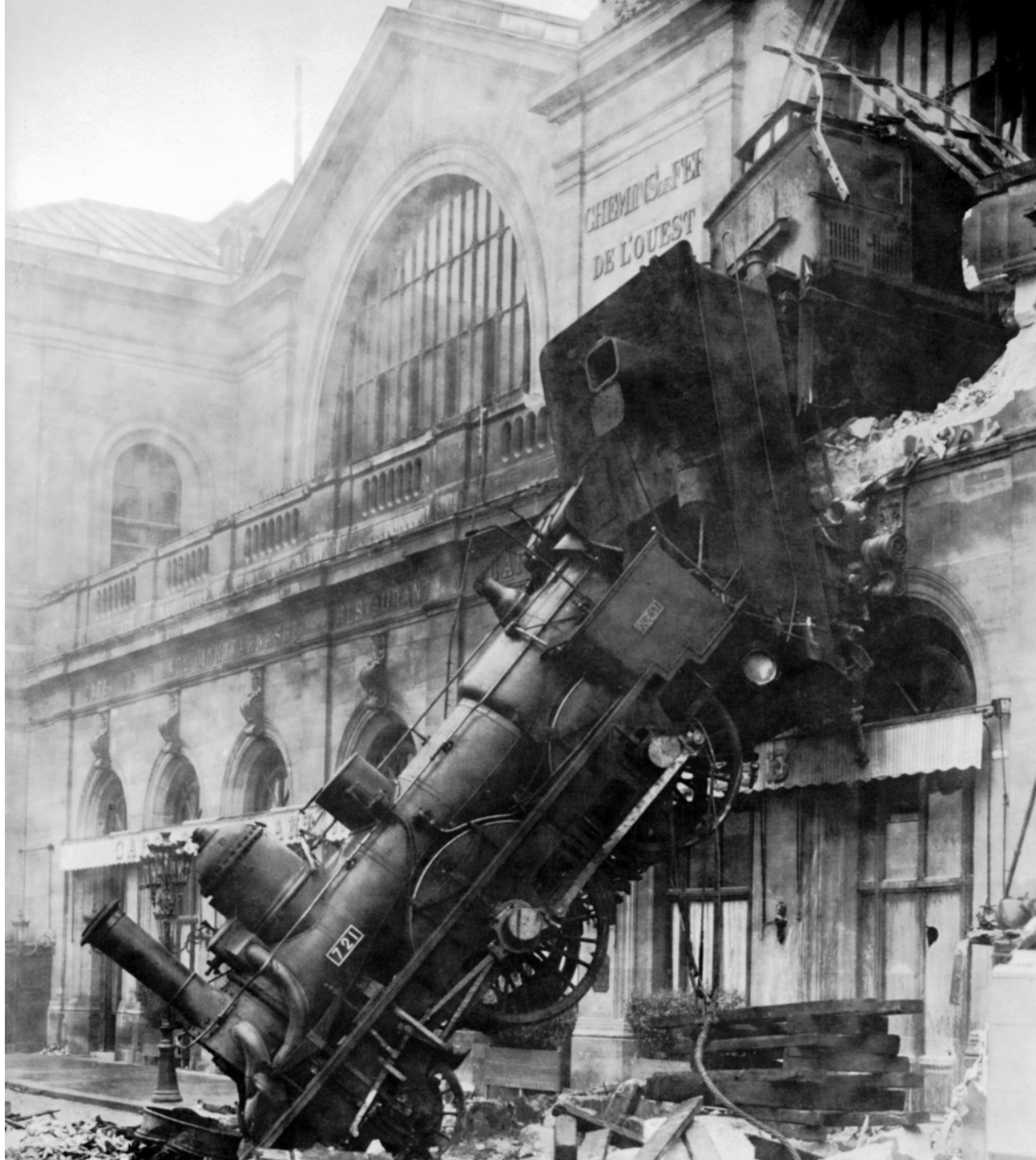
Frequency of events

- Behaviour events
  - begin/end system state
  - gameplay events
  - user input

Requirements

Frequency of events

- Logs
  - begin/end app state (world loaded, in-play, matchmaking)
  - warnings
  - crashes with callstack



