
AWS
re:Invent
NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

AUT301-R

Performance insights for automotive ADAS

William Fanelli

Senior Engineer Integrated Vehicle Systems SW/AU
Toyota IVS Automated Systems Development

Steve Miller

Principal Consultant, Professional Services
AWS

Bryan Landes

Senior Global Solutions Architect, Toyota Account Team
AWS

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Agenda

Introduce organization and business lifecycle

Level set on key terms and concepts

Provide specific example of a key performance indicator

Discuss cloud journey

Deep dive on solution architecture components

Gather feedback and suggestions from audience

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Presentation objective – 2-way dialogue



Please ask questions as we go through this discussion!

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Toyota Integrated Vehicle Systems

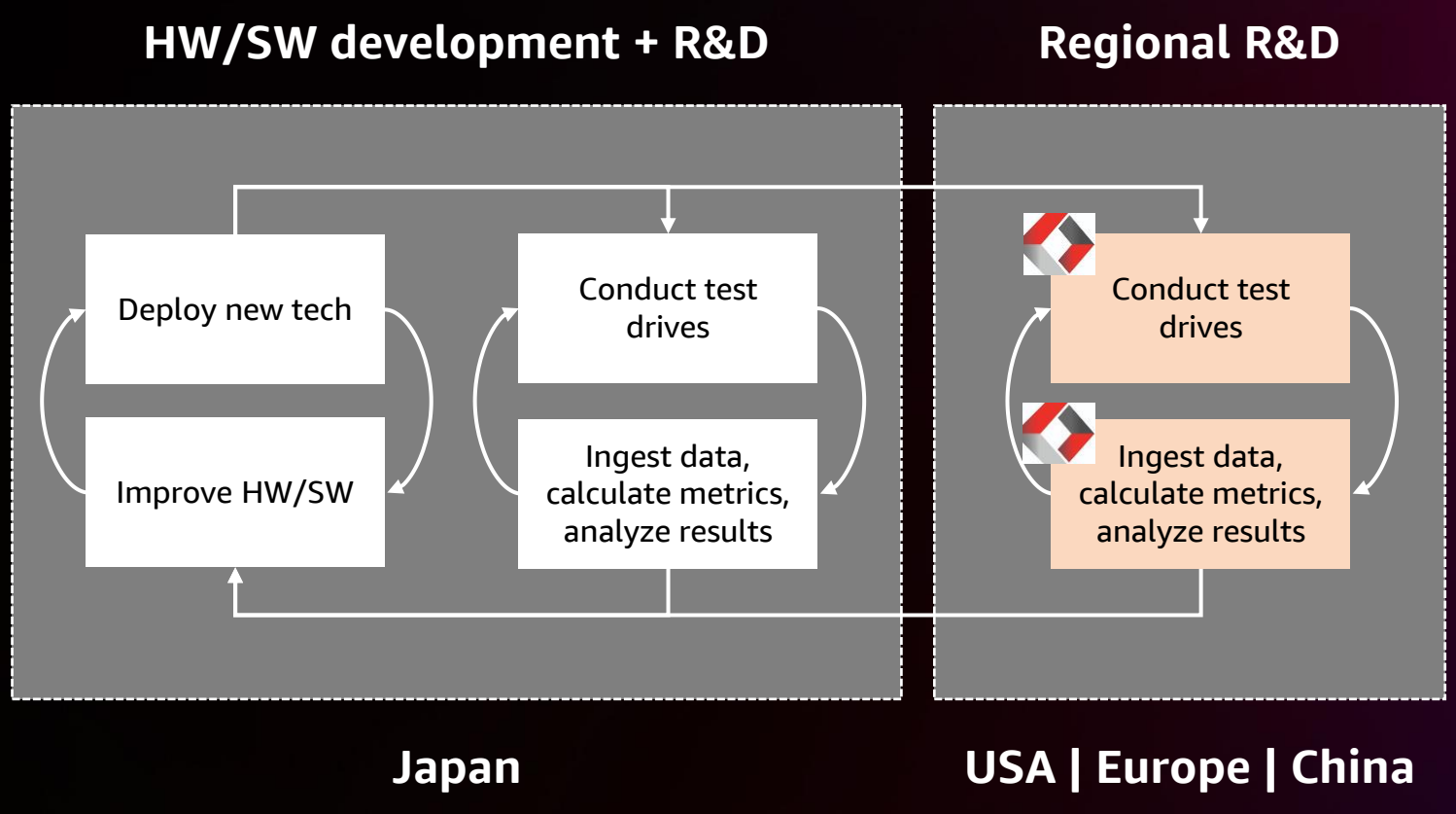


- Commonly referred to as “IVS”
- Division of Toyota Motor North America
- Multidisciplinary team
- Mission: mobility for all
- Support the Automated Driver Assistance System (ADAS) production cycle from research to production follow-up

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Big picture – ADAS business lifecycle







© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

How do we evaluate the driver experience?

Steering



Braking



Engage throttle



System cancel



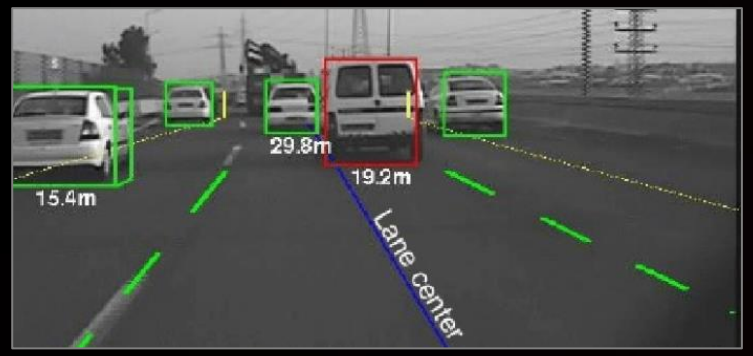
