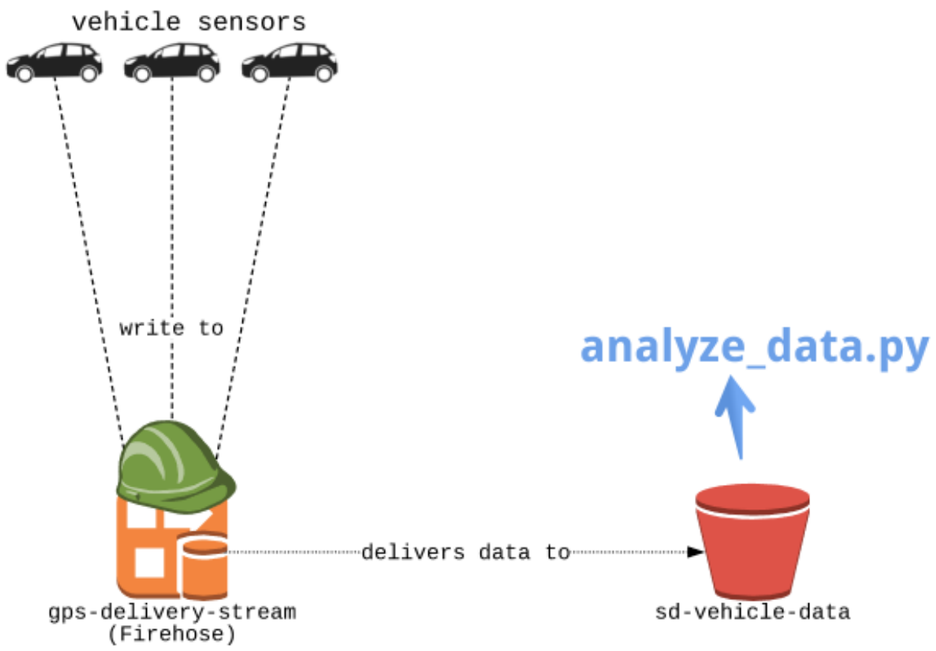
Going serverless

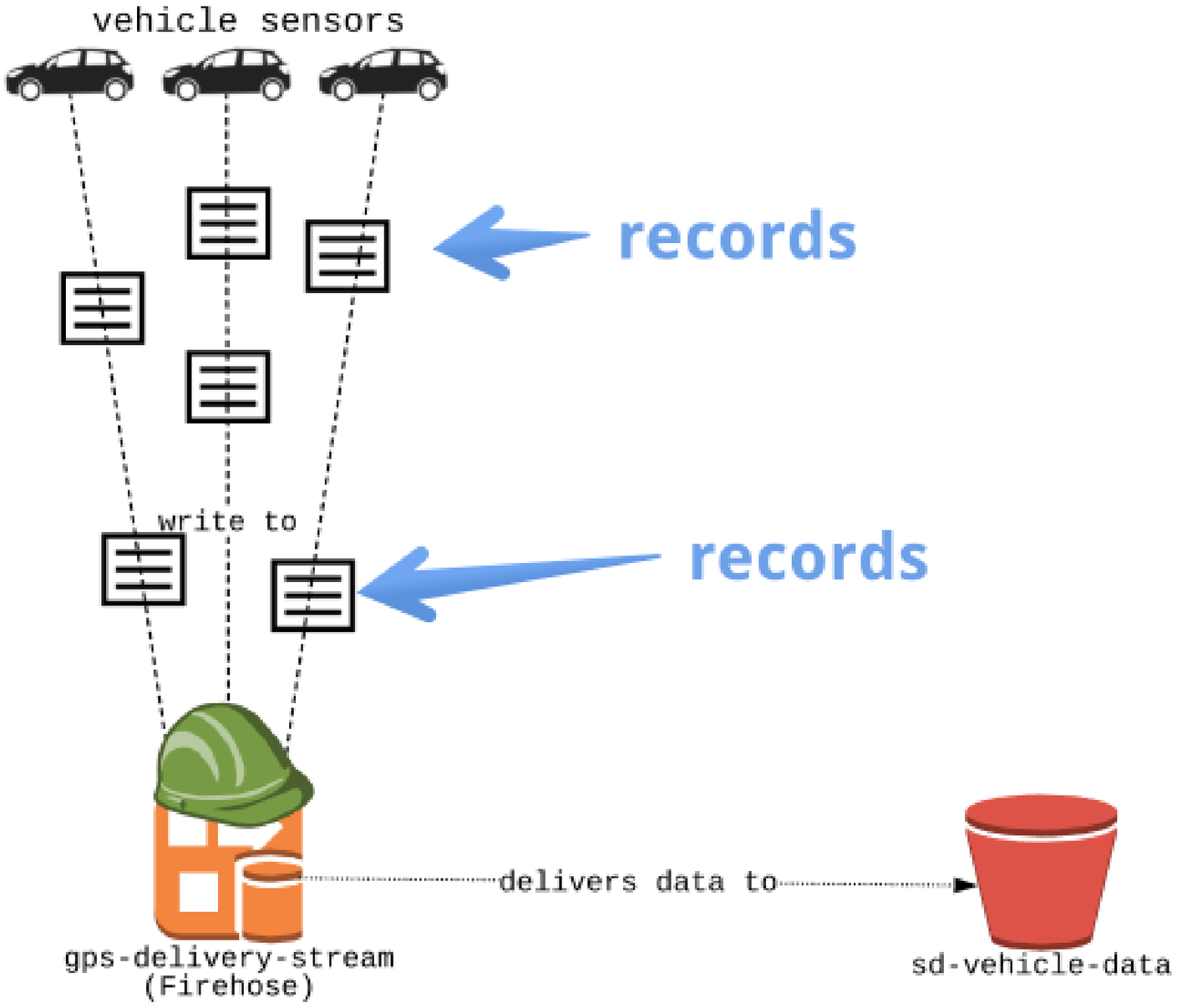
STREAMING DATA WITH AWS KINESIS AND LAMBDA

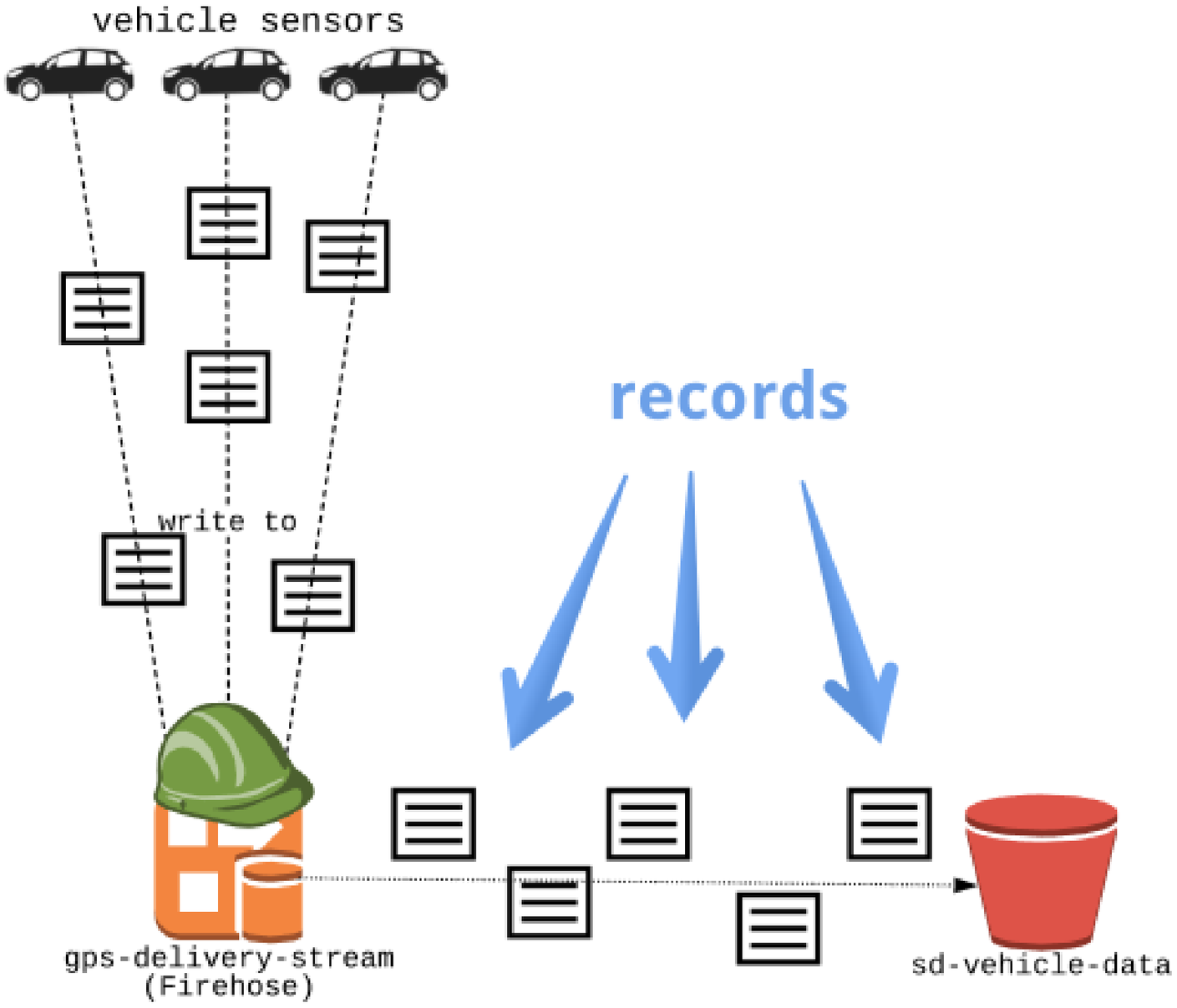
Maksim Pecherskiy
Data Engineer

datacamp

Last chapter




vehicle sensors
records
write to
records
delivers data to
gps-delivery-stream
(Firehose)
sd-vehicle-data