Requirements

Generic and Extensible event stream format

- Open/Closed principle: open for extension, but closed for modification
- Adding a feature-specific event should have no impact on ingestion pipeline
- No magic: specific reports/views depend on the presence of specific events
  - tagging of streams to advertise the purpose/suitability
  - i.e. dynamic duck typing
- not limited to time series

Requirements

Generic and Extensible event stream format

Performance characteristics

- write-friendly
  - most work is done with memcpy
  - important size optim: object references
- ingest-friendly
  - store without parsing whole block
  - compressed payload is not decompressed
- generic reader
  - as generic as JSON
  - metadata to decode the writer's memory model

Requirements

Understanding distributed applications

- one application session can extend to multiple processes
- sync clock easier for RPC model of distributed computation

Requirements

5 views to rule over all data

List / Table / Search

- recent sessions
- top crashes
- cpu budget report

Requirements

5 views to rule over all data

Time series

- Individual frame times over time
- Player health over time
- Cohort engagement over 30 days

Requirements

5 views to rule over all data

Graphs & Trees

- Cumulative function call statistics
- Loaded object graph

Requirements

5 views to rule over all data

Timeline

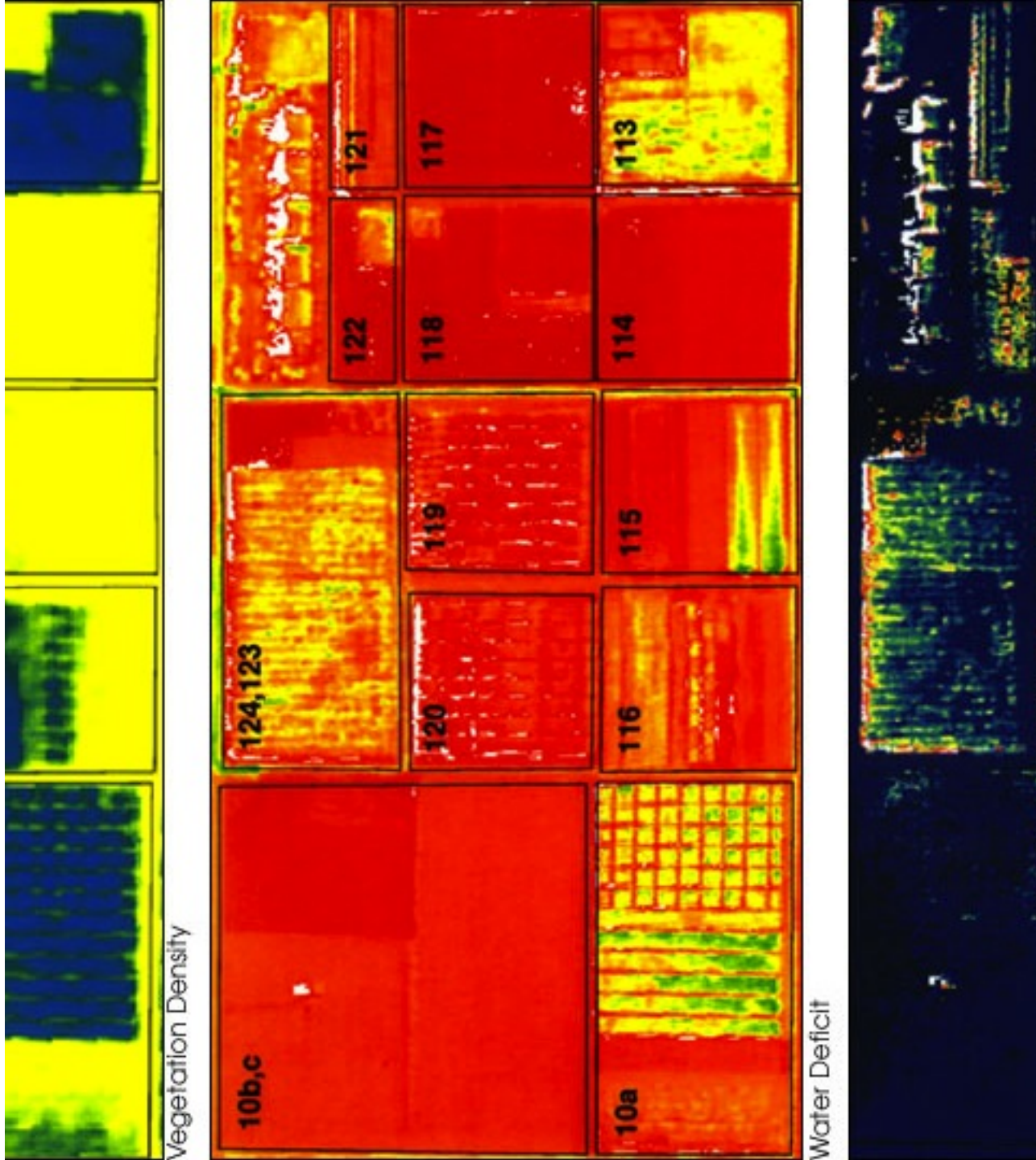
- Call tree instances per thread

Requirements

5 views to rule over all data

Heatmap

- death map
- geographic slow frames distribution



Requirements

non-requirements

- interactive debugging
- per-pixel profiling
- low-level cpu events (L1 cache miss, branch mispredictions, ...)

not yet

- Video streaming & overlay
- cpu sampling
- context switches

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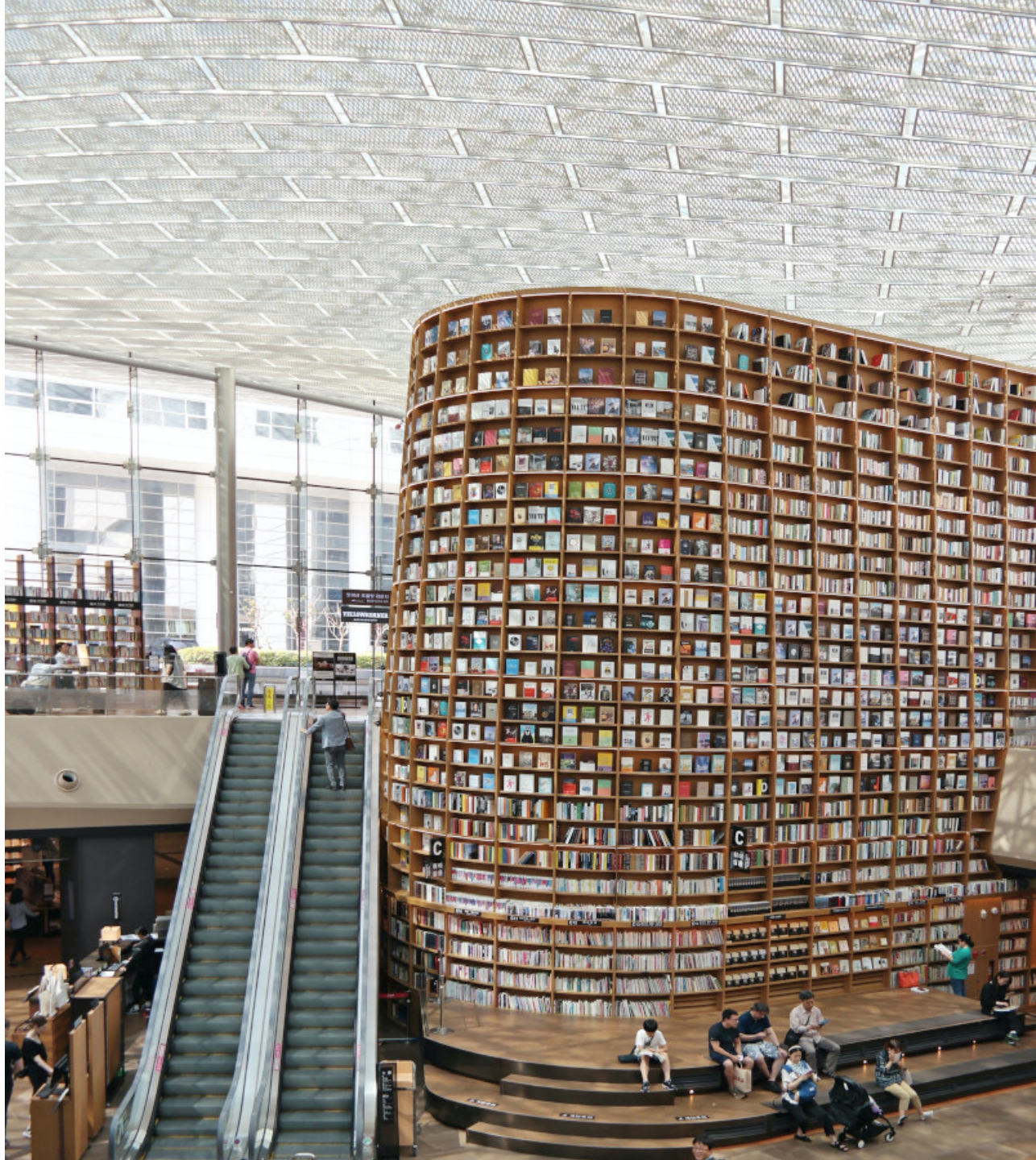
Architecture

