Teaching an old DAG new tricks

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Migrating a decade old pipeline to Airflow

Outline

Cloud native deployment

- Cloud native deployment
- Multi-repo DAG management
- Manage Airflow Variables with code through Terraform
- Airflow monitoring best practices with Datadog and Pagerduty

Airflow Migration

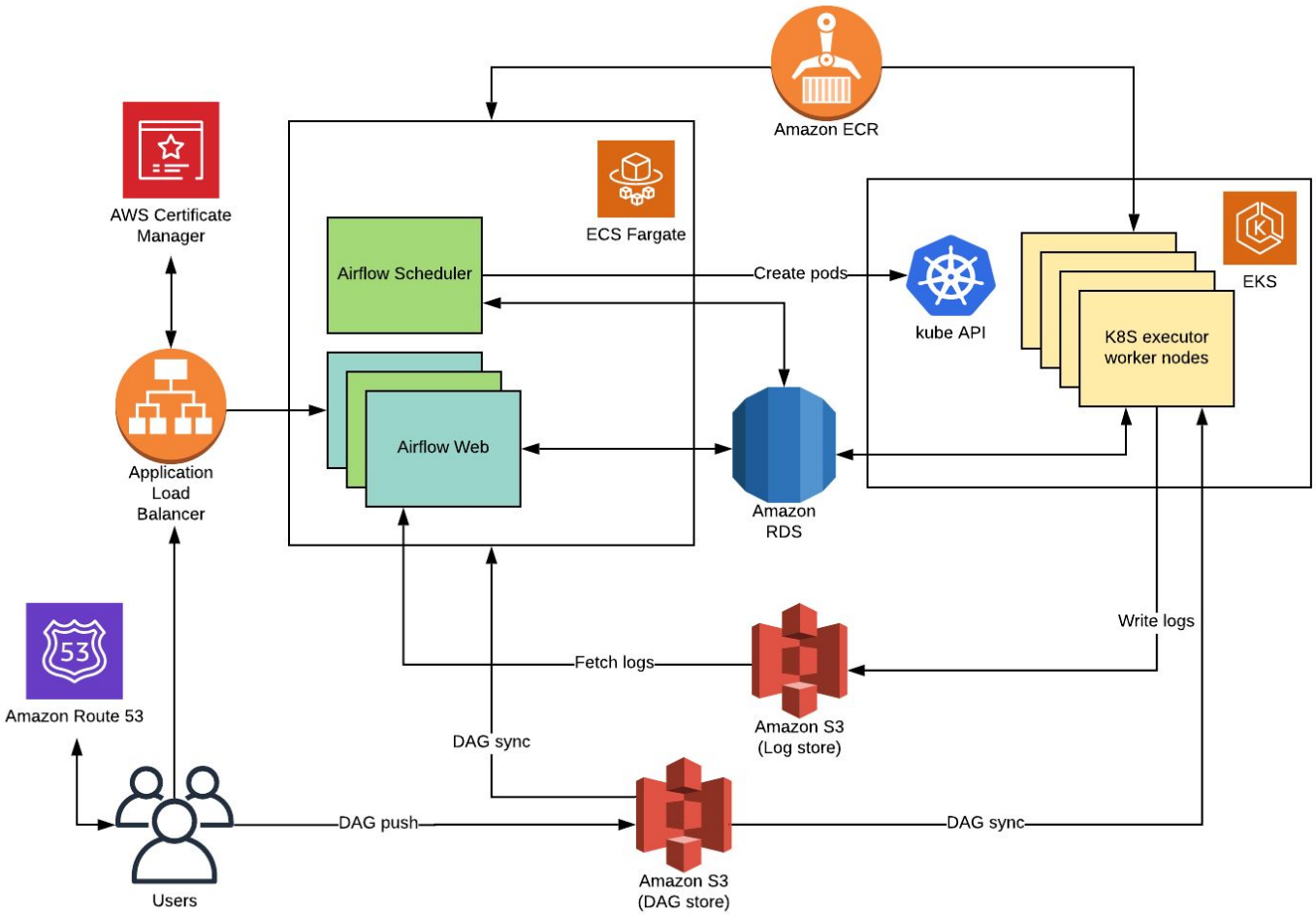
- Simulate production run to surface issues early
- Plan and execute with incremental deliverables

