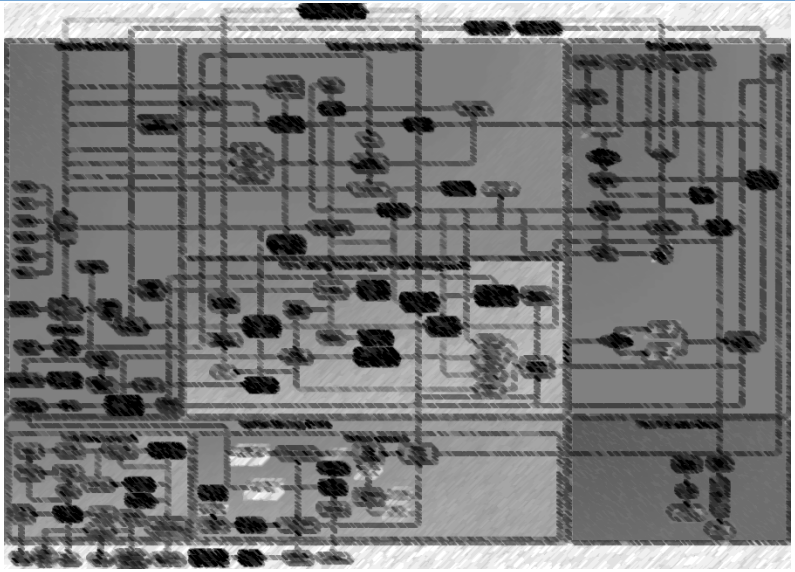
# Legalese…

*Opinions expressed are those of the author and may not be shared by all personnel of Man Group plc ('Man'). These opinions are subject to change without notice, and are for information purposes only and do not constitute an offer or invitation to make an investment in any financial instrument or in any product to which any member of Man's group of companies provides investment advisory or any other services. Any forward-looking statements speak only as of the date on which they are made and are subject to risks and uncertainties that may cause actual results to differ materially from those contained in the statements. Unless stated otherwise the source of all information is Man Group plc and its affiliates as of the date on the first page of this material. Unless stated otherwise this information is communicated by AHL Partners LLP which is which is registered in England and Wales at Riverbank House, 2 Swan Lane, London, EC4R 3AD and is authorised and regulated in the UK by the Financial Conduct Authority.*

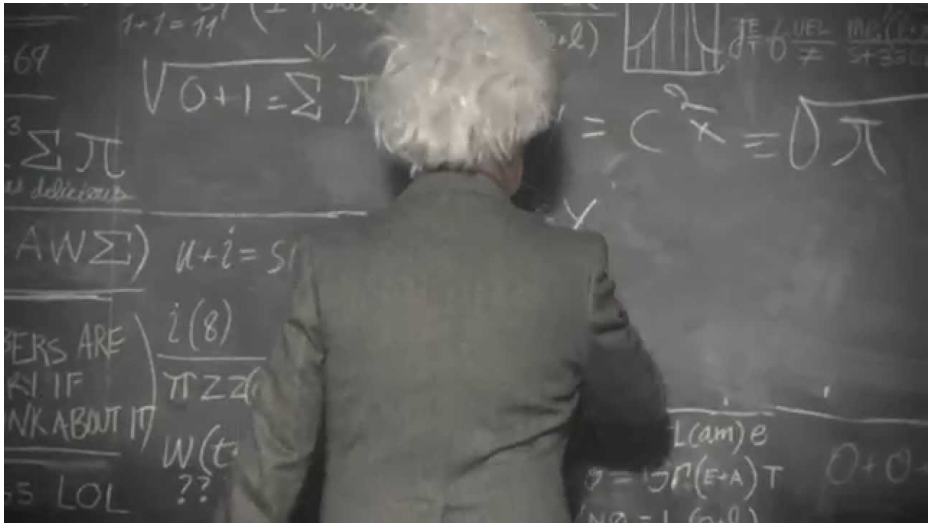
# AHL at a glance

**100%** systematic quant
**$19bn+** AUM
**Everyone** writes code
**65+** Tech
**30** years experience
**Open** culture
**Open** source software



## 25 **Core** technologists

- Linux infrastructure
- Data engineering
- Core platform
- Core trading
- Electronic execution
- Risk systems



## 35 **Research** technologists

- Across 10 research teams
- Support research
- Implement strategies
- Maintain strategies