vehicle sensors
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write to
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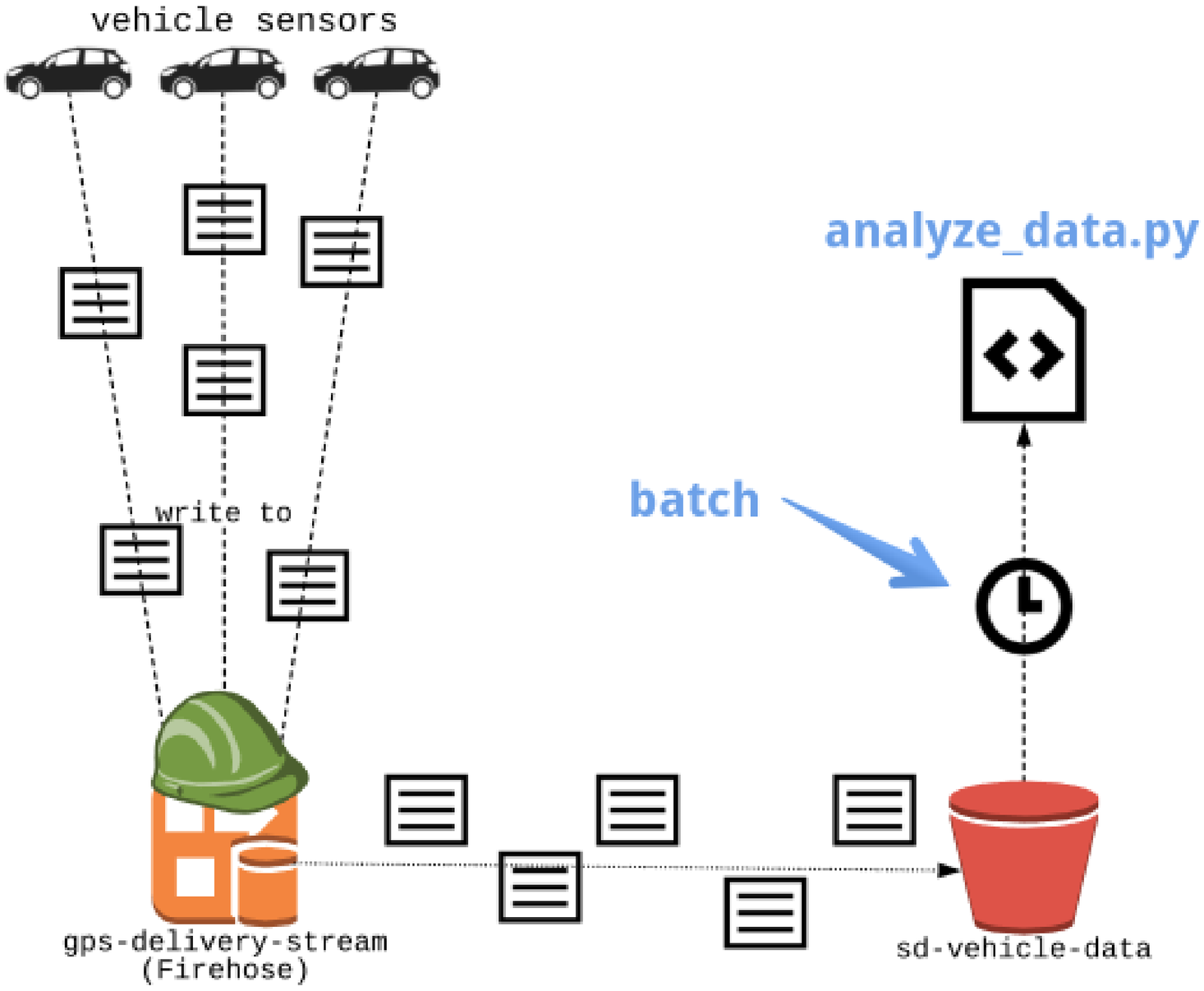
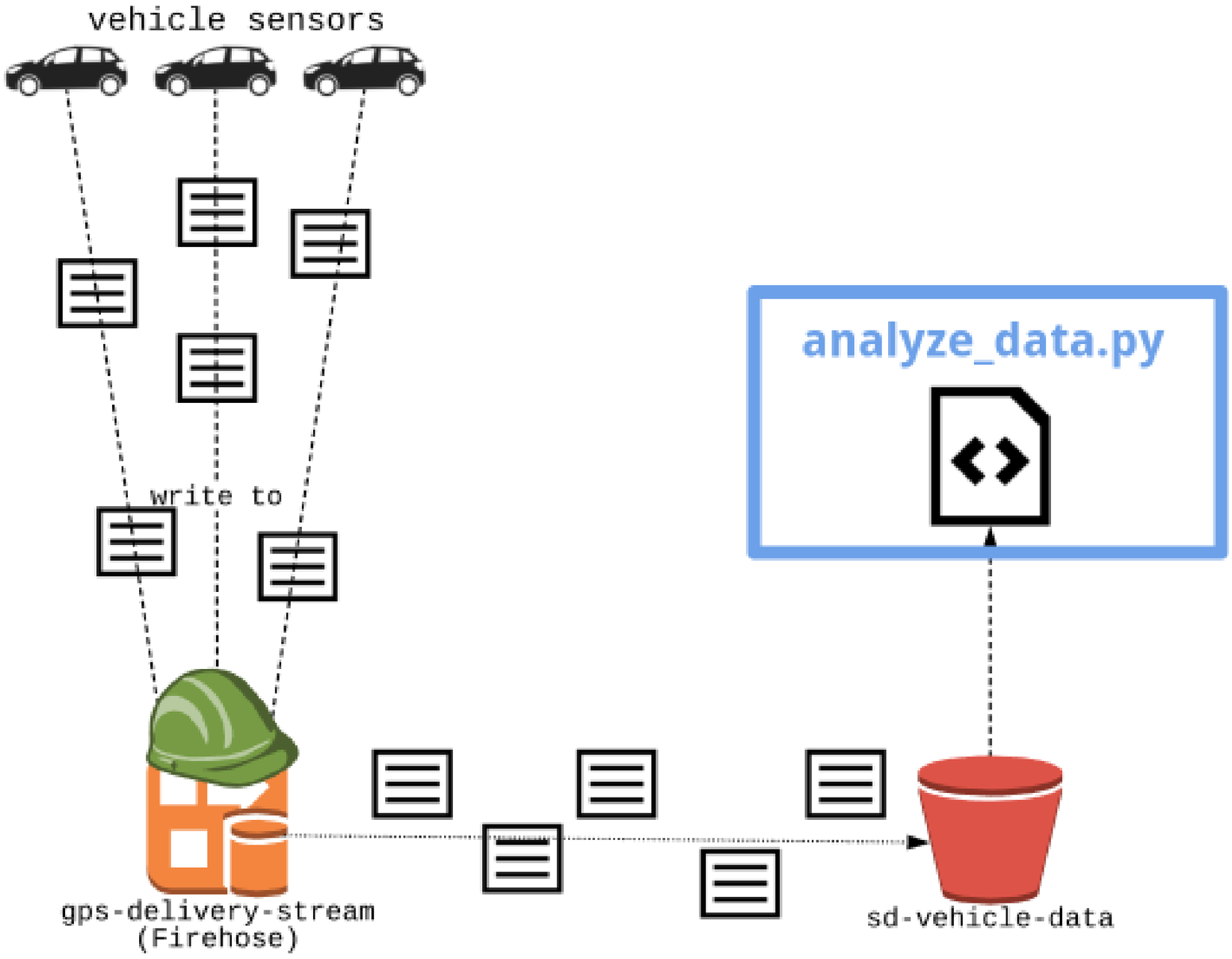