Scribd is moving to the cloud

https://tech.scribd.com/blog/2019/building-the-library.html

Cloud native Airflow

- Use managed service whenever possible
- Separation of stateless compute and stateful data store
- Separation of infrastructure (Airflow cluster) and application (DAG)
- Separation of environments
- Automate Infrastructure provisioning with code
- Running on development branch of Airflow for latest improvements and bug fixes



DATADOG

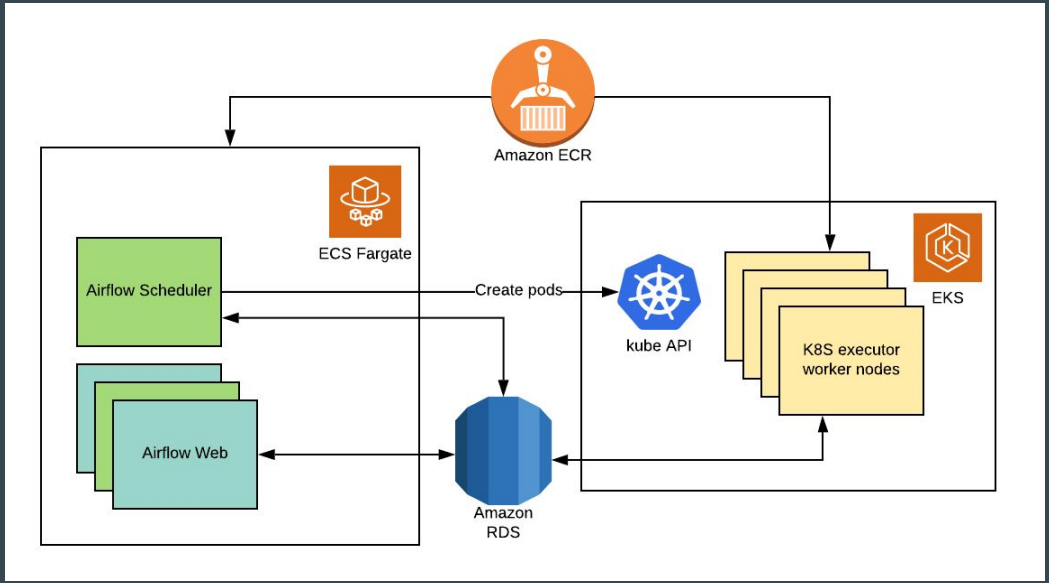
PagerDuty

Sentry

HashiCorp Terraform

ECS and EKS?!

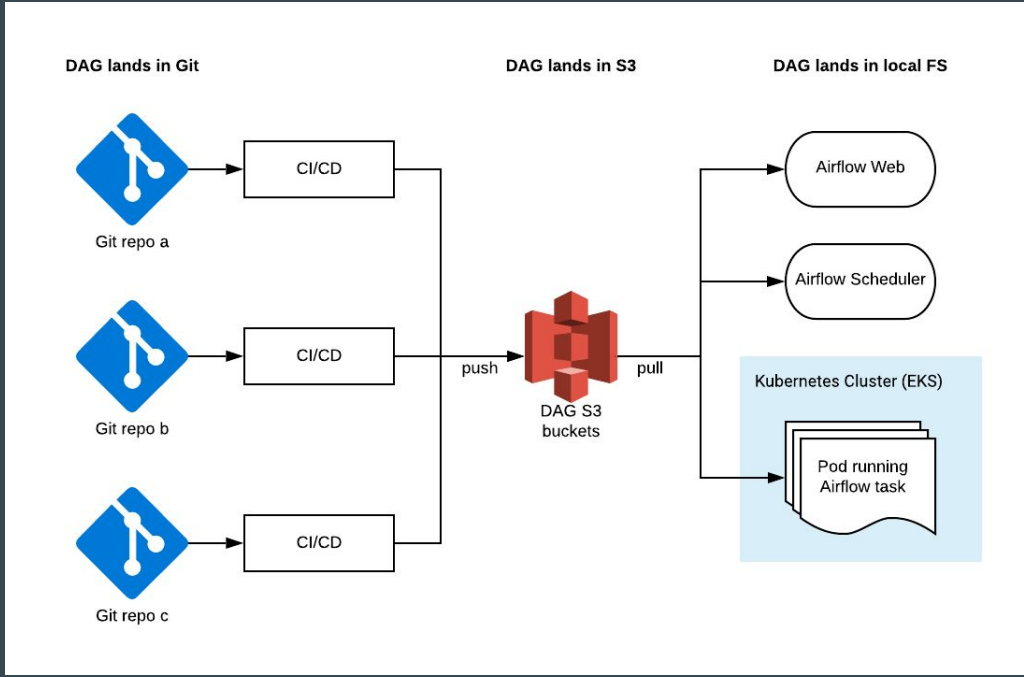
- Different crash zones
- Reduce maintenance burden with ECS fargate