# The problem

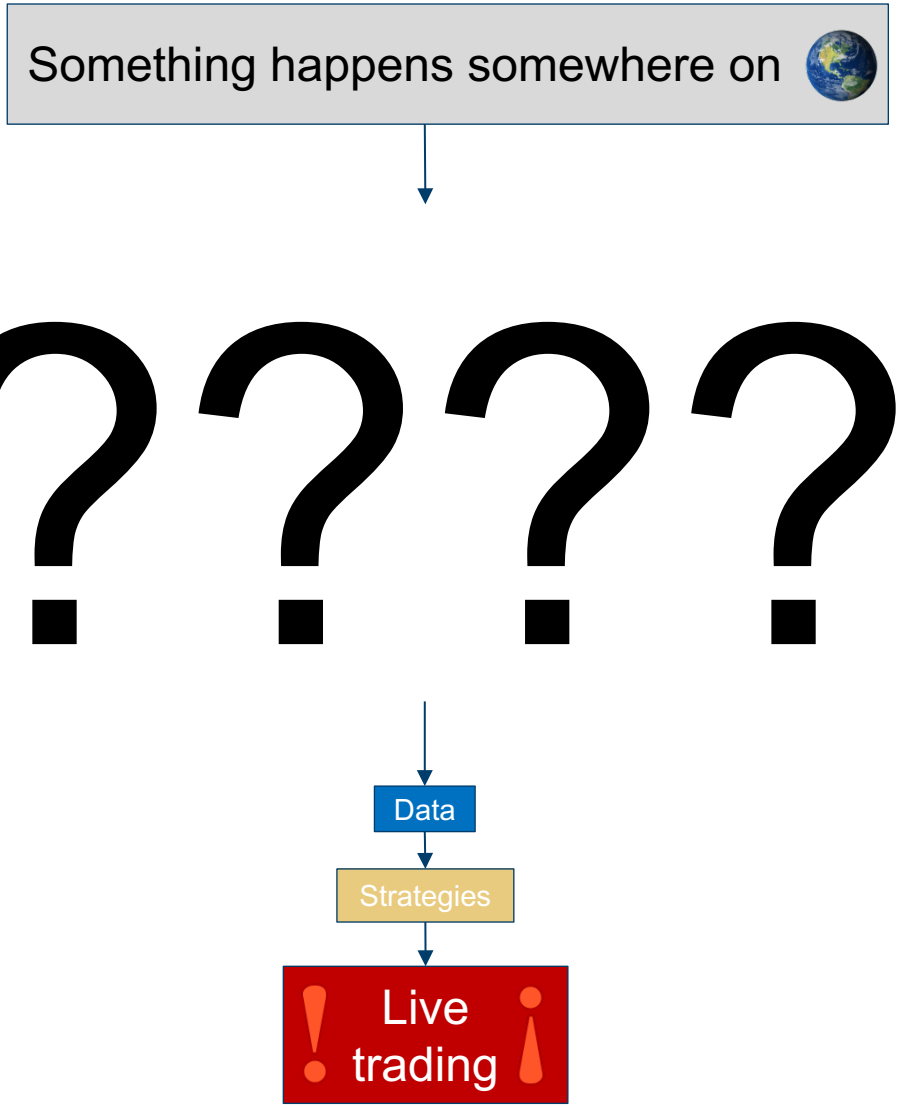
# The AHL streaming data pipeline

## From the sky

Something happens somewhere on 

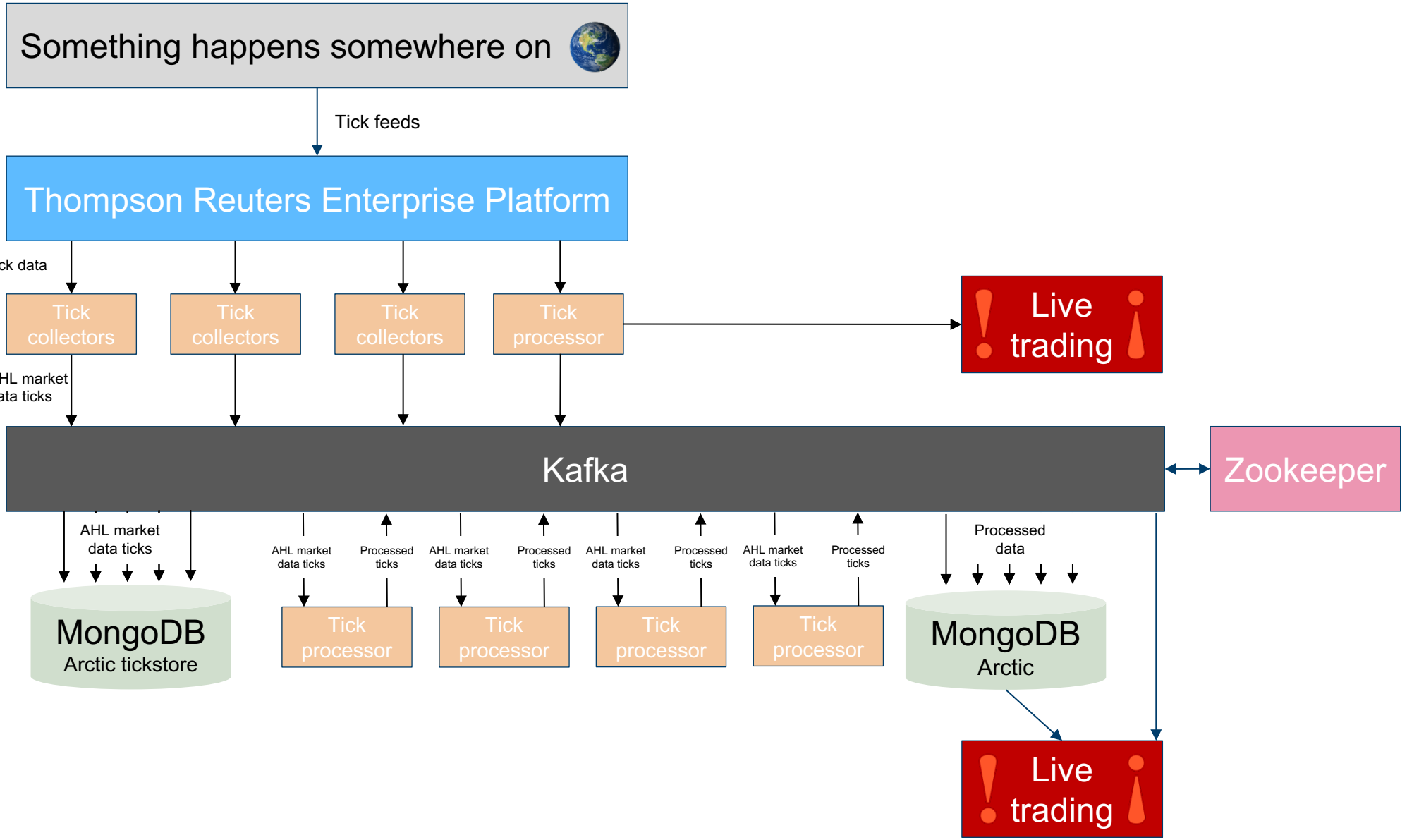
# The AHL streaming data pipeline

From the sky



# The AHL streaming data pipeline

From the sky



# The AHL streaming data pipeline

Something happens somewhere on 

Tick feeds

Thompson Reuters Enterprise Platform

Tick data

```
2018-02-07 15:59:18,712 INFO  [sub_worker_6] LoggingSubscriber - Type: UPDATE Subject: BPOD.TRI.US
                  PROD_PERM:       Long:                14003
                 DelayedEID:       Long:                    0
                    UpdType:     String:                  ASK
                  ASK_MMID1:     String:                   UN
                     ASKXID:     String:                  NYS
                   ASK_TIME:  LocalTime:                15:59
                  ASK_TIME1:  LocalTime:             15:59:18
                 ASK_TIM_MS:       Long:             57558635
                   AskPrice:     Double:                40.87
                     AskLSc:     String:                   UN
                  LstAIsInd:       Long:                    0
                    AskTime:  LocalTime:             15:59:18
                     QUOTIM:  LocalTime:             15:59:18
                  QUOTIM_MS:       Long:             57558635
                        ASK:     Double:                40.87
                    ASKSIZE:     Double:                  1.0
```

# The AHL streaming data pipeline

Something happens somewhere on 

Tick feeds

Thompson Reuters Enterprise Platform

Tick data

```
2018-02-07 15:59:18,712 INFO  [sub_worker_6] LoggingSubscriber - Type: UPDATE Subject: BPOD.TRI.US
                PROD_PERM:       Long:                14003
               DelayedEID:       Long:                    0
                  UpdType:     String:                  ASK
                ASK_MMID1:     String:                   UN
                   ASKXID:     String:                  NYS
                 ASK_TIME:  LocalTime:                15:59
                ASK_TIME1:  LocalTime:             15:59:18
               ASK_TIM_MS:       Long:             57558635
                 AskPrice:     Double:                40.87
                    AskLSc:     String:                   UN
                LstAIsInd:       Long:                    0
                  AskTime:  LocalTime:             15:59:18
                   QUOTIM:  LocalTime:             15:59:18
                QUOTIM_MS:       Long:             57558635
                      ASK:     Double:                40.87
                  ASKSIZE:     Double:                  1.0
```

x2 billion a day

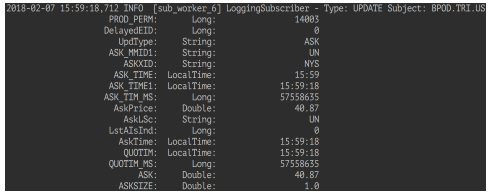
# The AHL streaming data pipeline

Something happens somewhere on 

Tick feeds

Thompson Reuters Enterprise Platform

Tick data



```
2018-02-07 15:59:18,712 INFO  [sub_worker_6] LoggingSubscriber - Type: UPDATE Subject: 8POD.TRI.US
                PROD_PERM:       Long:              14003
               DelayedID:       Long:                  0
                 UpdType:     String:                ASK
              ASK_MMID1:     String:                 UN
                 ASKXID:     String:                NYS
               ASK_TIME:  LocalTime:              15:59
              ASK_TIME1:  LocalTime:           15:59:18
             ASK_TIM_MS:       Long:           57558635
               AskPrice:     Double:              40.87
                 AskLSc:     String:                 UN
              LstAIsInd:       Long:                  0
                AskTime:  LocalTime:           15:59:18
                QUOTIM:  LocalTime:           15:59:18
             QUOTIM_MS:       Long:           57558635
                   ASK:     Double:              40.87
               ASKSIZE:     Double:                1.0
```