vehicle sensors
analyze_data.py
batch
write to
gps-delivery-stream
(Firehose)
sd-vehicle-data


vehicle sensors
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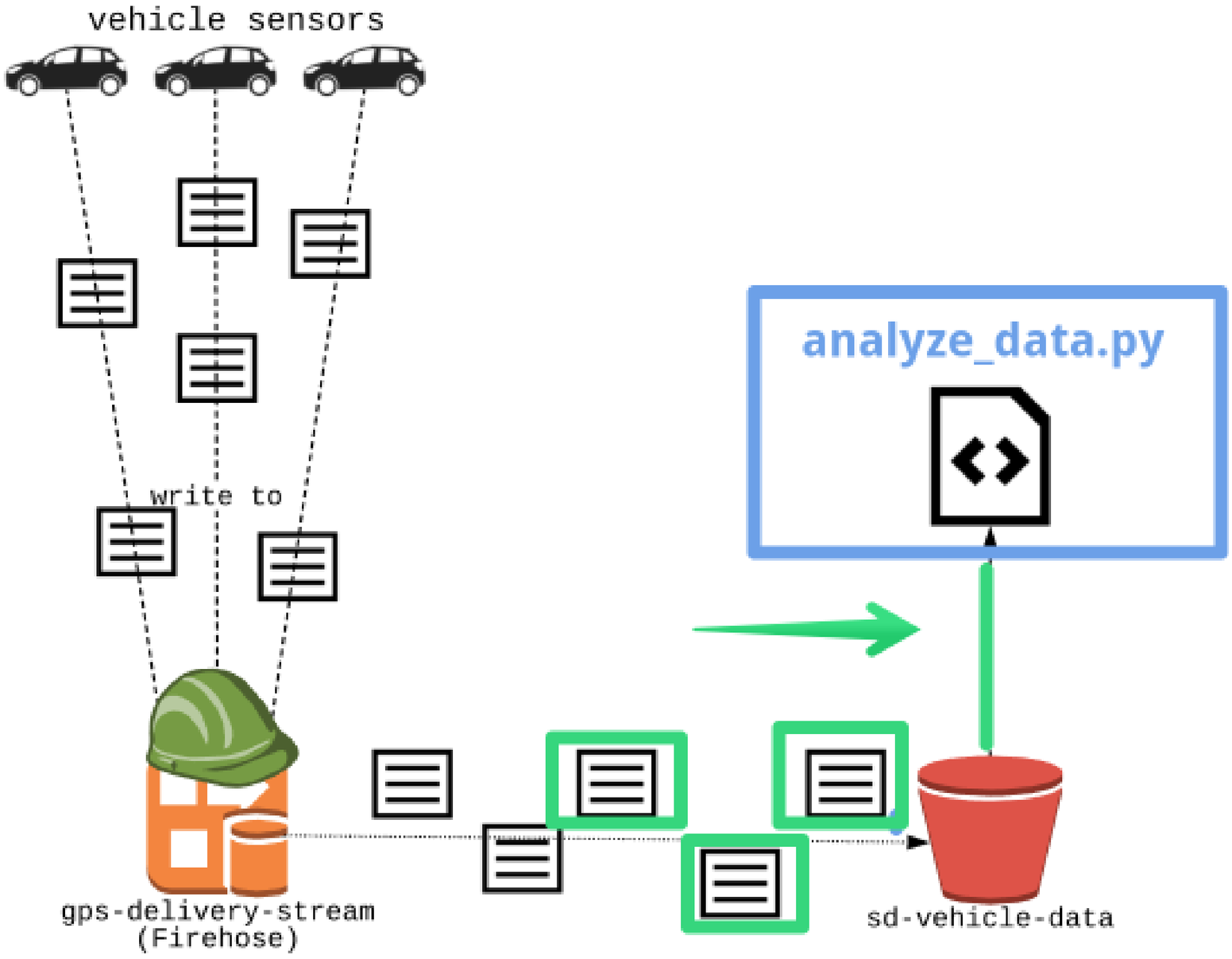
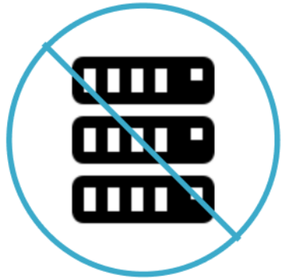
analyze_data.py
gps-delivery-stream
(Firehose)
sd-vehicle-data


vehicle sensors
write to
analyze_data.py
gps-delivery-stream
(Firehose)
sd-vehicle-data

Lambda

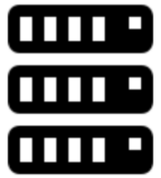
Execute code.
In the cloud.
Triggered by an event.

Serverless



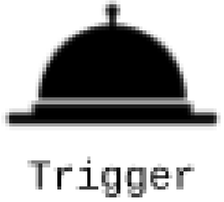
- Servers managed by cloud provider
- Pay per execution
- Automatic scaling
- Lower memory and exec time limits
- Great for quick, targeted functions
- Responding to an event with a callback

Servers (Traditional)

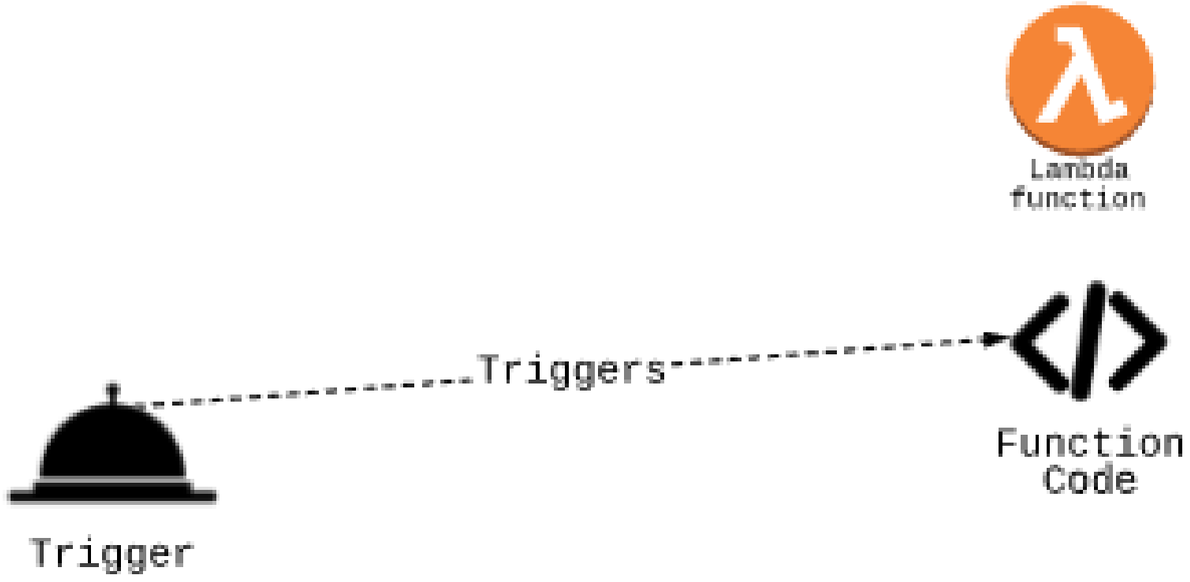


- Servers managed by user
- Pay per hour of running the machine
- Manual scaling
- Higher memory and exec time limits
- Great for long running code executions
- Training a machine learning model