- An override is when the driver has to take over when the ADAS system is active
- There are four key types of overrides: steering, braking, throttle, system cancel
- Goal is to reduce the number of overrides to improve performance of system for end user
- Ultimate target is zero overrides

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Example KPI – Lane centering assist

Normal operation



- Describes system during normal operation
- Some are not noticeable to the user
- Measured per kilometer
  - Deviation from lane center
  - Deviation from constant heading

Driver override



- Describes scenarios when driver takes control
- System must be canceled in some way
- Measured per kilometer
  - Outside conditions (such as construction)
  - Internal conditions (such as driver attentiveness)

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

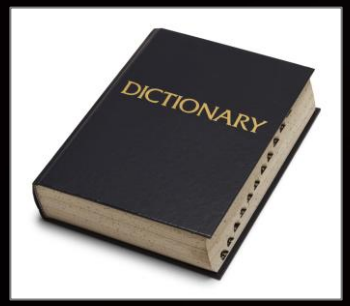
Anatomy of test drive data

Raw signals



Raw timestamp sensor data

Decoded signals

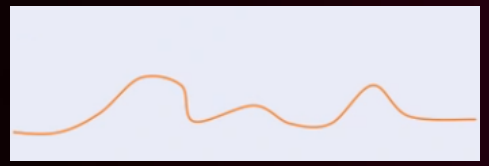


Convert radians to degrees

Abstract data to a naming system for engineering purposes

Don’t need to know underlying data itself to work with it

Calculated signals (features)



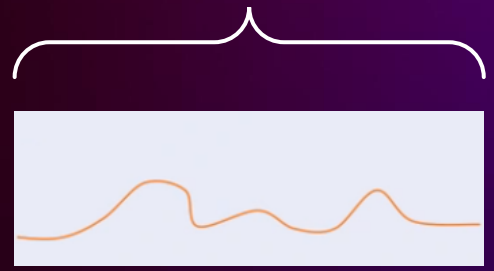
“Is there a large deviation from lane center?”

“Is there a sudden motion occurring?”

“Is the turn signal on?”

“How much lateral acceleration is there?”

Calculated metrics (KPI) *x*



“How many large deviations occurred (per km) for all instances where the car is turning?”