Out of cluster Kubernetes executor support for EKS

- Kubernetes Python client doesn't work well with EKS
- API token generated by aws-iam-authenticator expires about every 14 minutes
- Python client fix backported to Airflow: https://github.com/apache/airflow/pull/5731

Develop DAGs across multiple repos



https://tech.scribd.com/blog/2020/breaking-up-the-dag-repo.html

DAG sync daemon

- Background daemon written in Golang with small CPU and memory footprint
- Single binary ready to run in any environment
- File list and checksums are cached in memory to minimize network and disk IO
- DAG release gets picked up within seconds
    - Future plan to use S3 event notification to make it near realtime
- Expose operational metrics as prometheus format through HTTP
    - DAG Update/Delete/Create statistics
    - Time spent on DAG sync
    - Daemon uptime

Project Github: https://github.com/scribd/objinsync

Manage Variables with Terraform

We use variables to templatize a lot of things

- IAM roles for Databricks clusters
- Glue catalog id
- EC2 Instance profile ARN
- Application Jar release version
- ...

```
{"assume_role_arn":"arn:aws:iam::1234567:role/automated
-job-role","glue_catalogid":"2234567","instance_profile
_arn":"arn:aws:iam::3234567:instance-profile/foo","inst
ance_profile_arn":"arn:aws:iam::4234567:instance-profil
e/databricks-jobs-dev-profile"}
```

Airflow Terraform Provider

```
locals {
  team_a_remote_state = data.terraform_remote_state.team_a.outputs
  dev_vars = {
    "team_a_cluster" = {
      "assume_role_arn"      = local.team_a_remote_state.databricks_role_arn,
      "glue_catalogid"       = local.team_a_remote_state.glue_catalogid,
      "instance_profile_arn" = local.team_a_remote_state.databricks_instance_profile_arn,
    }
  }
}

provider "airflow" {
  variables_output_path = "development.variables.json"
}

resource "airflow_variable" "development" {
  for_each = local.dev_vars
  key      = each.key
  value    = jsonencode(each.value)
}
```

Airflow Terraform Provider

- Project Github: https://github.com/houqp/terraform-provider-airflow
- Experimental branch using Airflow Go client:
  - https://github.com/houqp/terraform-provider-airflow/tree/openapi
  - https://github.com/apache/airflow-client-go/pull/1