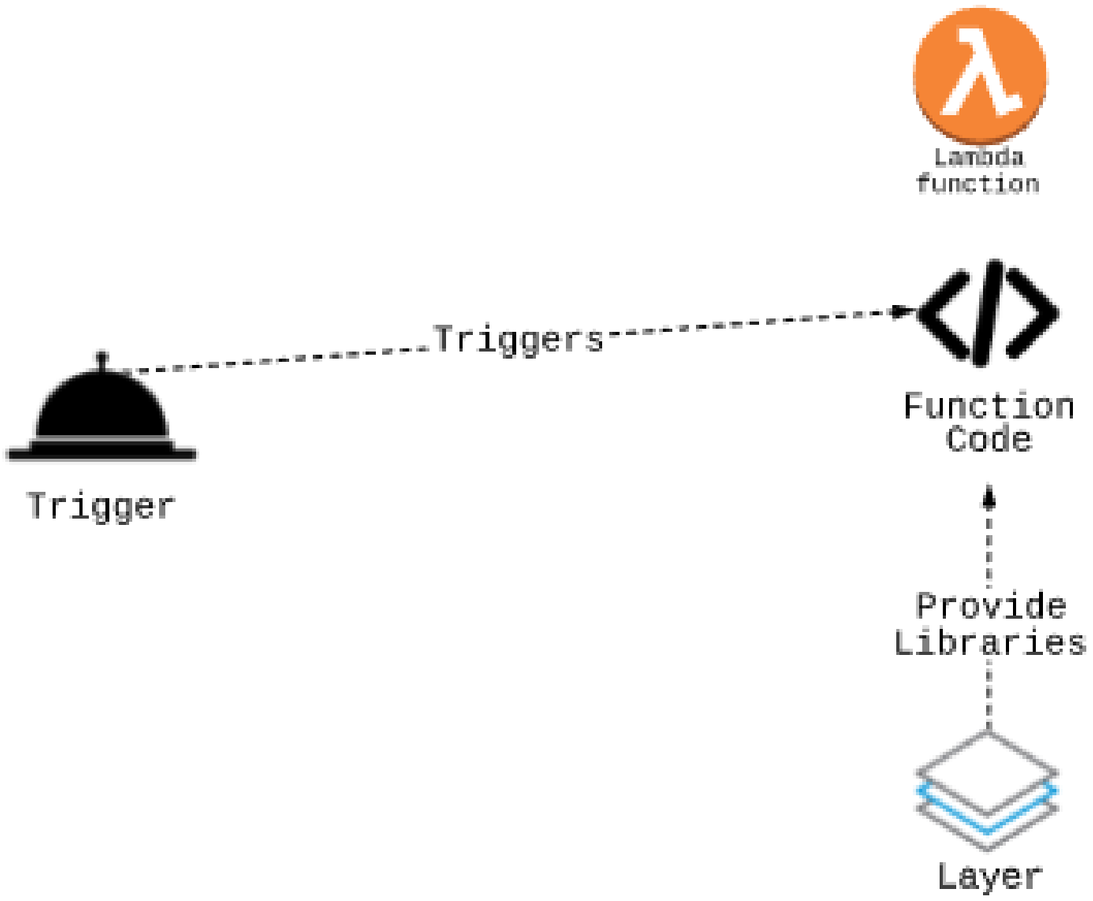
1. Trigger



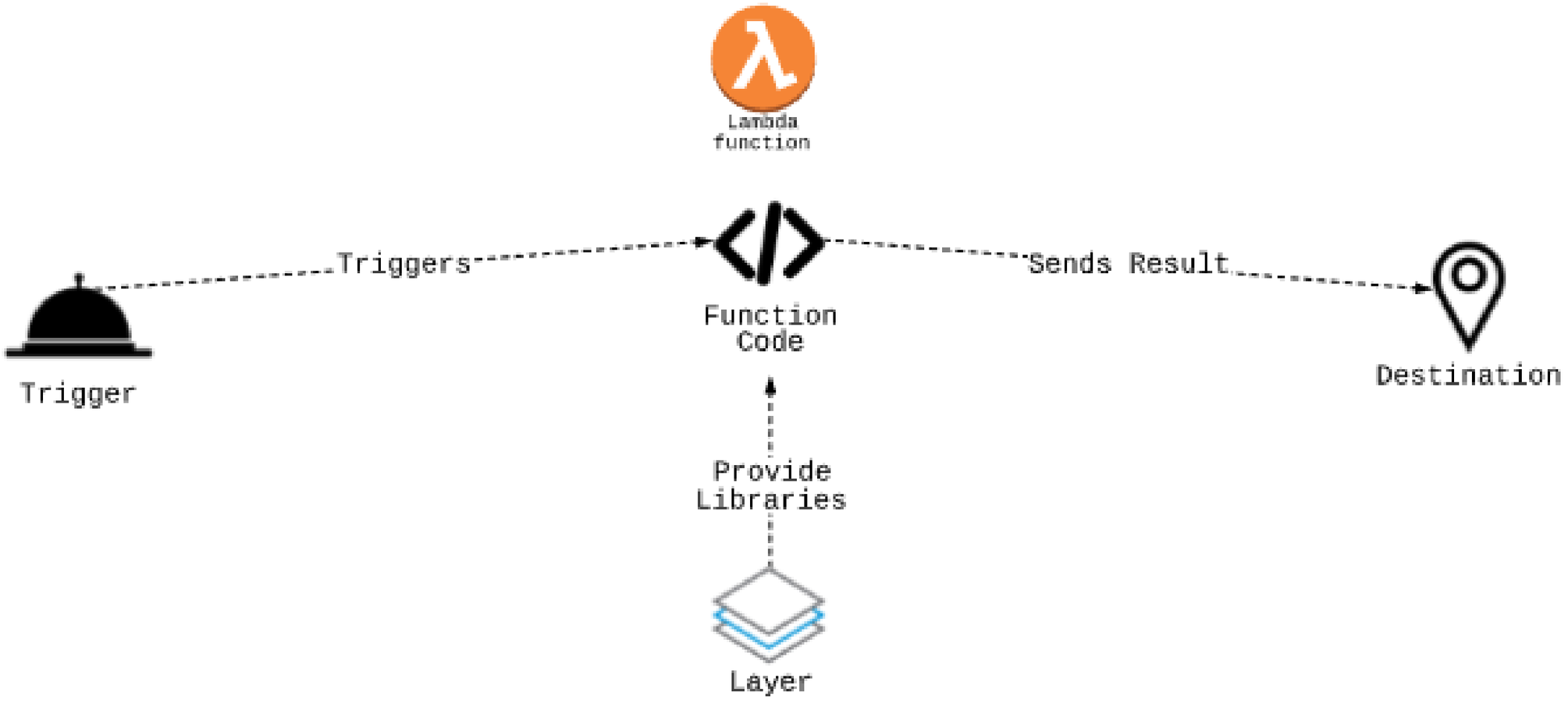
2. Handler



3. Layer

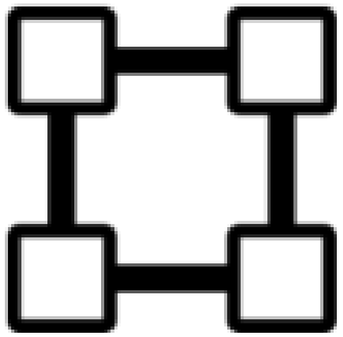

Lambda function
Triggers
Function Code
Trigger
Provide Libraries
Layer

4. Destination



Powerful combination

Data Transformation



API

Alerting

Alexa

Sample handler

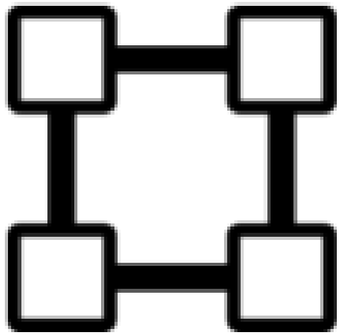
```python
import json

def lambda_handler(event, context):
    return {
        'statusCode': 200,
        'body': json.dumps('Hello from Lambda!')
    }
```