“How many sudden steering motions occurred throughout the entire test drive?”

aws

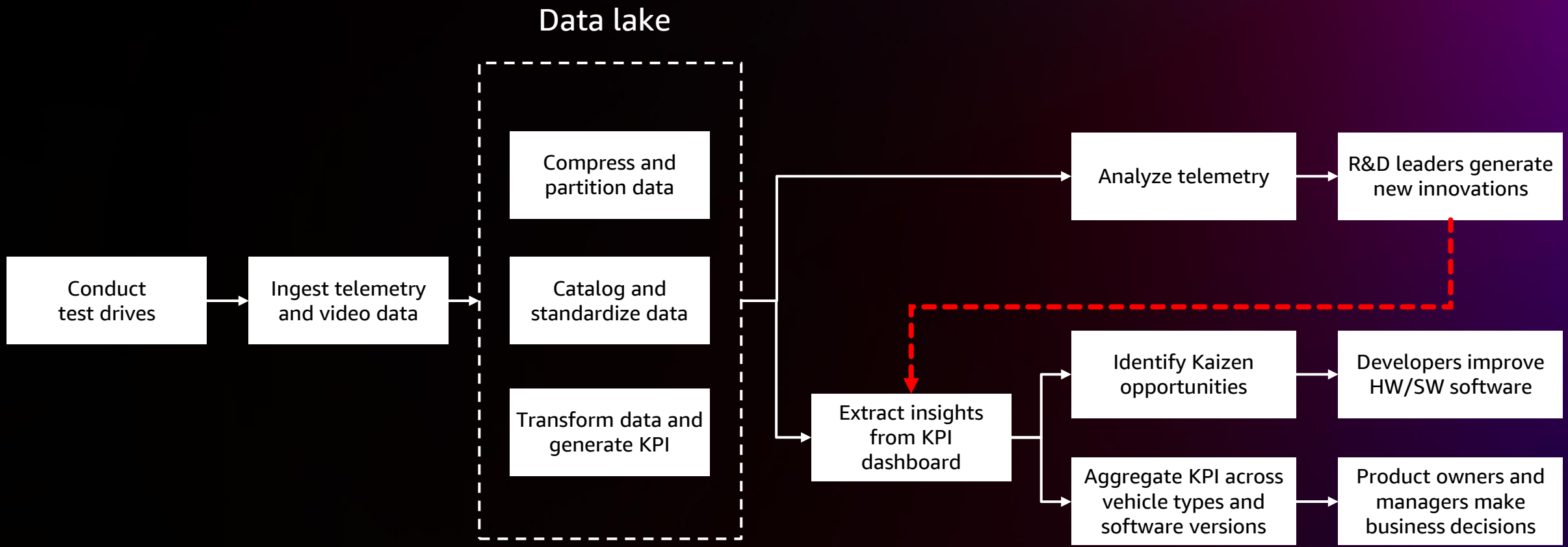
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Whiteboard