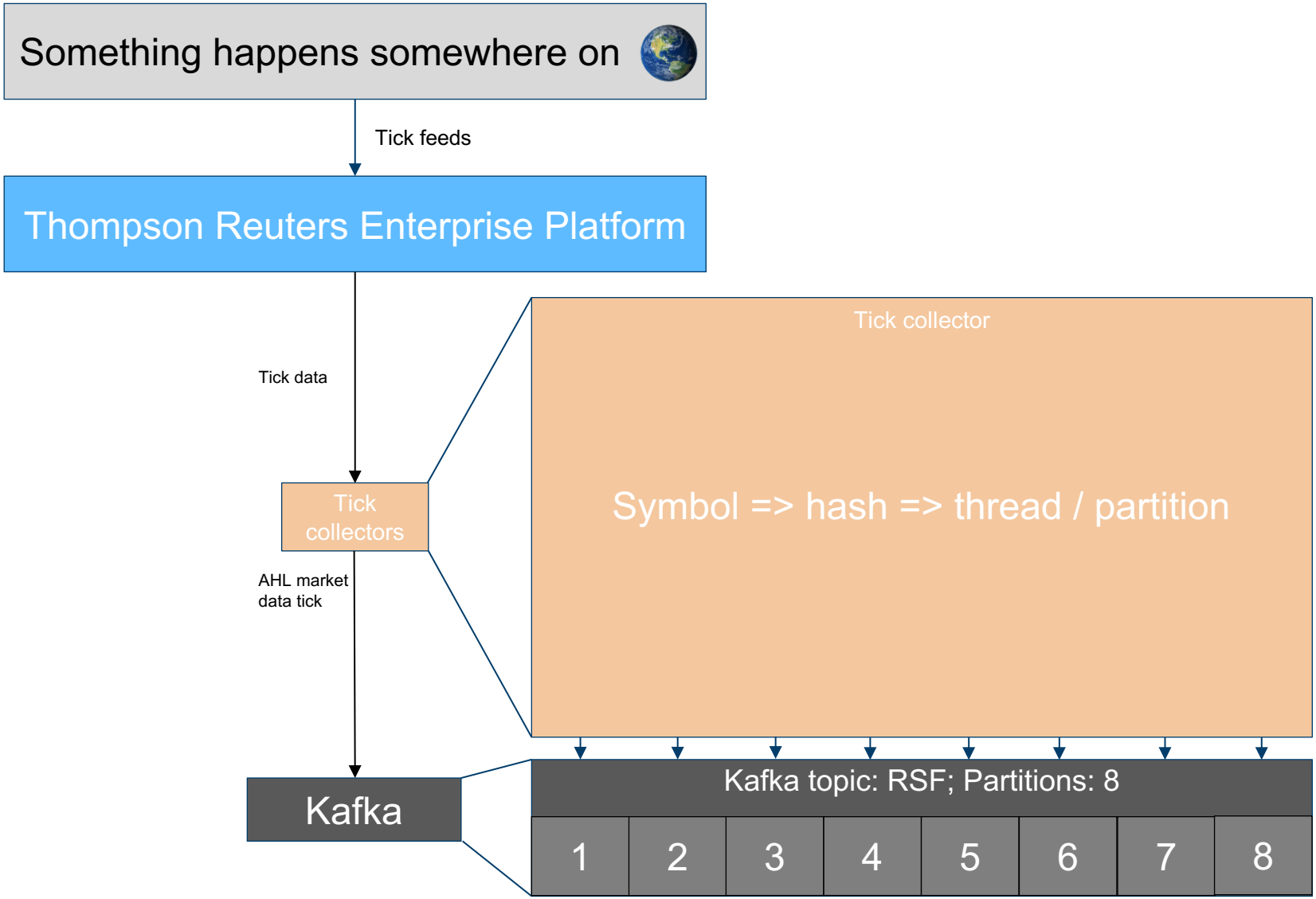
Tick collectors

AHL market data tick

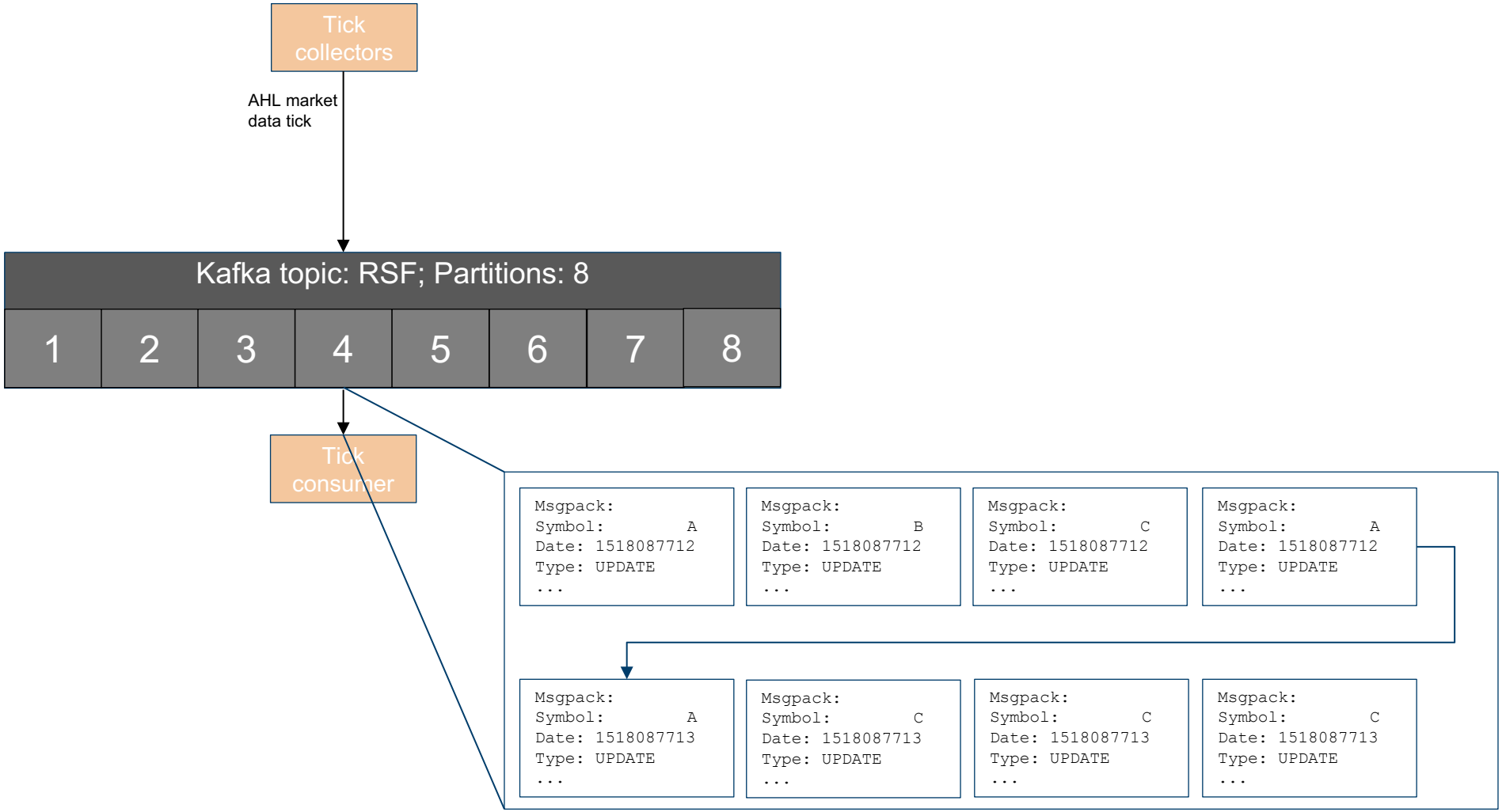
```
Message pack encoded structure:
string:    symbol
int:       date
string:    type
int:       sequence number
dict:      data
```