Review

Review

Data Transformation



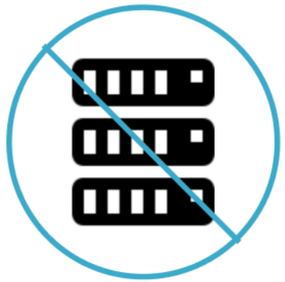
API

Alerting

Alexa

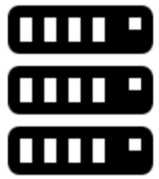
Review

Serverless



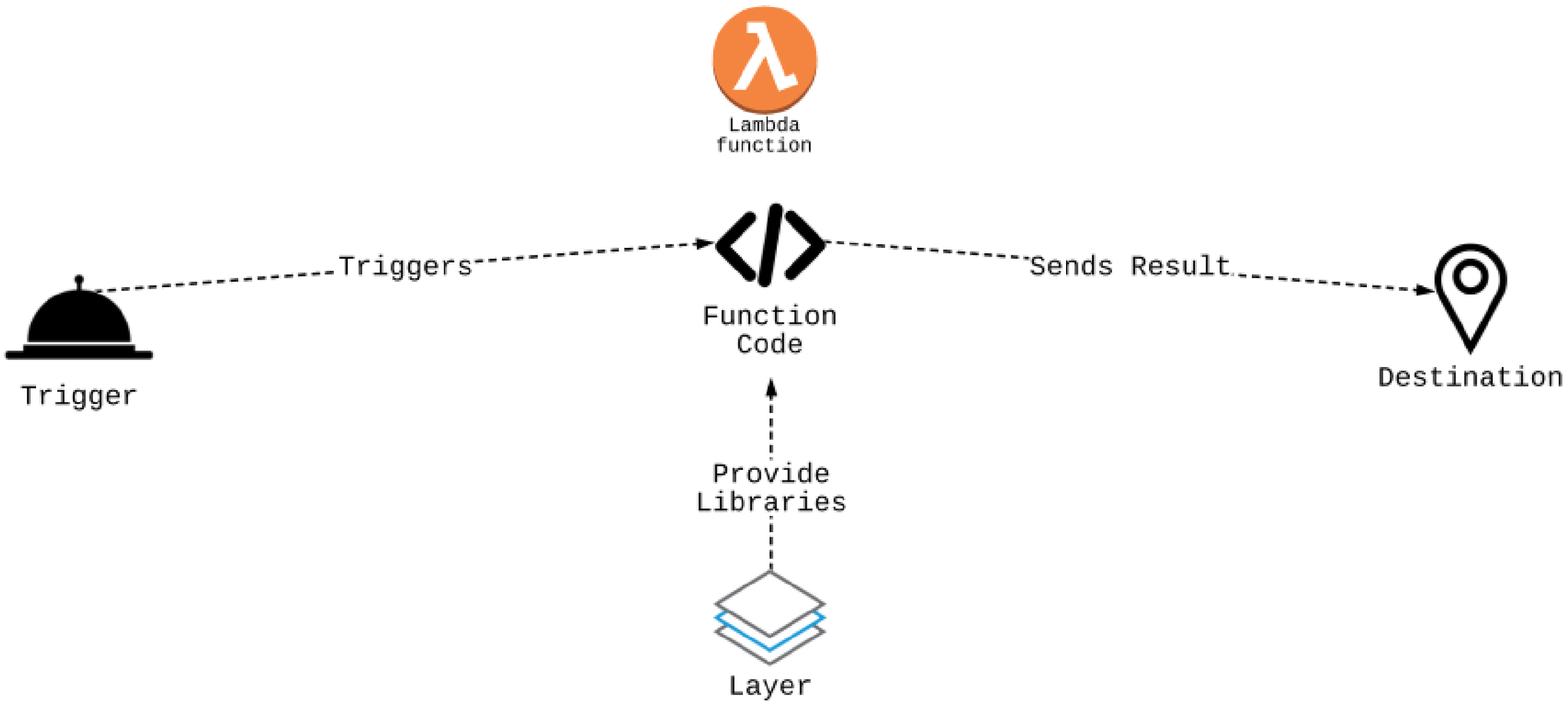
- Responding to an event

Traditional



- Training an ML model

Review


Lambda function
Triggers
Sends Result
Function Code
Trigger
Destination
Provide Libraries
Layer

Let's practice!

STREAMING DATA WITH AWS KINESIS AND LAMBDA

Creating and running Lambda functions

STREAMING DATA WITH AWS KINESIS AND LAMBDA

Maksim Pecherskiy
Data Engineer

datacamp

Let's practice!

STREAMING DATA WITH AWS KINESIS AND LAMBDA

Your first live lambda!

STREAMING DATA WITH AWS KINESIS AND LAMBDA

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Data Engineer

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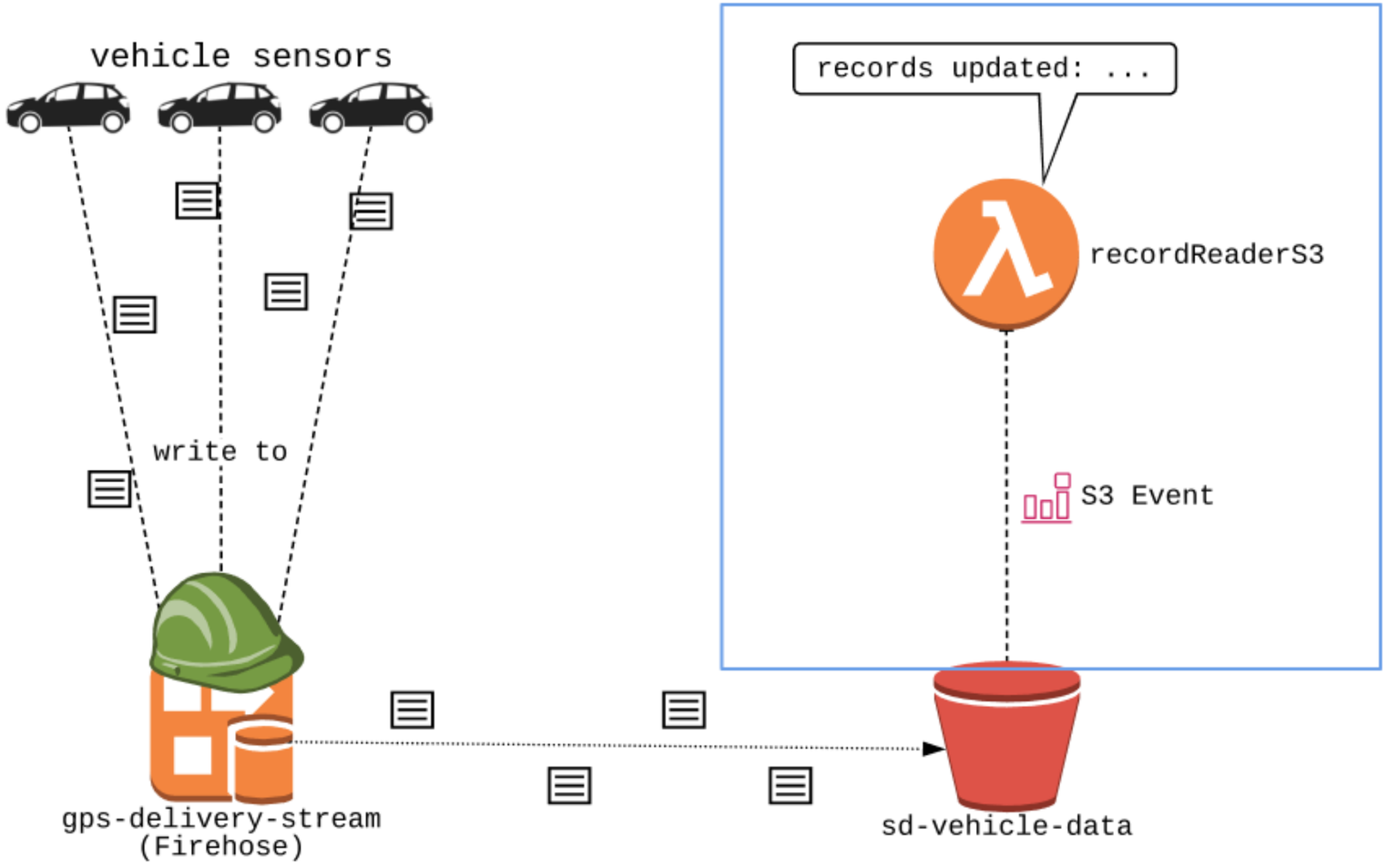
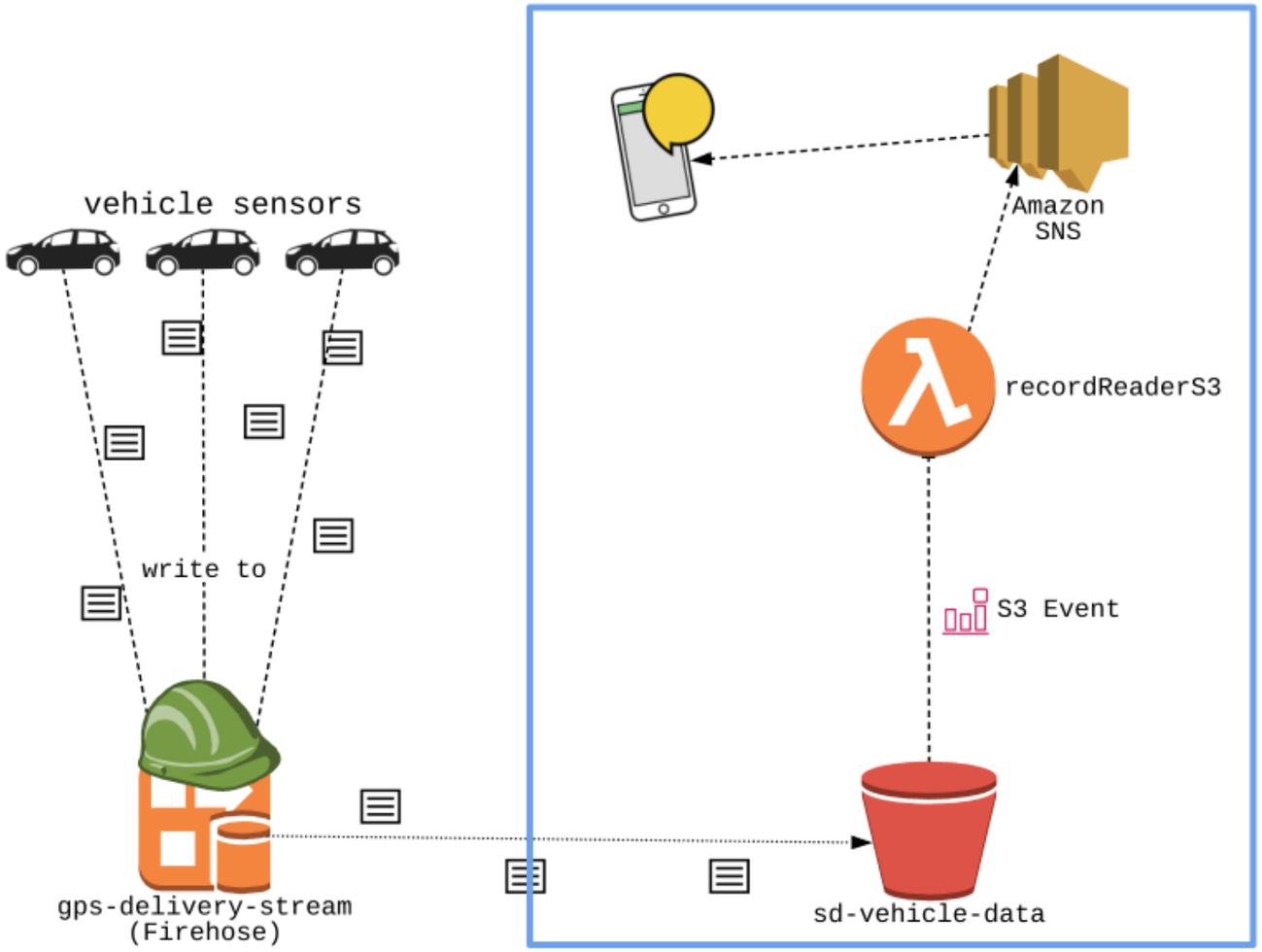
Last lesson