Monitor Airflow with Datadog

Datadog agent as sidecar container within ECS

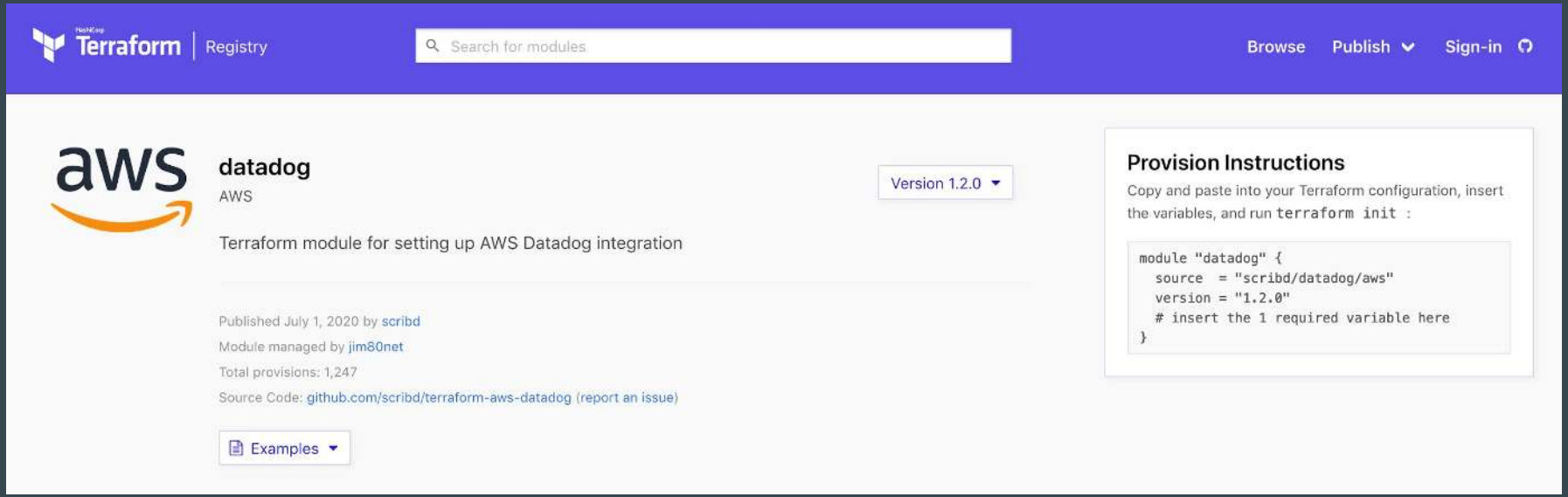
```
datadog_container = {
  name      = "datadog-agent",
  image     = "datadog/agent:latest",
  essential = true,
  environment = [
    { name  = "DD_API_KEY",
      value = var.datadog_api_key
    },
    { name  = "DD_TAGS",
      value = "env:${local.env} application:airflow"
    },
    { name  = "DD_DOGSTATSD_TAGS",
      value = "[\"env:${local.env}\", \"application:airflow\"]"
    },
    { name  = "ECS_FARGATE",
      value = "true"
    },
  ]
  portMappings = [
    { protocol      = "tcp"
      containerPort = 8125
    }
  ]
```

Statsd config for scheduler

```
# monitoring
{ name  = "AIRFLOW__SCHEDULER__STATSD_ON"
  value = "True"
},
{ name  = "AIRFLOW__SCHEDULER__STATSD_HOST"
  value = "127.0.0.1"
},
{ name  = "AIRFLOW__SCHEDULER__STATSD_PORT"
  value = "8125"
},
{ name  = "AIRFLOW__SCHEDULER__STATSD_PREFIX"
  value = "airflow"
},
```

Monitor Airflow with Datadog

- Synchronize ALB, RDS, S3, ECS and EKS Cloudwatch metrics to Datadog using Terraform (https://github.com/scribd/terraform-aws-datadog)