< Example call tree >

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Business logic



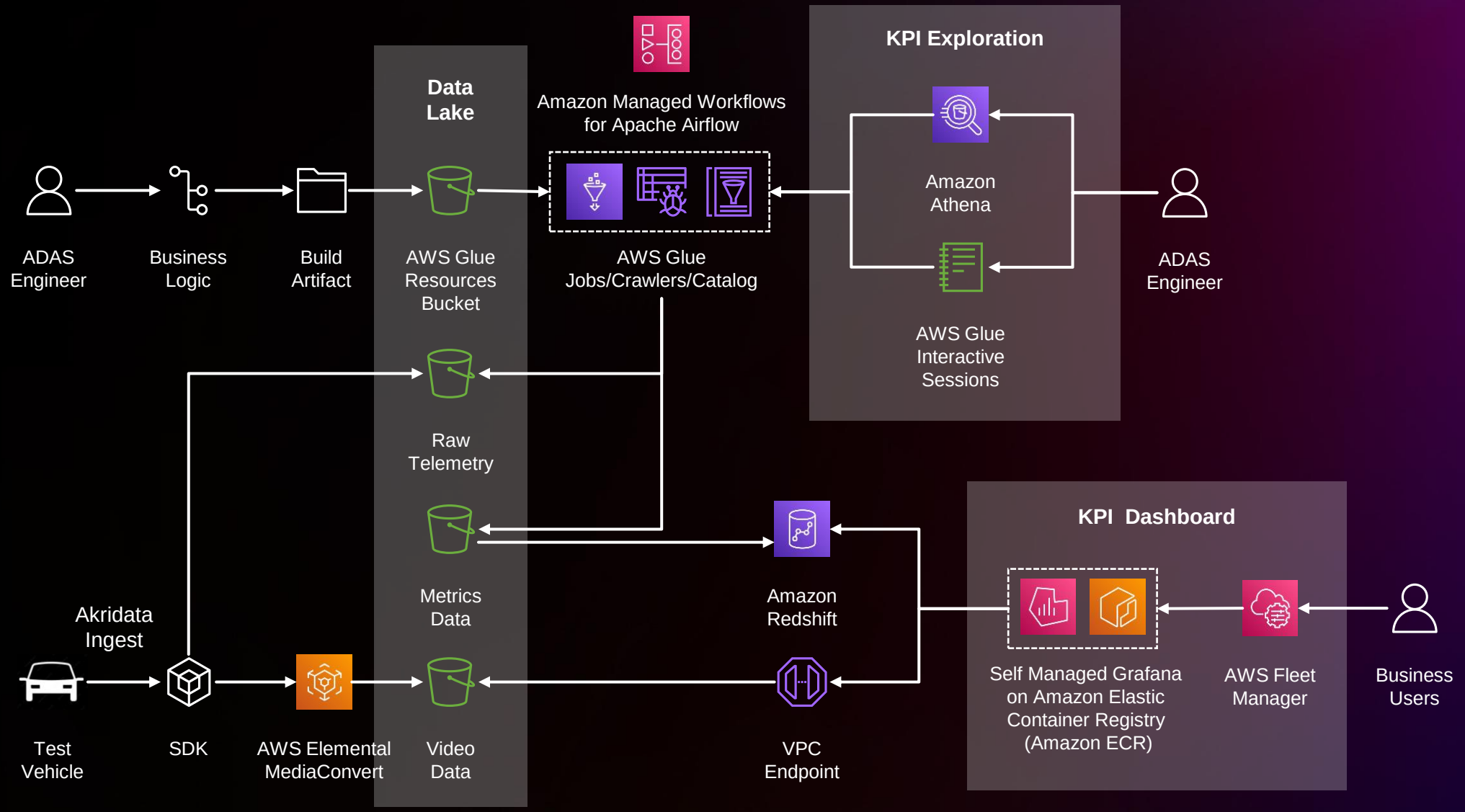
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Challenges

Challenge	Proposed Solution
Calculating changes in metrics over long periods of time	Enable distributed processing frameworks (when possible)
Creating and back-testing new KPIs	Leverage AWS Glue interactive sessions
Scaling up to future data volumes	Decouple application
Enabling reuse across the globe	Terraform all components
Automating workflows	Modular Airflow solution
Leveraging existing code base	Decouple application
Visualize telemetry and video side-by-side	Leverage environmental variables within Grafana