Kafka

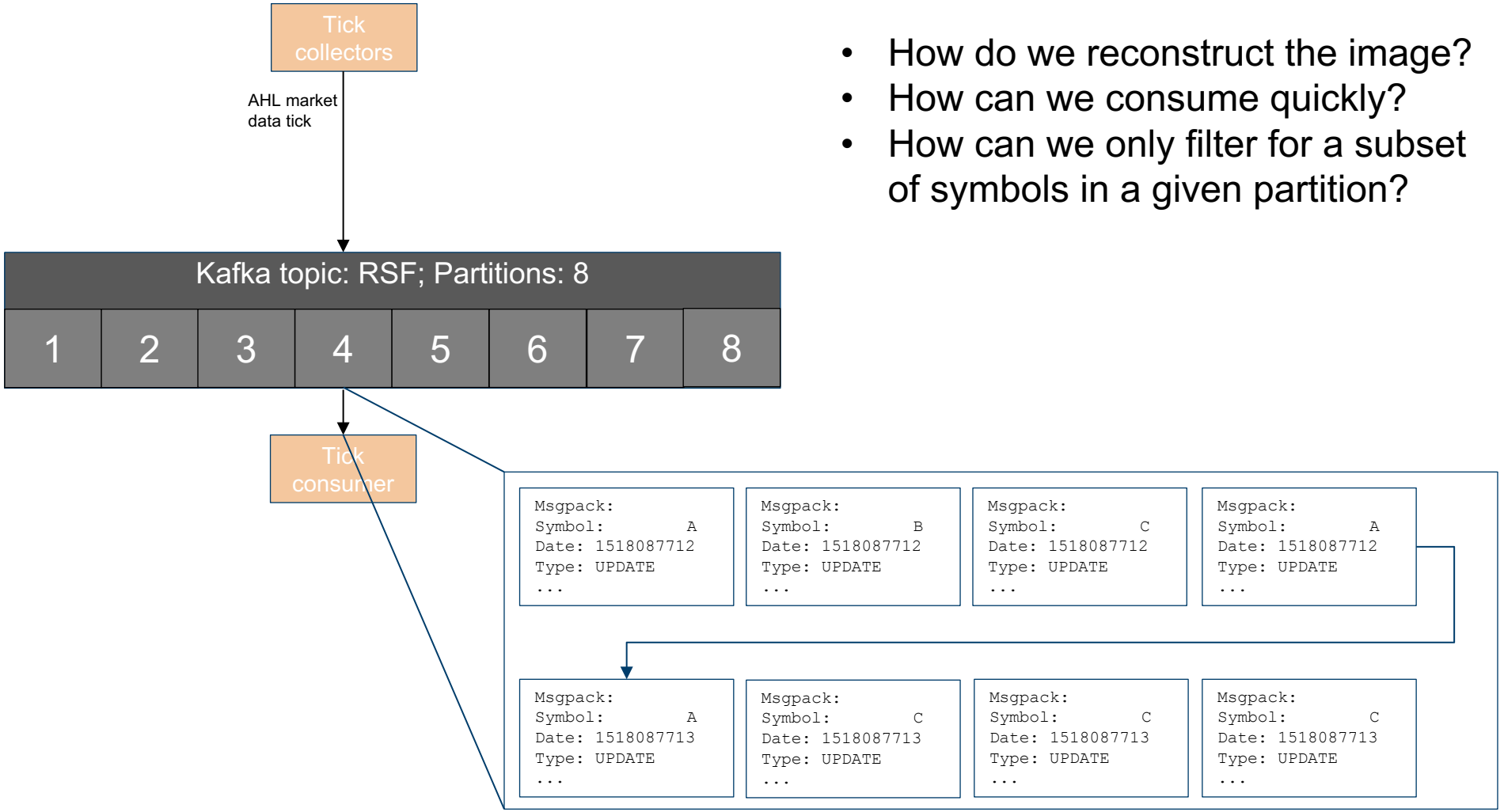
# The AHL streaming data pipeline



# The AHL streaming data pipeline

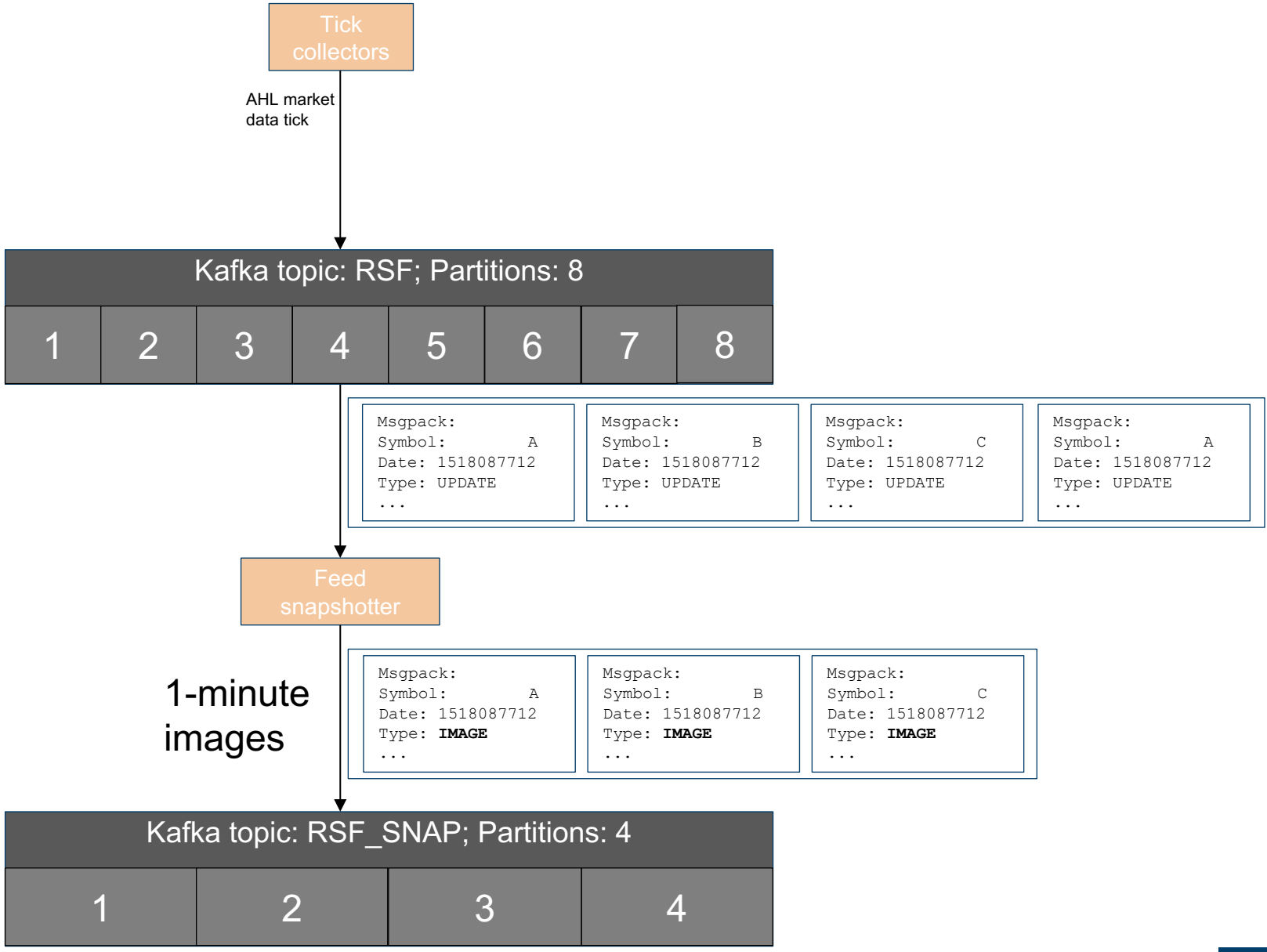


# The AHL streaming data pipeline




- How do we reconstruct the image?
- How can we consume quickly?
- How can we only filter for a subset of symbols in a given partition?

# The AHL streaming data pipeline



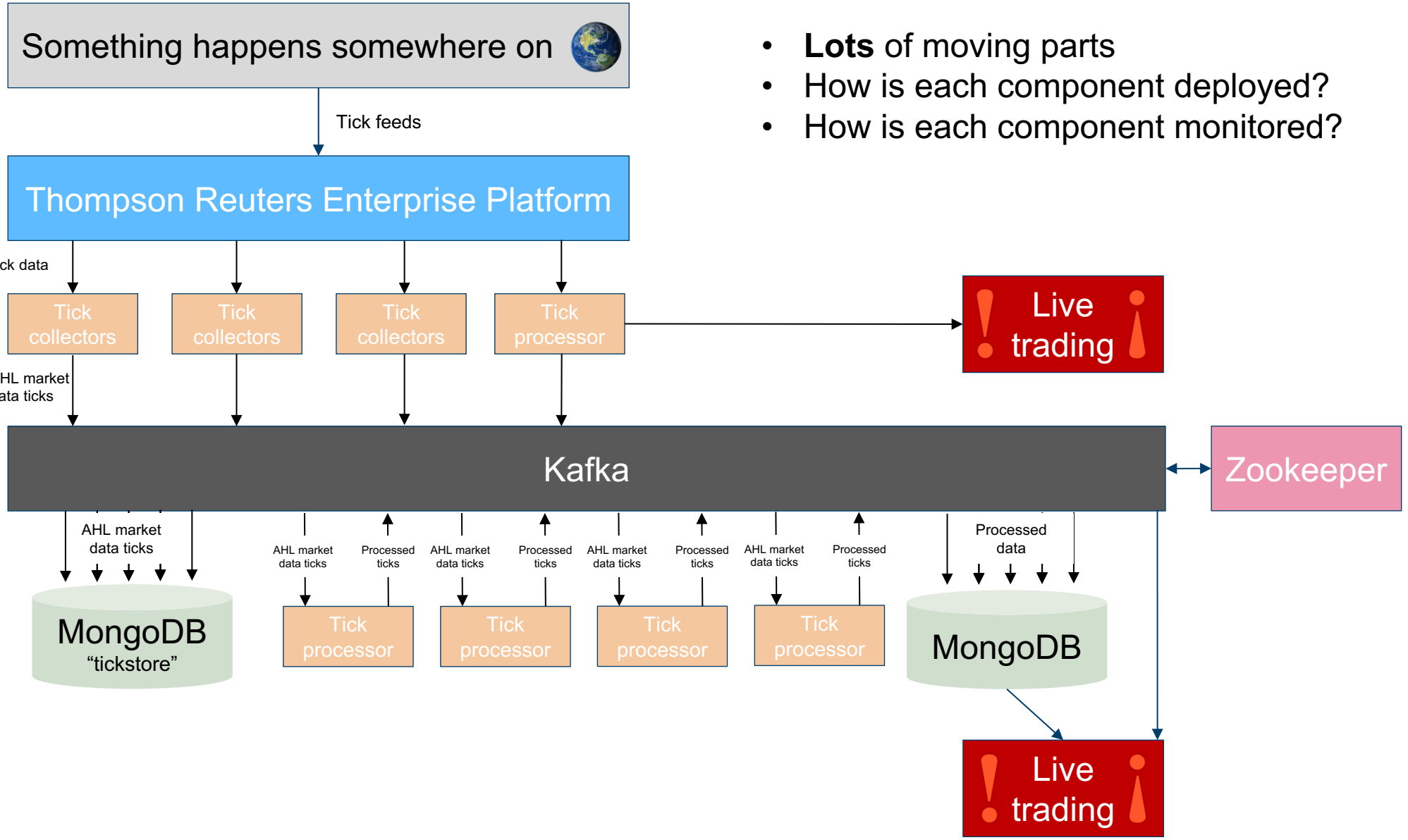
# The AHL streaming data pipeline

## AHL Kafka client

- AHL is a Python shop.
- Only one mature Python Kafka client in 2013 – kafka-python. Kafka-python is **pure Python** implementation. It's also (relatively) slow to consume ☹
- We use a custom Kafka message set decoder written in Cython. ~10x speed up. Filtering based on Symbol done in Cython.
- Our Kafka clients (Java and Python) talk in terms of timestamps rather than Kafka offsets – does binary search into the partition behind the scenes.
- Time-based search now implemented natively in Kafka (since 0.10.1.0) on the broker side.
- Kafka-python is also slow to produce ☹ Python client creates a pool of producers. Maps from symbol -> producer -> partition.