vehicle sensors
write to
gps-delivery-stream
(Firehose)
records updated: ...
recordReaderS3
S3 Event
sd-vehicle-data

This lesson


vehicle sensors
write to
gps-delivery-stream
(Firehose)
Amazon
SNS
recordReaderS3
S3 Event
sd-vehicle-data

Common log format

```
bc75da5f-1bf6-444c-80ad-49c180e1b8de 23:16:06.000 3FTEX1G5XAK844393 -76.6990172 2.481207 40
ff8e7131-408d-463b-8d07-d016419b0656 20:26:44.000 2LAXX1C8XAK844292 114.39239199999999 36.097577 90
f29a5b3d-d0fa-43c0-9e1a-e2a5cdb8be7a 8:10:47.000 3FTEX1G5XAK844393 108.58068100000001 34.79925 37
```

Reading S3 files

```
import pandas as pd
```

results in:

```
Response:
{
  "errorMessage": "Unable to import module 'lambda_function': No module named 'panda
  "errorType": "Runtime.ImportModuleError"
}
```

Updating the handler

```
#lambda_function.py
import json, boto3, pandas as pd
# Initialize clients
...
SPEED_ALERT_THRESHOLD = 45
ALERT_PHONE_NUMBER = "+1234567890"
# Helper function to get dataframe from written records
def get_new_data(event):
    pd.read_csv()...
    ...
    return data
# Lambda function handler
def record_created_handler(event, context):
    data = get_new_data(event)
    ...
    sns.publish()
    ...
```

get_new_data()

```
def get_new_data(event):
    # Create a list to store new object keys.
    written_objects = []

    # Iterate over each S3 event record.
    for record in event['Records']:

        # Get the variables to check for
        event_name = record['eventName']
        bucket_name = record['s3']['bucket']['name']
        obj_key = record['s3']['object']['key']
```

get_new_data()

```
def get_new_data(event):
        ...
        # Verify that event is created from sd-vehicle-data bucket.
        if event_name == 'ObjectCreated:Put' and bucket_name == 'sd-vehicle-data':
            obj = s3.get_object(Bucket=bucket_name, Key = obj_key)
            df = pd.read_csv(obj['Body'], delimiter = " ",
                   names=["record_id", "timestamp", "vin", "lon", "lat", "speed"])
            written_objects.append(df)
       # Concatenate new records into a single dataframe.
       return pd.concat(written_objects)
```

record_created_handler()

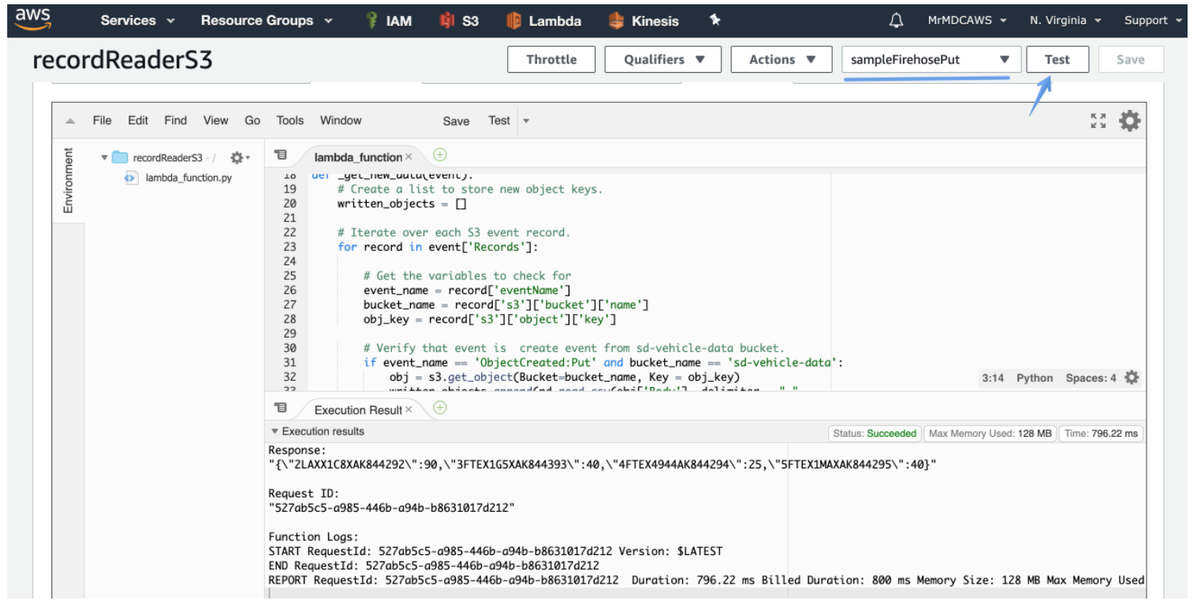
```
SPEED_ALERT_THRESHOLD = 45
ALERT_PHONE_NUMBER = "+1234567890"
...
def record_created_handler(event, context):
    # Call the helper method
    data = get_new_data(event)
    ## Get the top speeds
    top_speeds = data.groupby(['vin'])['speed'].max().reset_index()
    ## Get top speeds that exceed the limit of 45
    too_fast = top_speeds.loc[top_speeds.speed > SPEED_ALERT_THRESHOLD, :]
```

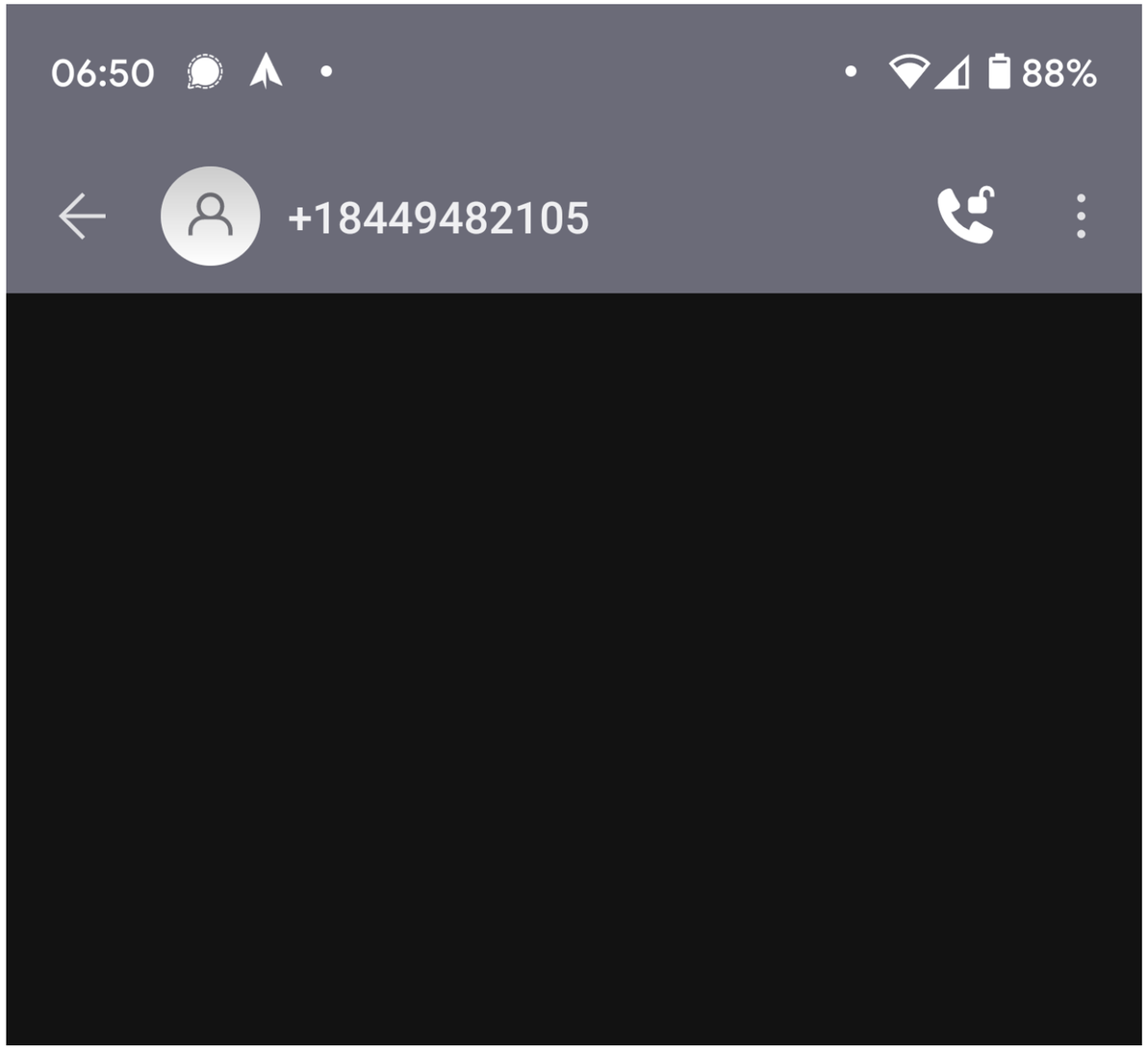
record_created_handler()

```
SPEED_ALERT_THRESHOLD = 45
ALERT_PHONE_NUMBER = "+1234567890"
...

def record_created_handler(event, context):
    ...
    ## Send SMS
    sns.publish(PhoneNumber=ALERT_PHONE_NUMBER,
        Message="Speeding Alert \n" + too_fast.to_string())
    ## This doesn't go anywhere yet, but we need to return something.
    totals = data.groupby(['vin'])['speed'].max().reset_index()
    return totals.to_csv(sep=" ", index=False)
```