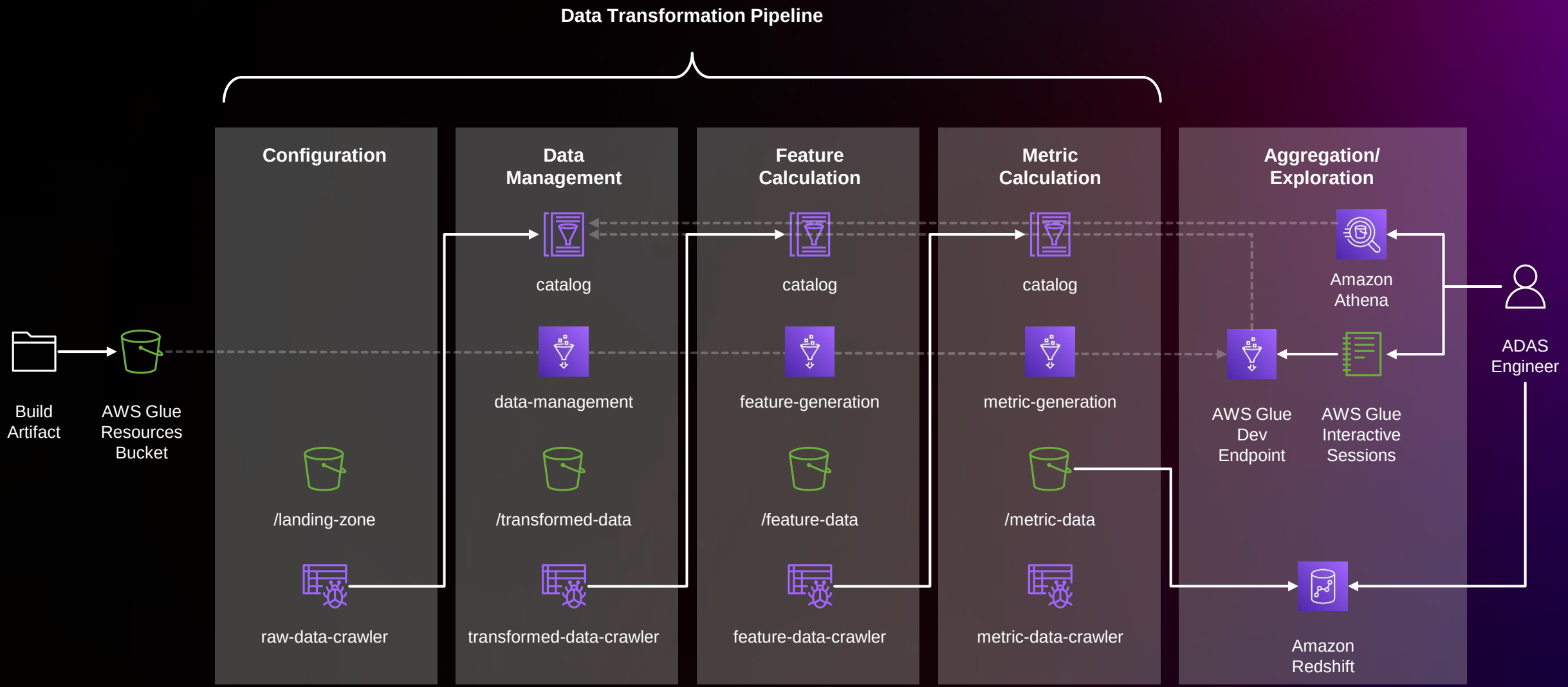
aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

AWS proposed architecture



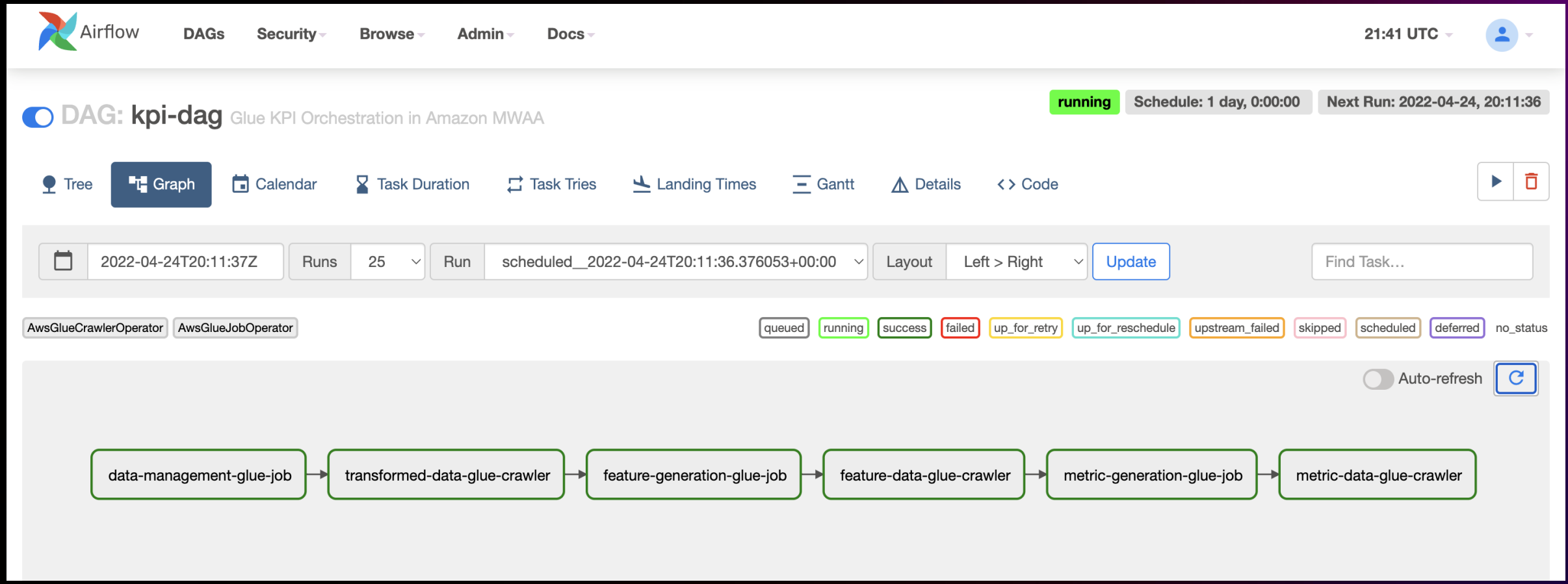
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Architecture – ETL