# The AHL streaming data pipeline

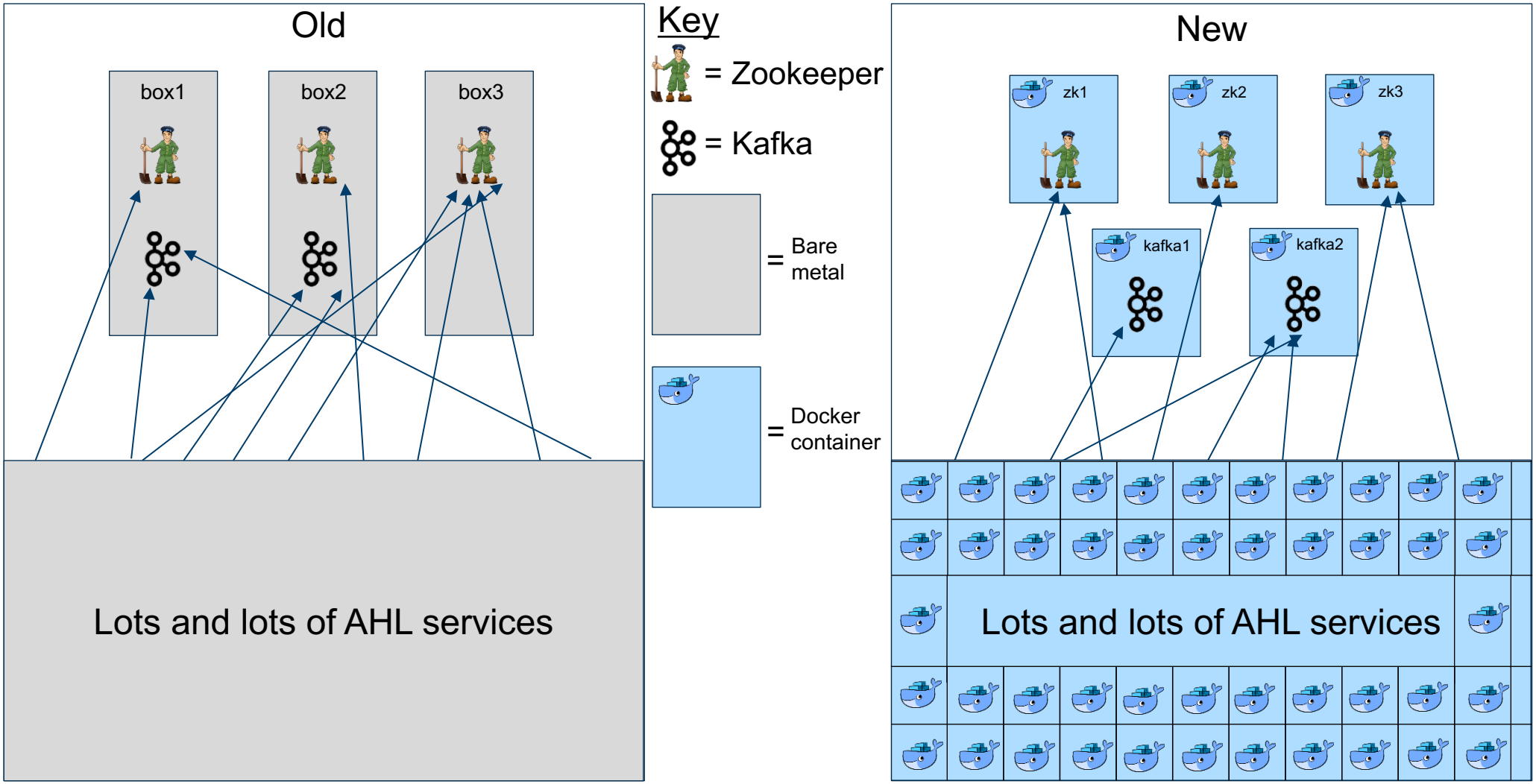
How is this deployed? How do we know it works?




- **Lots** of moving parts
- How is each component deployed?
- How is each component monitored?

# The AHL streaming data pipeline

## How is each component deployed?



# The AHL streaming data pipeline

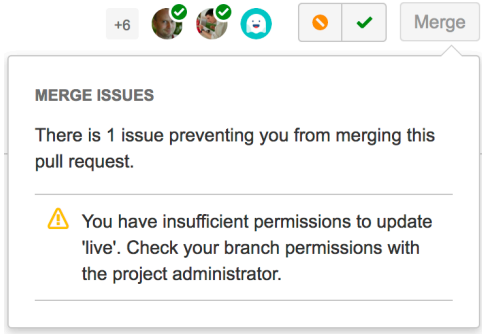
## How is each component deployed?

- At AHL we've drunk *some* of the Docker kool-aid.
- Dockerize everything!


- Docker-compose deploy everything!


- **No** Kubernetes, docker swarm, linkerd, etcd, etc.
  - We use manually managed CNAMEs heavily for aliasing/indirection


- We use our own internal solution for deploying docker-compose services
  - Heavily integrated with Bitbucket. Engineers and Researchers are **not allowed to touch the live trading system.**
  - Services are created and destroyed on merge. Merges are only permitted by support staff.




- For basic container administration, every box runs an instance of an agent called **Dockit.**

# The AHL streaming data pipeline

## How is each component deployed?

- Dockit

Dockit *1.26.0* No Dockitfile loaded, showing all containers

### Config

| Name | Loaded |
|---|---|
| .dockit.auth | 2018-01-20 17:08 |

### Containers

dockit|mongo_inst

ALL

| Name | Uptime | Actions |
|---|---|---|
| dockit_dockit_1 Running | 19 days | |
| mongo_instances_config Exited (0) 2 weeks ago | | |

Log:

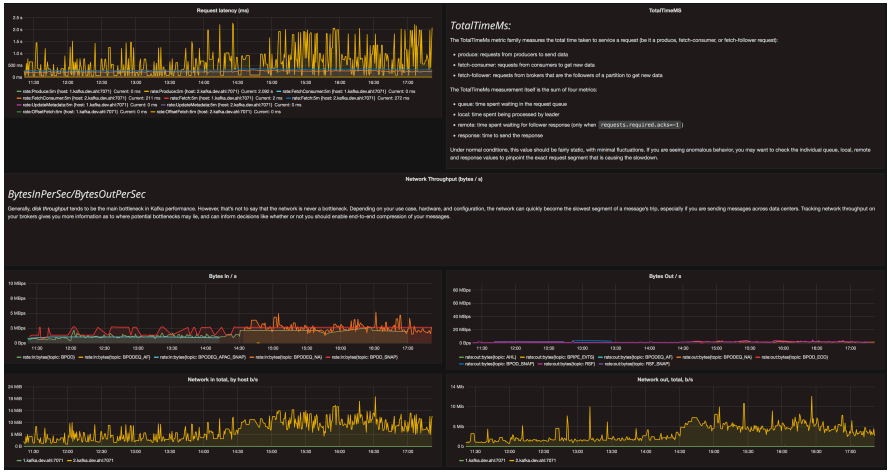

```
{"time":"2018-02-08T17:13:32Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/containers","status":200, "latency":119864,"latency
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/configs","status":200, "latency":63,"latency_human
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/nameprefixes","status":200, "latency":10,"latency_
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/configstatus","status":200, "latency":41,"latency_
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/images","status":200, "latency":27230,"latency_hu
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/containers","status":200, "latency":137986,"laten
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/configstatus","status":200, "latency":26,"latency_h
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/nameprefixes","status":200, "latency":10,"latency_h
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/configs","status":200, "latency":304,"latency_human
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/log/dockit_dockit_1?tail=20","status":200, "latency
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/images","status":200, "latency":32798,"latency_huma
{"time":"2018-02-08T17:13:35Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/containers","status":200, "latency":137458,"latency
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/configs","status":200, "latency":74,"latency_human
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/nameprefixes","status":200, "latency":23,"latency_
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/configstatus","status":200, "latency":48,"latency_
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/images","status":200, "latency":28593,"latency_hu
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.145","method":"GET","uri":"/v1/containers","status":200, "latency":130594,"laten
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/configstatus","status":200, "latency":41,"latency_h
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/configs","status":200, "latency":78,"latency_human"
{"time":"2018-02-08T17:13:38Z","remote_ip":"10.200.31.70","method":"GET","uri":"/v1/nameprefixes","status":200, "latency":13,"latency_h
```