Test the Lambda function





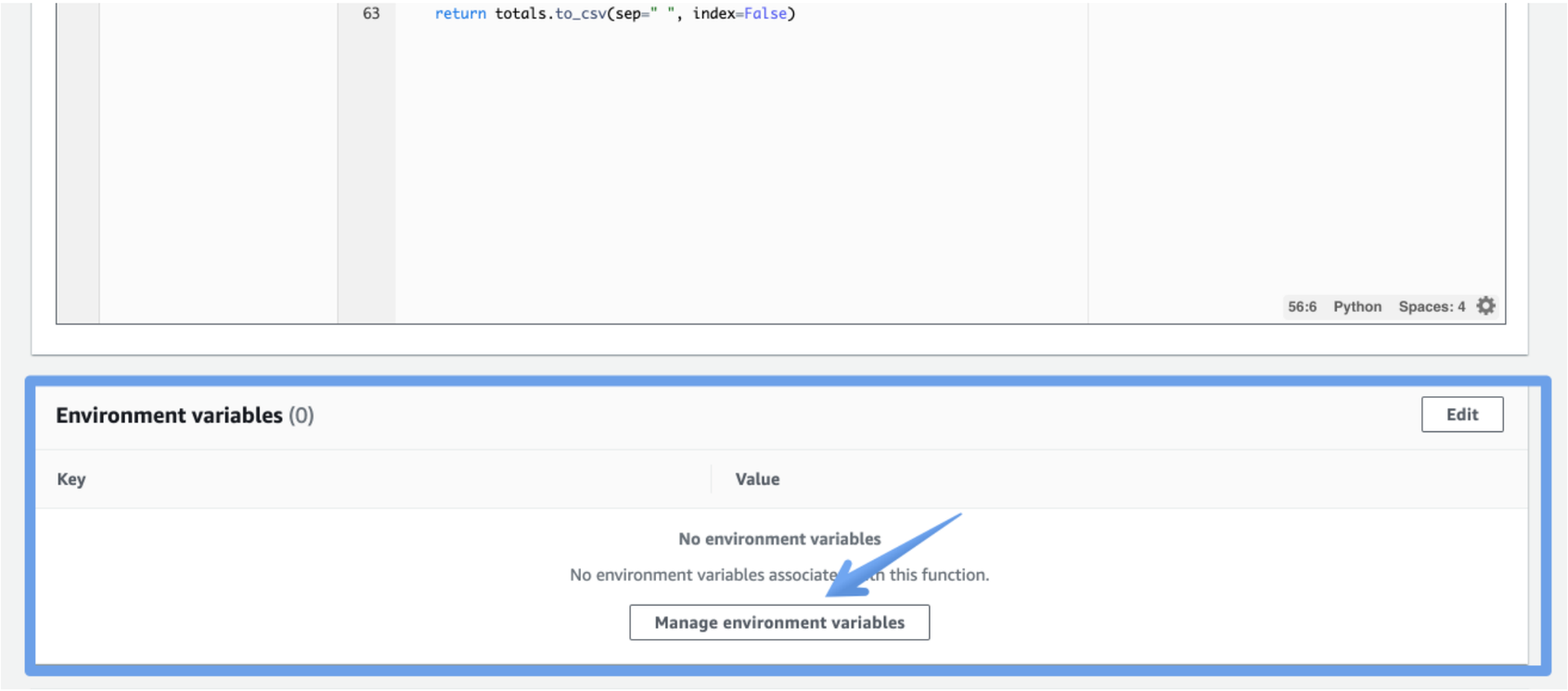
Adding environment variables

```
import os
os.environ.get("ENV_VARIABLE_NAME", "DEFAULT_VALUE")
```

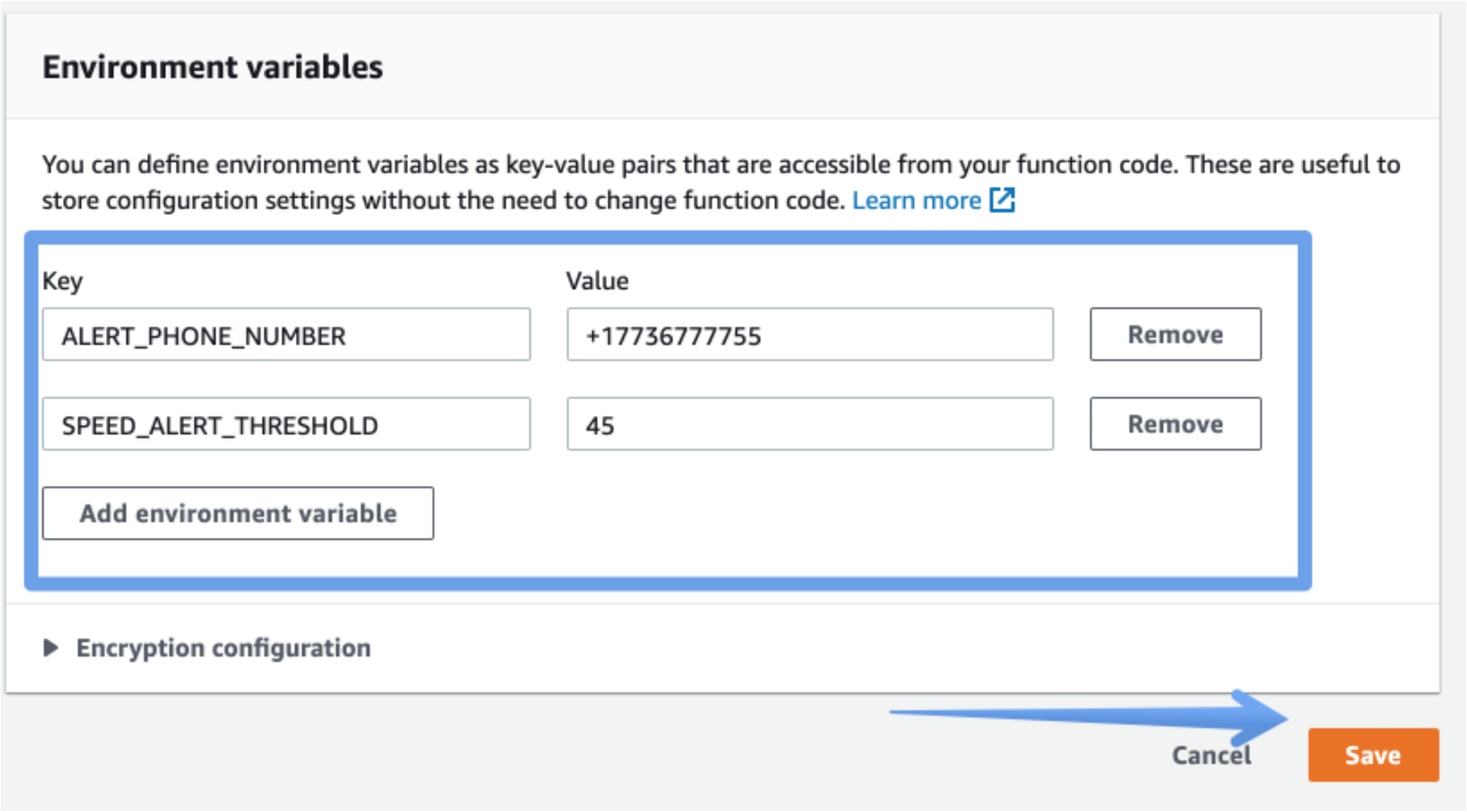
```
import os
SPEED_ALERT_THRESHOLD = os.environ.get("SPEED_ALERT_THRESHOLD", 45)
ALERT_PHONE_NUMBER = os.environ.get("ALERT_PHONE_NUMBER", None)
...

def record_created_handler(event, context):
    ...
```