Airflow
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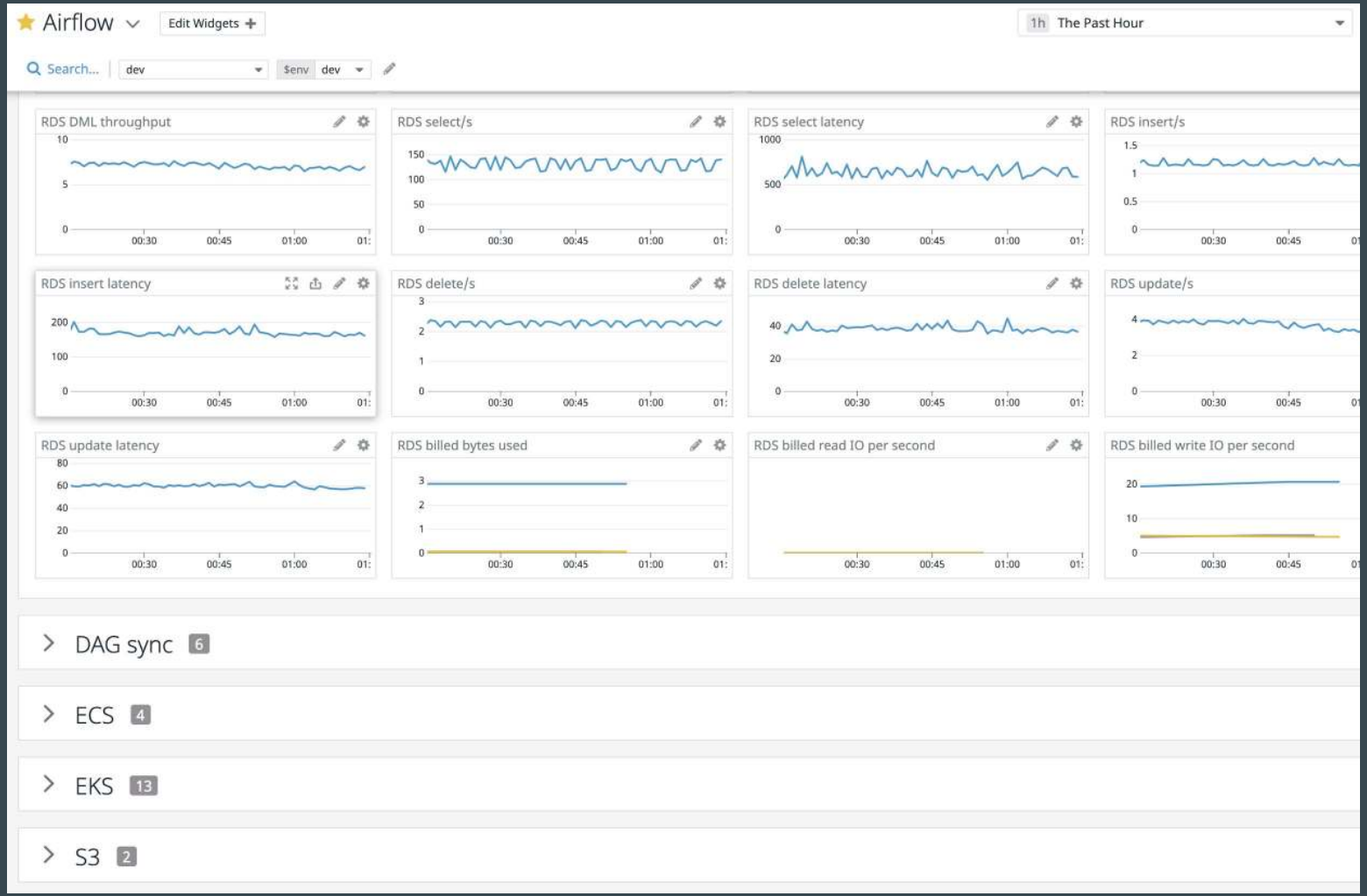
dev
$env dev
Overview 18
Scheduler 19
Web 11
RDS 28
DAG sync 6
ECS 4
EKS 13
S3 2