# The AHL streaming data pipeline

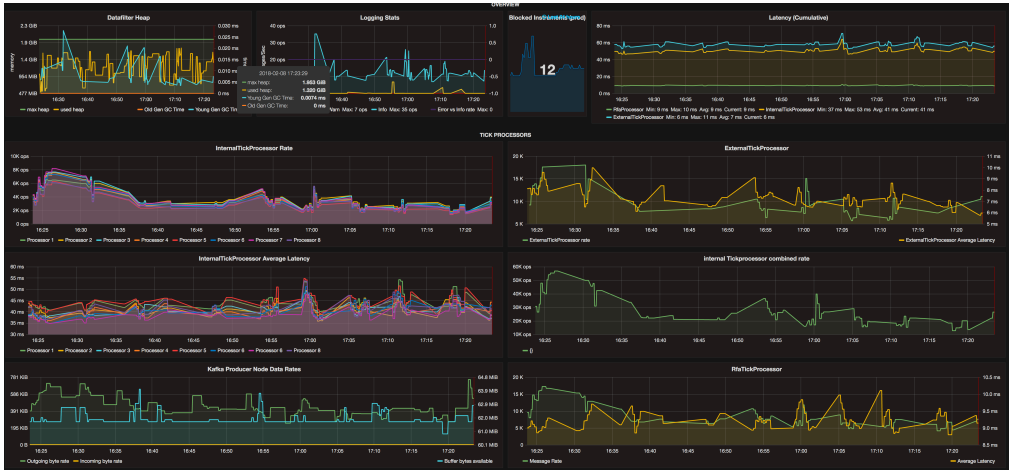
## How is each component monitored?

- We **need** to know when something goes wrong
- Prometheus + nagios + grafana + alerta

### Kafka




### Tickprocessor

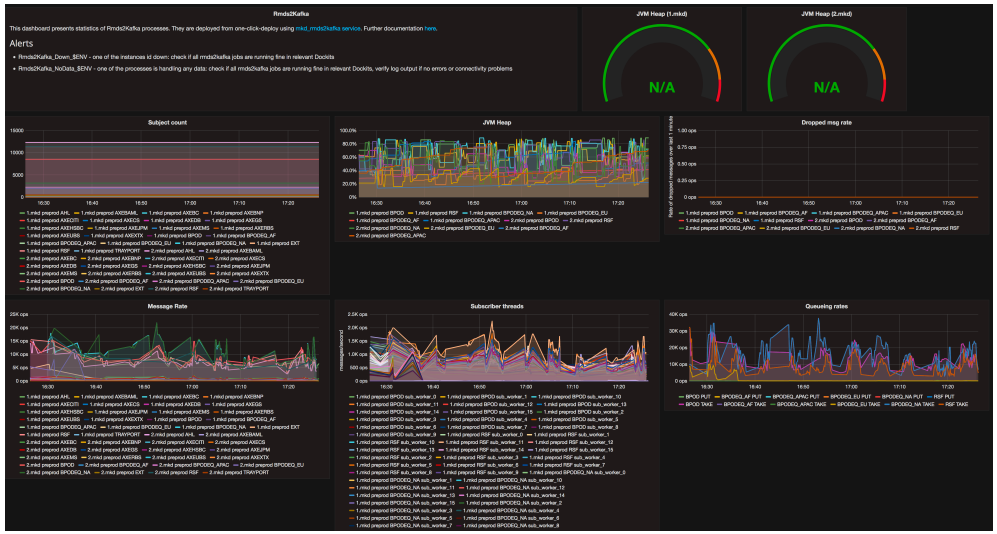


# The AHL streaming data pipeline

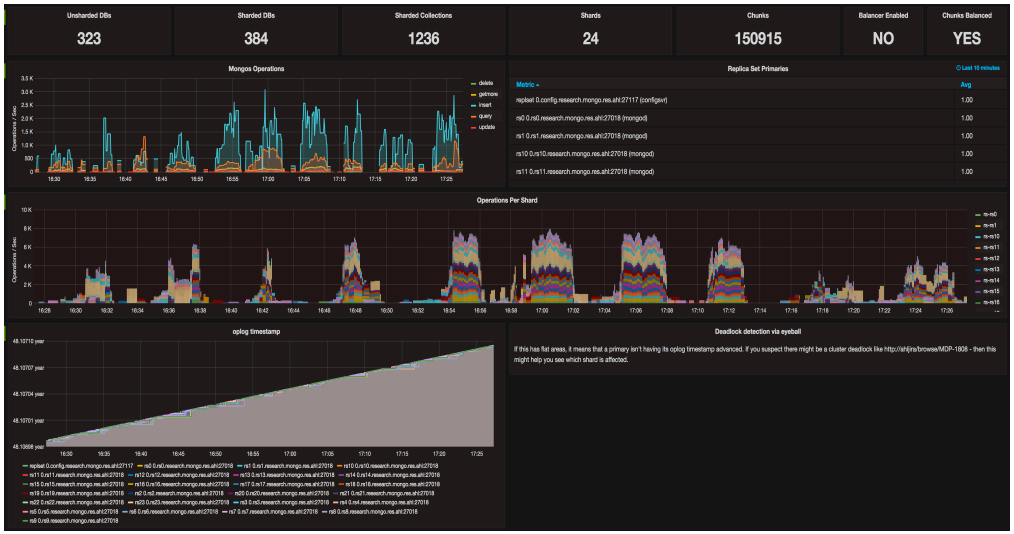
## How is each component monitored?