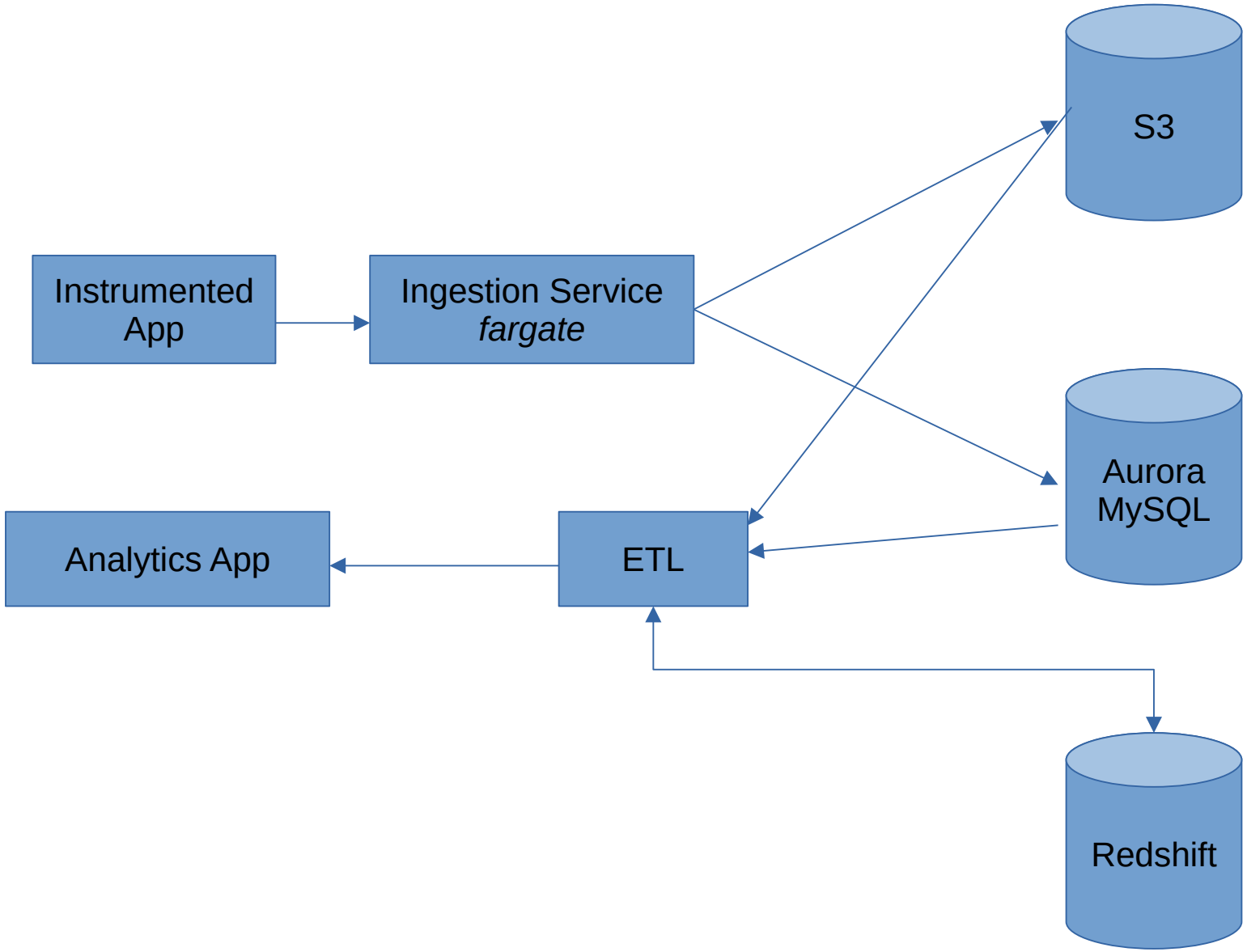
Object hierarchy

- Process instance
  - Stream
    - Stream block
      - Event



Architecture

Online architecture



Architecture

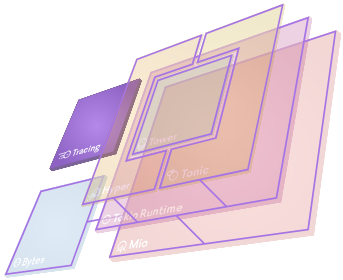
Integration/reuse of existing solutions

Many ideas in common with `tracing` crate from the `tokio` project.

https://docs.rs/tracing/0.1.26/tracing/

But `Collect` trait at the center of the system is a poor fit.

Could support the interface to get visibility into crates that are already instrumented.



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- **Roadmap**

Progress 2021

Halloween 2021

- Initial version of client telemetry library
- Local ingestion server (sqlite & files)
- CLI analytics (csv output)

Christmas 2021

- Web Analytics client (svelte & Canvas)
- Visualization of call tree timeline

Progress 2022

January 2022

- Logging improvements, Timeline levels of details

February 2022

- Cloud infra, Time series, UI redesign

March 2022

- Time series & Timeline improvements, Async function tracing

Roadmap

April 2022

- Unreal telemetry module (MAD)
- Cumulative call graph improvements (Tim)
- Timeline report view (Tim)
- Process List Hierarchy (Tim)
    - ordered by last update
- Auth flow polish (Kevin)
- Review regulatory requirements (Liem)

Roadmap

May 2022

- Unreal telemetry module (MAD)
- Infra visibility & alterting UAT (ingestion + analytics)(Liem)
- Logs (dual mode) (Kevin)
  - Paging when not filtering
  - n-first results when there is a filter
- External Dashboards & reports (at least one full stack dev)
  - elk? db+grafana? parquet/orc + superset?
- TSC frequency calibration (MAD)

Roadmap

Juin 2022

- Backups data lake (Liem)
- l10n/i18n (Kevin)
- API key refactor (Julien)
- IAM permissions cleanup for ingestion & analytics (Julien)
- Async spans stitching/LOD (MAD)

Backlog

- Memory tracing and analytics (MAD)
- VM monitoring / Fluentd output command (MAD)
- GPU profiling
- Support for Google Cloud Storage
- Landing page
- Object Graphs
    - Why is this texture loaded?

More Backlog

- Process dashboards
  - monitoring thousands of processes
  - graphs of processes to lists of processes
- Task-based timeline & async span parenting
  - unifying thread-bound and async tasks
- Heat maps
- Real-time logs, metrics and timeline
  - block consolidation