Airflow
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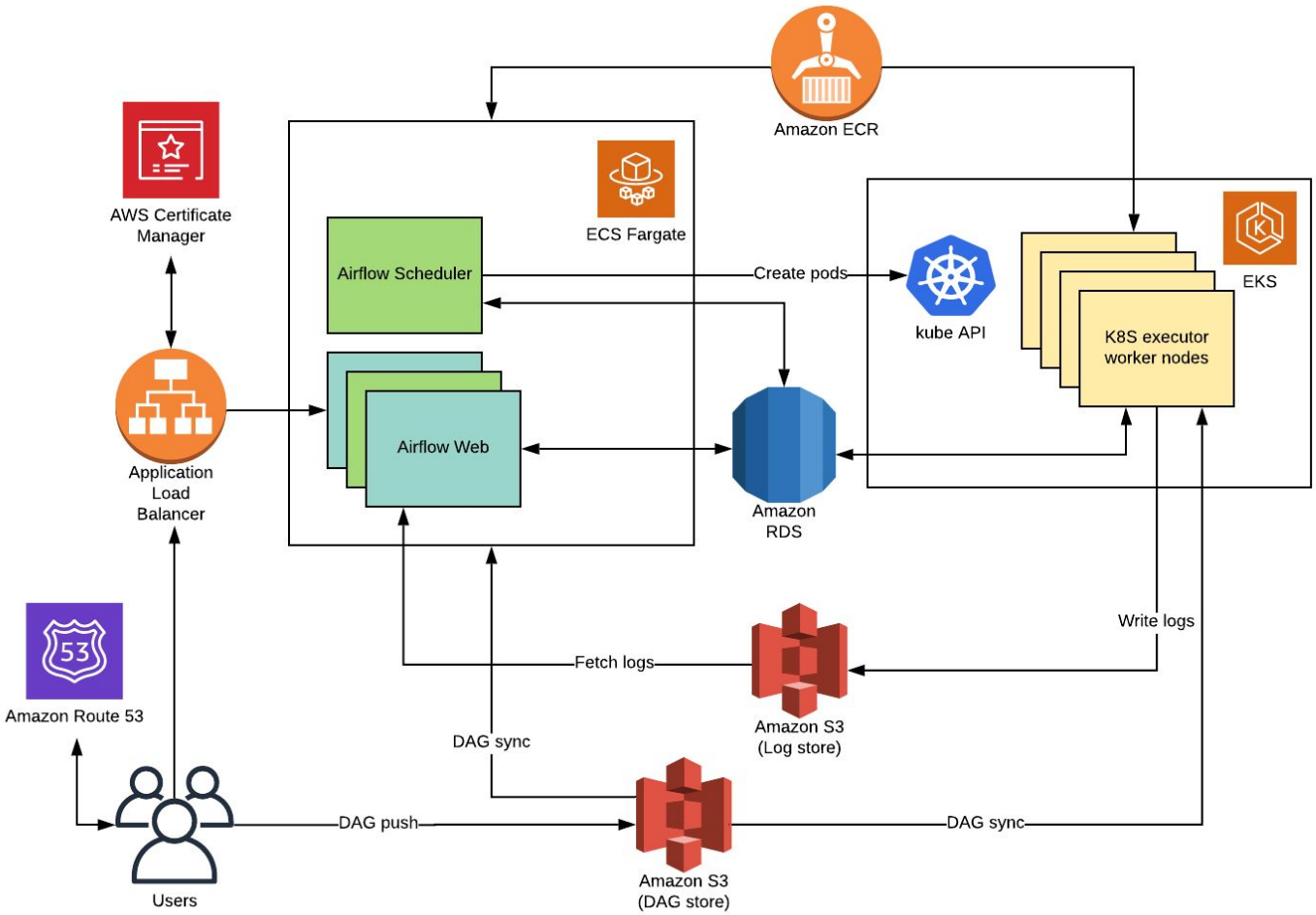
dev
$env dev
RDS DML throughput
RDS select/s
RDS select latency
RDS insert/s
RDS insert latency
RDS delete/s
RDS delete latency
RDS update/s
RDS update latency
RDS billed bytes used
RDS billed read IO per second
RDS billed write IO per second
DAG sync 6
ECS 4
EKS 13
S3 2

Incident response with Pagerduty

- Paging for infrastructure incidents
  - Through Datadog monitors
- Paging for application incidents
  - Pagerduty event emitted from Airflow for
    - Task failures
    - SLA misses
    - Adhoc events