- We **need** to know when something goes wrong
- Prometheus + nagios + grafana + alerta

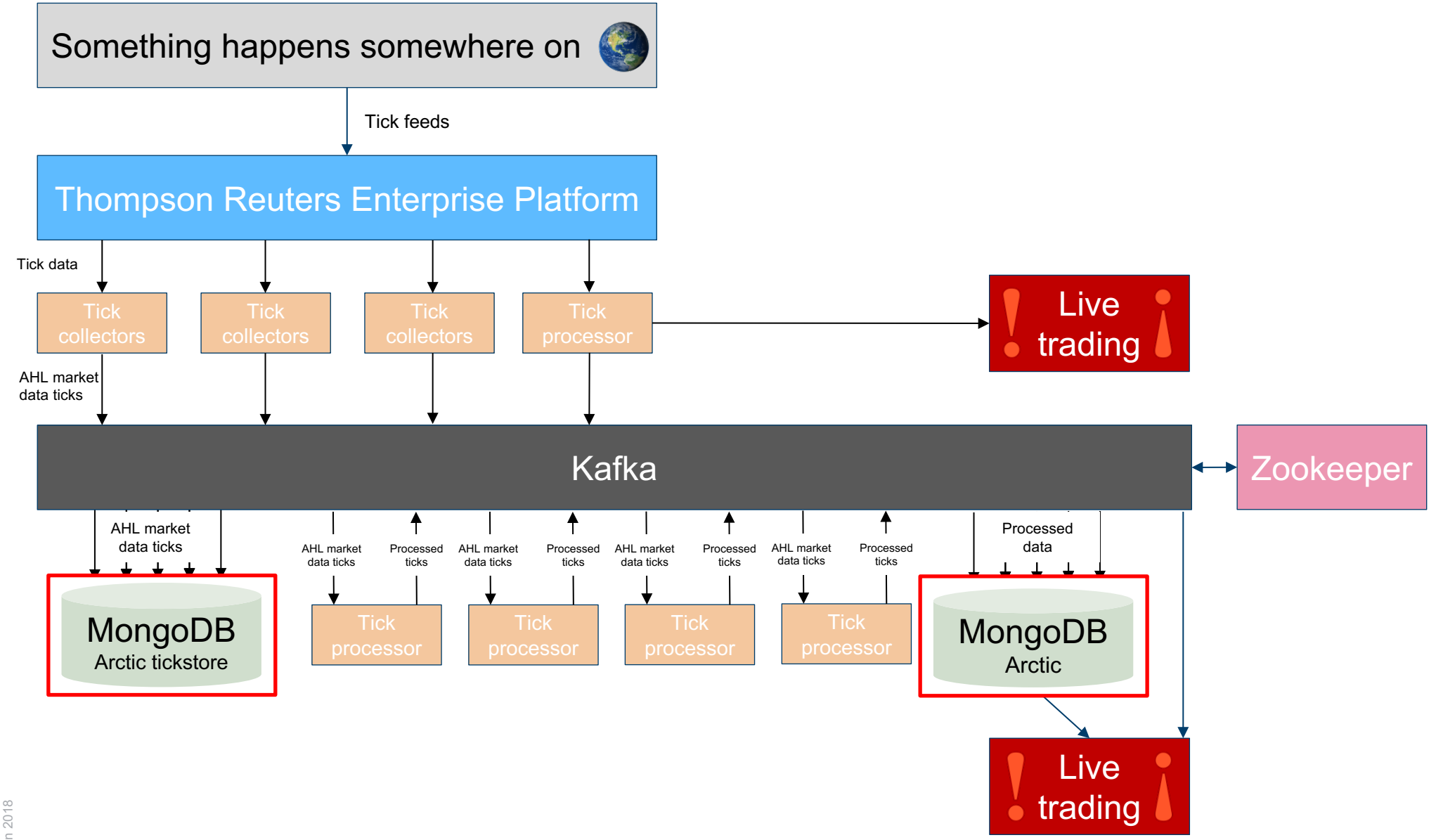
### Tickcollector




### Mongo



# The AHL streaming data pipeline



# The AHL streaming data pipeline

## Arctic – our time series database

- Data sizes we deal with…
  - ~1MB x 1000s — 1x a day price data — 10k rows (30 years)
  - ~0.5GB x 1000s — 1-minute data — 4M rows (20 years)
  - ~1GB x 1000s — 10k x 10k data matrices — 100M cells (30 years)
  - ~30TB — Tick data — 200k msgs/s
  - >1B msgs/day

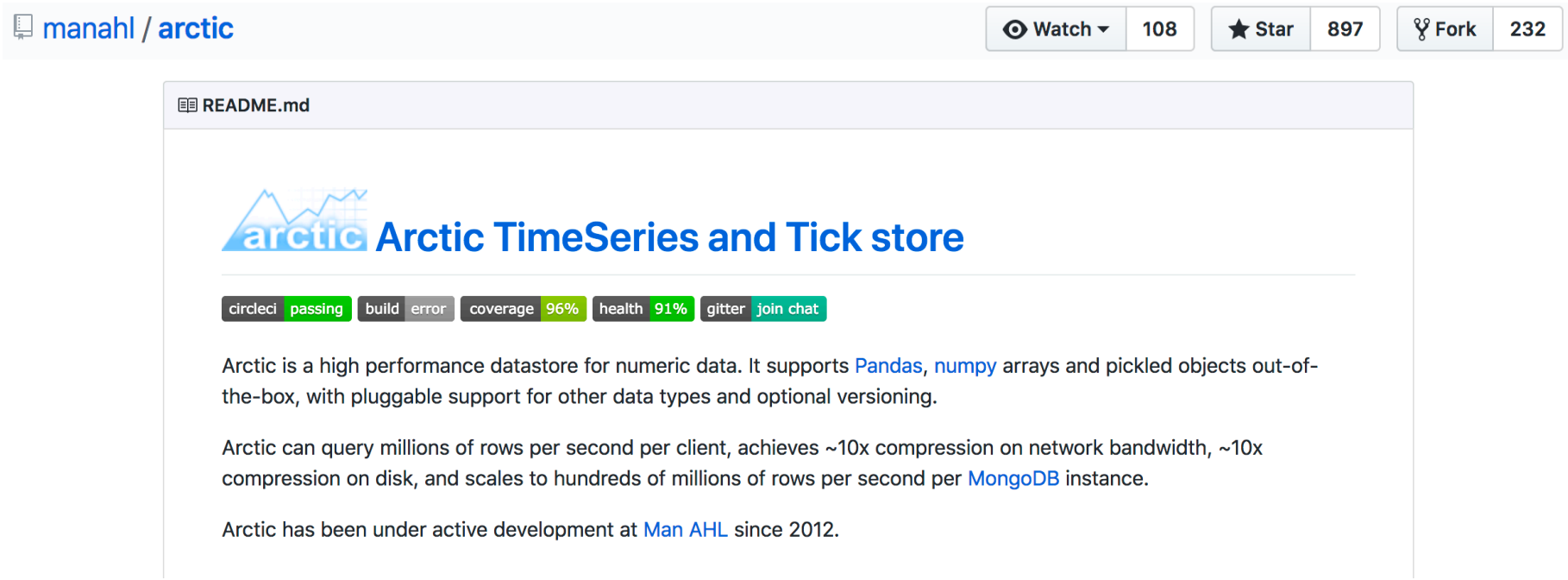
- … Rand different shapes
  - Time series of prices
  - Event data
  - News data
  - Metadata
  - What's next?

- Requirements
  - Easy to use – *and we mean easy*
  - Fast – *as fast as local files*
  - Scalable – *unbounded in data-size and number of clients*
  - Agile – *any data shape; new shapes; iterative development*
  - Complete – *all data behind the simple API*

# The AHL streaming data pipeline

## Arctic – our time series database

- We store all our data, of every type and shape, in Arctic. Arctic is an optionally versioned, columnar, time-series database backed by Mongo, which is entirely open source…




- Check it out at https://github.com/manahl/arctic
- Every tick, every EOD sample, every downsampled 1-minute-bar is stored permanently in Arctic.
- **Everything is retrievable - nothing is thrown away!**

# Questions



@ManAHLTech

?

- We're hiring!

mparrott@ahl.com