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

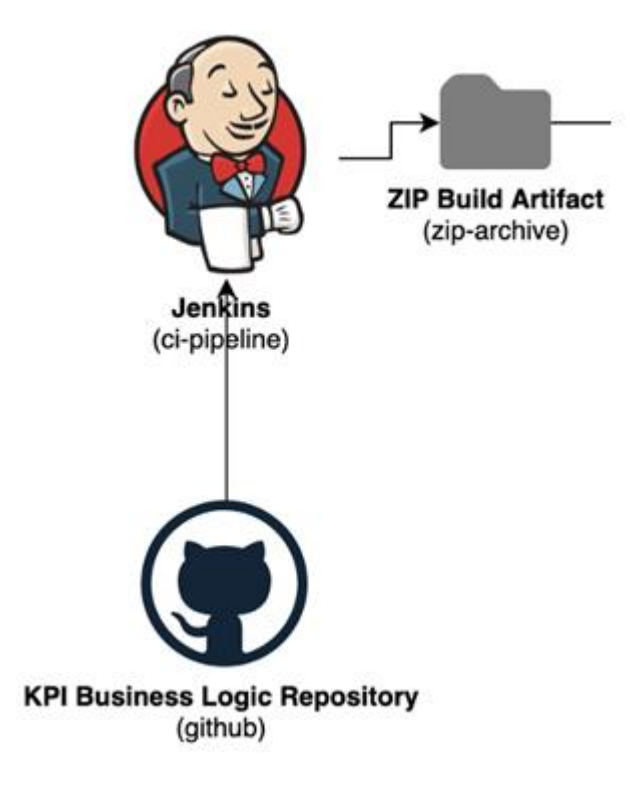
Architecture – Orchestration



© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Architecture – Glue

Business Logic



--extra-py-files argument

Python lib path	s3://kpi-glue-resources/kpi.zip

Glue Job Reference

History | Details | Script | Metrics

```
19 from tool.datatypes import (
20     DataDictionary,
21     SignalsBySource,
22 )
23
24 from data_management.data_management import (
25     get_signals_by_source,
26     transform_table,
27 )
28
```

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Architecture – Python

```
start_unix = test_drive.get('TestDriveStart')
end_unix = test_drive.get('TestDriveEnd')
transformed_data = transformed_data.toDF().where(f"utcTime_sec >= {start_unix} and utcTime_sec <= {end_unix}")
# Convert to Pandas DataFrame
transformed_data = transformed_data.toPandas()
```

Effective data partitioning and filtering strategy is enables reuse of existing code