Integration with Pagerduty



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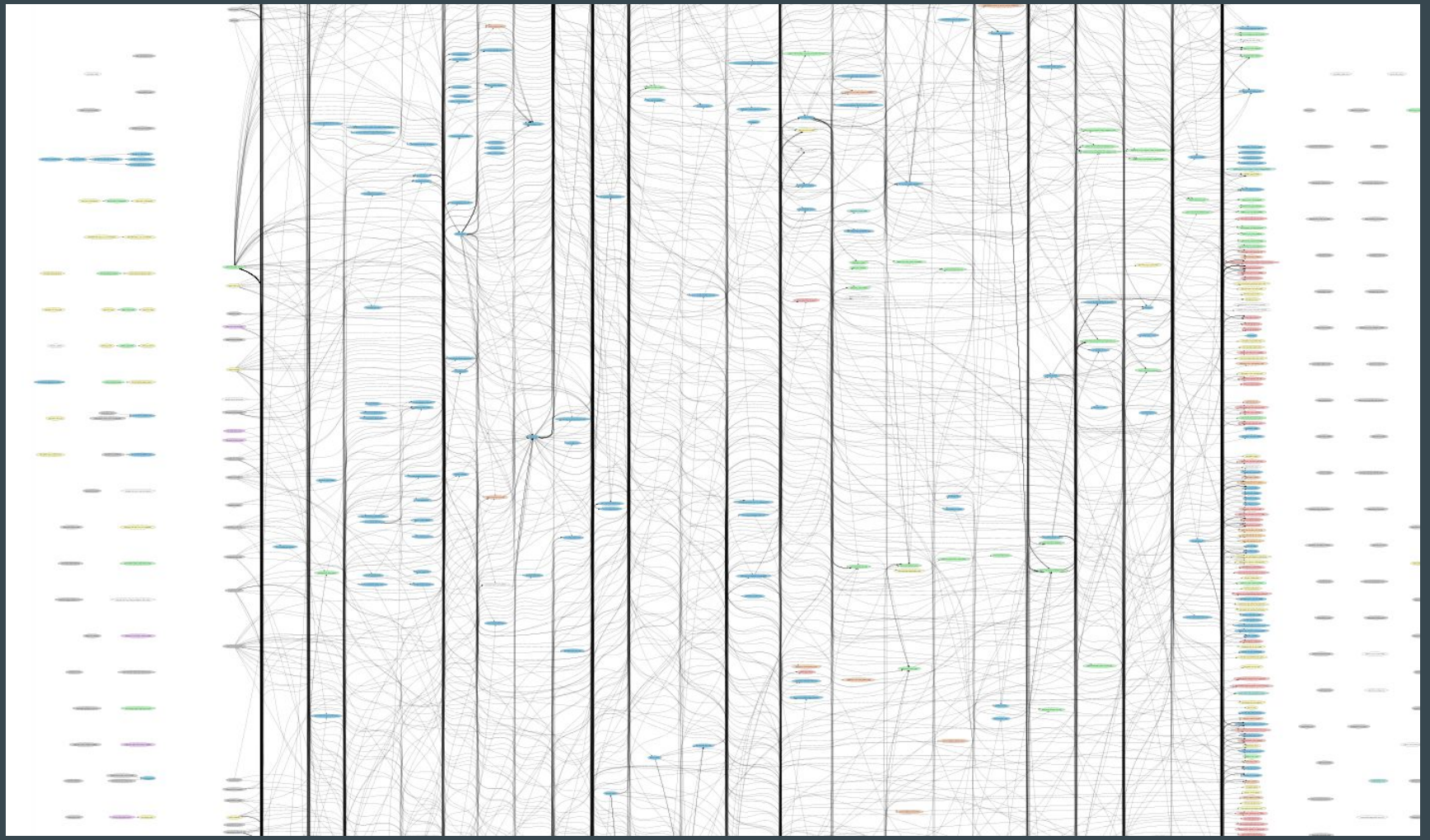
Migration

A decade old data pipeline

- In house workflow orchestration system called Datapipe
- First commit dates back to 2010
- 1500+ tasks with 1200+ of them in a single DAG
- Depend on features not supported by Airflow out of the box
- Data storage: HDFS, S3, Kafka, MySQL, Redis, ES
- Compute: Hive, Implala, Spark 1, Spark 2, Ruby

A brave new world

- Orchestrated through Airflow
- Data storage: S3 with Delta lake, Kafka, RDS, ElasticCache
- Compute: Spark 3 (Databricks)