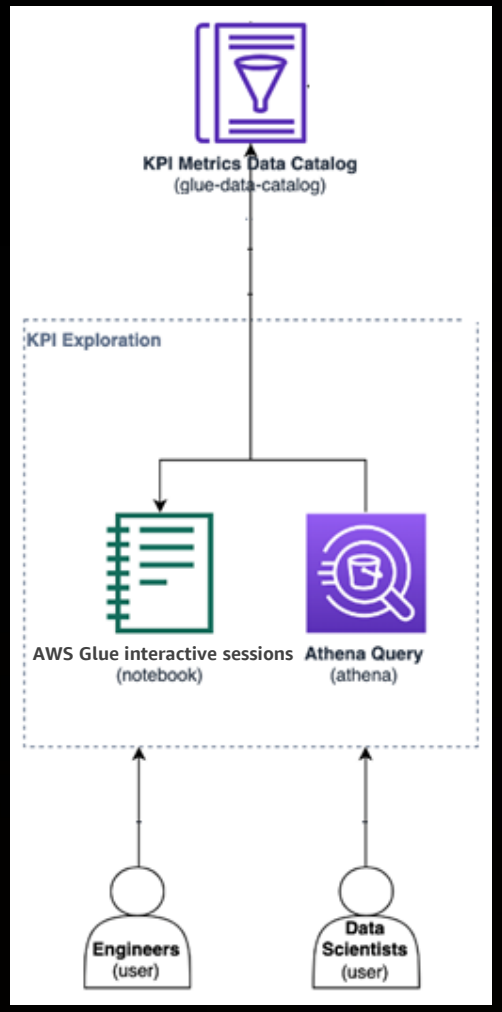
Can easily convert Spark DataFrame to Pandas DataFrame

Filter for specific timestamps of interest to limit data size

aws

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Architecture – AWS Glue interactive sessions



Provides engineers with a common place to develop new KPI

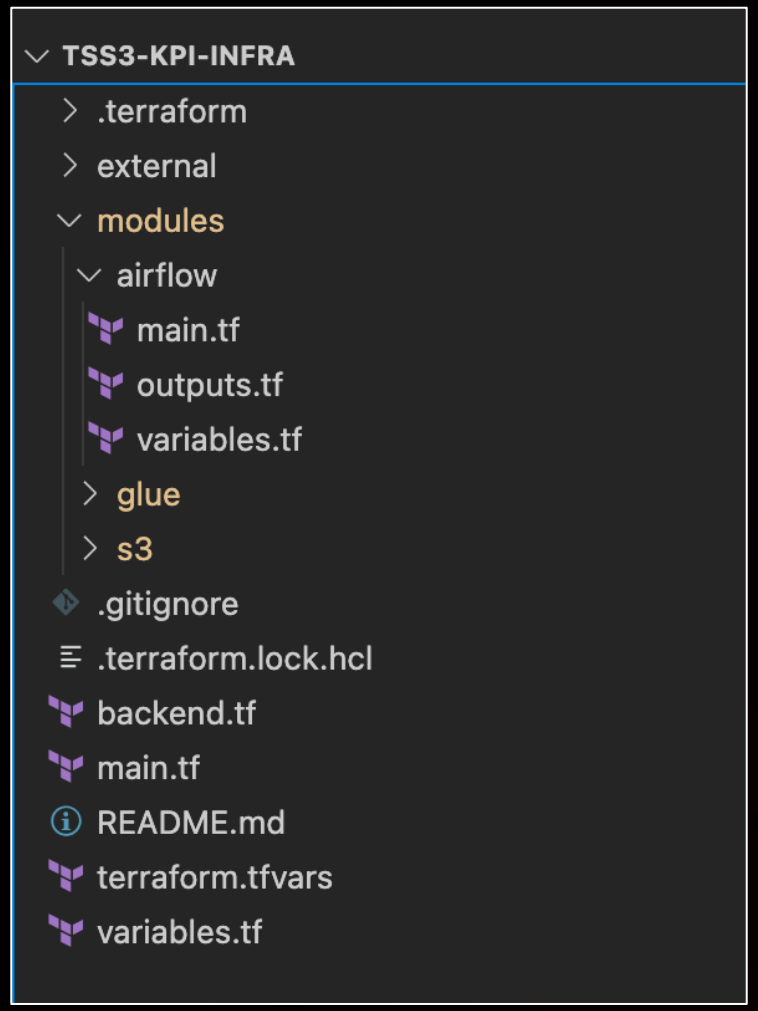
No longer bounded by local storage

No need to manually download files

New metrics are now possible

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

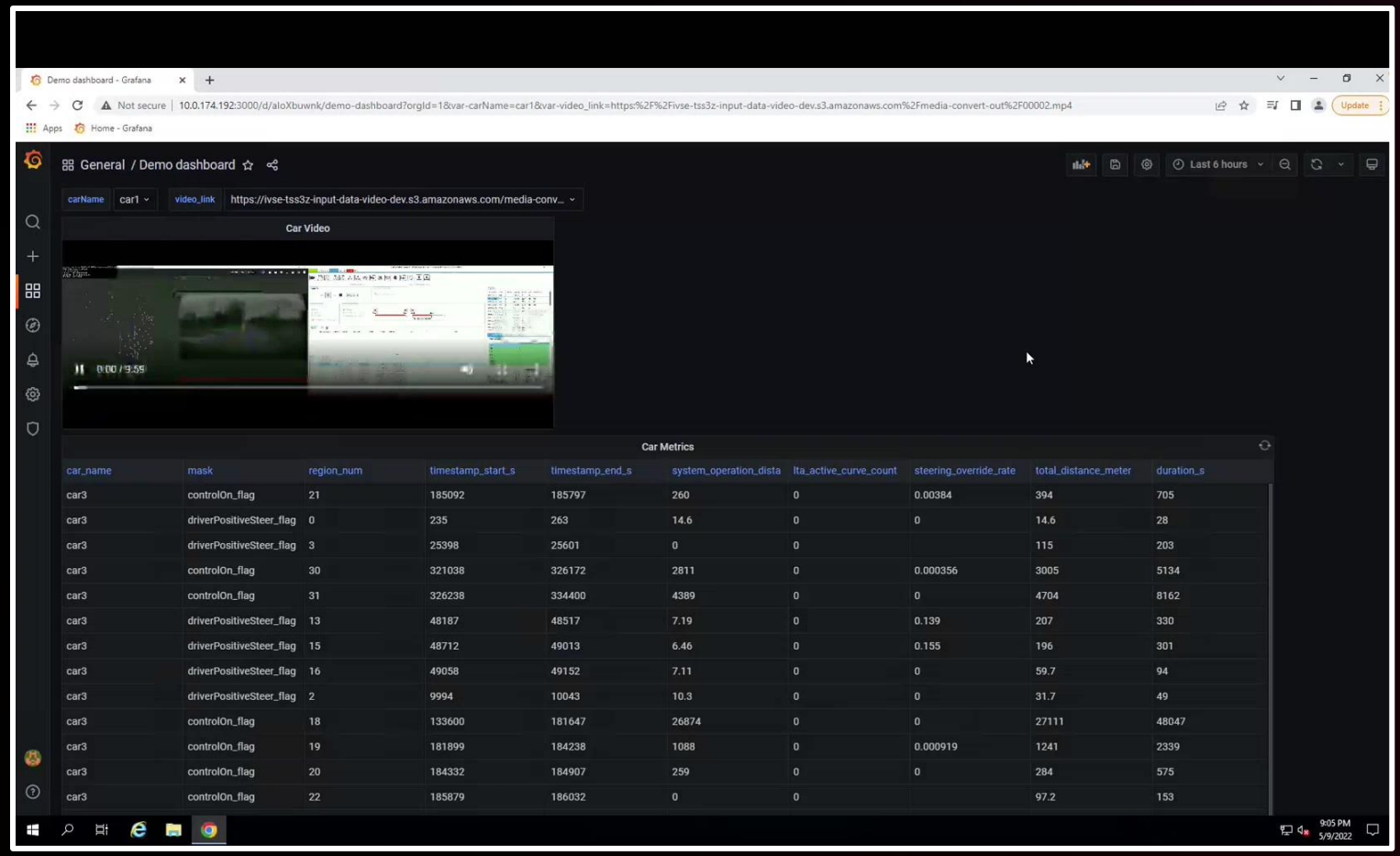
Architecture – Terraform



- Terraform enables cross-Region deployment
- Parameterize as much as possible
- Store .tfstate in S3 backend
- Separate resources into logical modules
- Simplifies code review process

aws
© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Architecture – Grafana



Visualize video side-by-side with KPI and telemetry

Set global variables based on user selection

Reference variable in query

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.



Questions?

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Thank you!



Please complete the session survey in the **mobile app**

© 2022, Amazon Web Services, Inc. or its affiliates. All rights reserved.