Simulate production run early

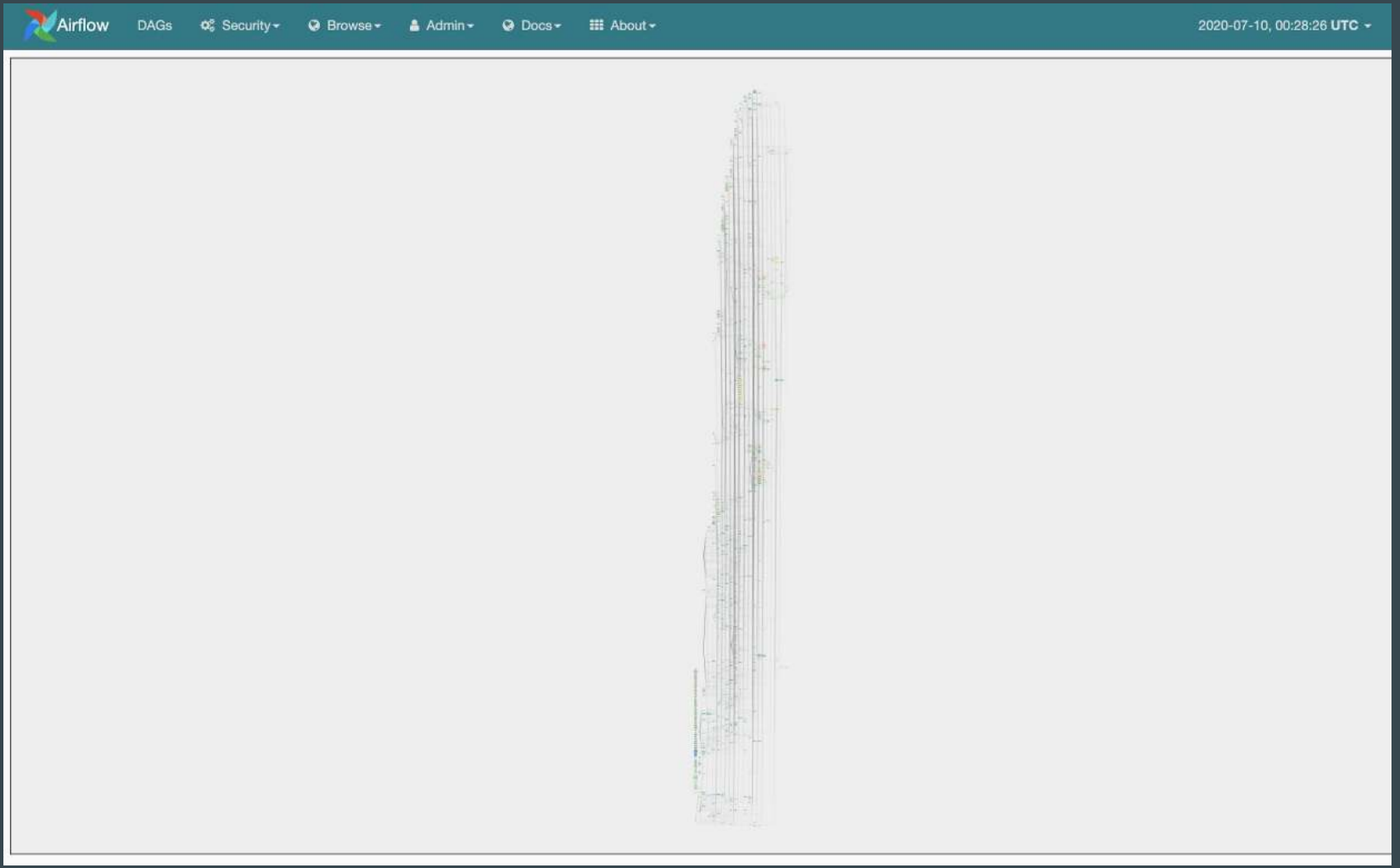
- Automation to transpile Ruby DSL to Airflow DAG
  - Each task is a dummy operator that sleeps to simulate a run
  - Task sleep time calculated based off Avg runtime recorded by in-house system
- Scheduler was able to handle this DAG out of the box

503

Service Unavailable

How to render a 1500+ tasks DAG in Airflow

- It takes a long time to generate and render a 100MB page (tree view)
- Optimizations:
  - Avoid serialize the whole ORM object
  - Remove unnecessary if statements
  - Serialize JSON as string to be parsed with JSON.parse in the frontend
  - ...
  - https://github.com/apache/airflow/pull/7492
- Reduced page size by more than 10X
- Improved page load time by 5X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To the cloud, with incremental deliverables

- Incremental daily sync for new data lake in S3
  - Wrote a mini Python parser in Ruby
- Move ad-hoc read-only interactive queries
- Trim the dependency graph
- Move output phase of the pipeline to unblock external services
- Move remaining of the pipeline

About me (QP Hou)

Engineer at Scribd's Core Platform team

New Airflow committer

Maintainer and contributor of many other open-source projects

You can find me at:

- Airflow slack and mailing list
- https://about.houqp.me

Closing

- Truly a team effort within different engineering teams at Scribd
  - Driven by Platform Engineering
    - Core platform team
    - Data engineering team
- Embrace the open-source community
  - 41 PRs merged into upstream Airflow, many more to come
- Openings: https://www.scribd.com/about/engineering