Adding environment variables

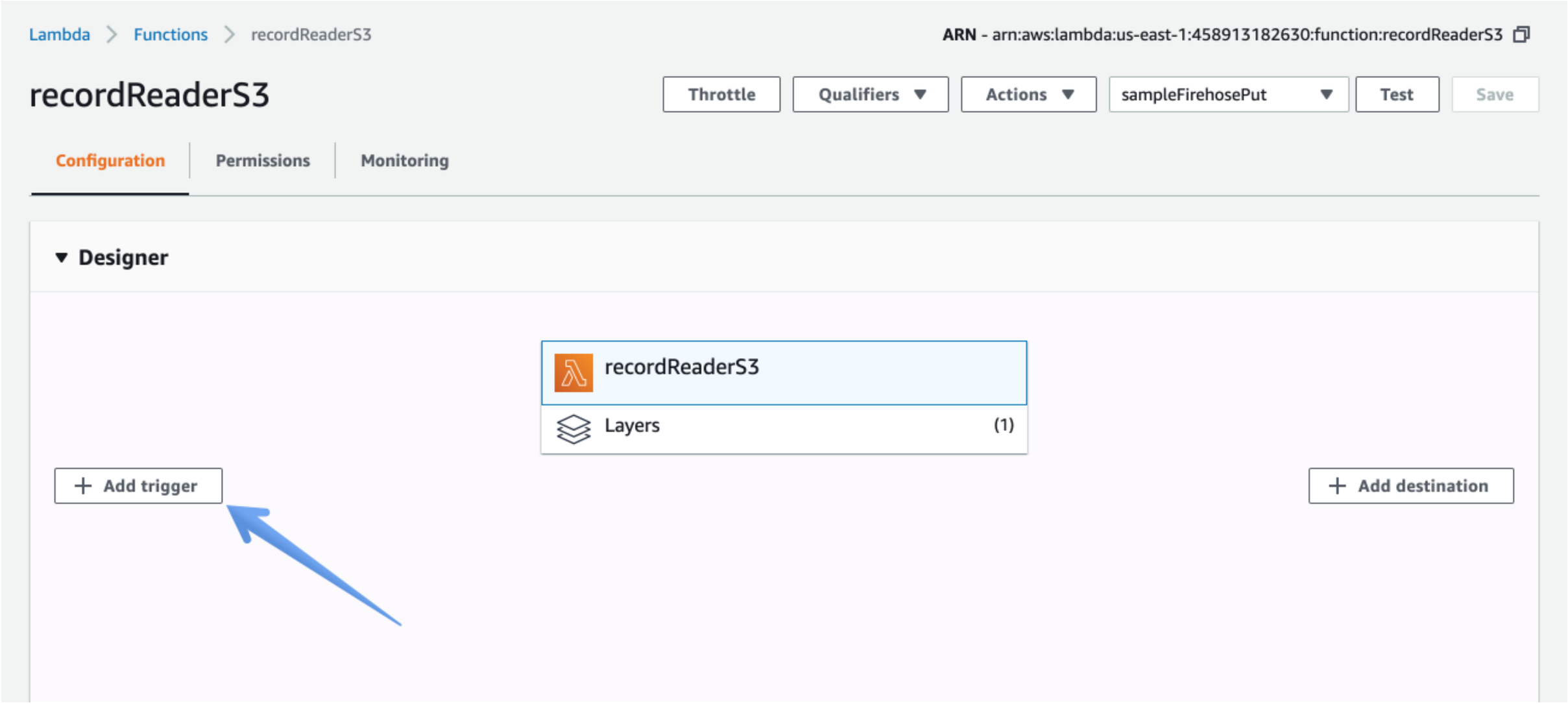


Adding environment variables




340 x 256

Adding a trigger



Adding a trigger

Trigger configuration

S3
aws

Bucket
Please select the S3 bucket that serves as the event source. The bucket must be in the same region as the function.

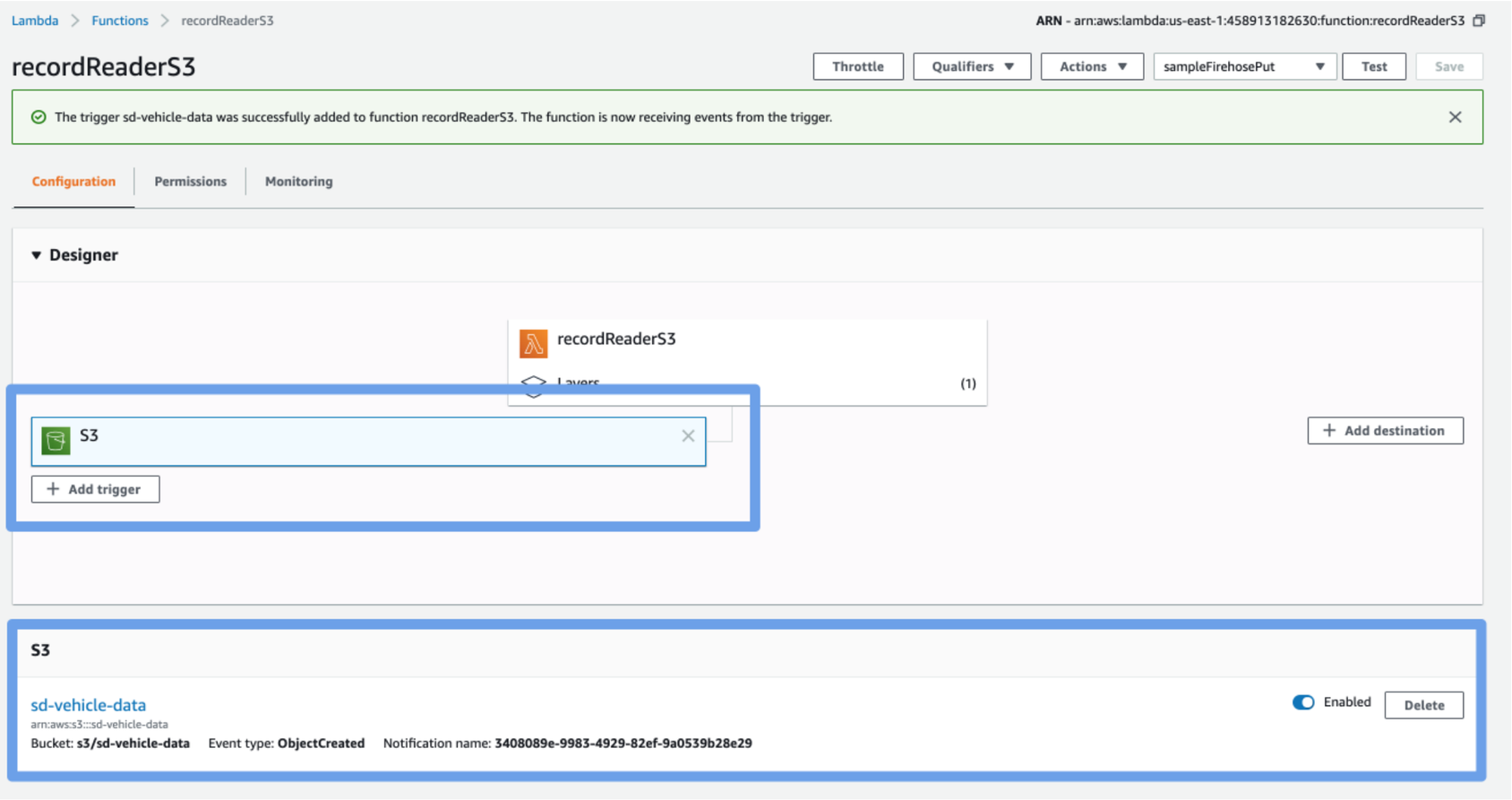
sd-vehicle-data

Event type
Select the events that you want to have trigger the Lambda function. You can optionally set up a prefix or suffix for an event. However, for each bucket, individual events cannot have multiple configurations with overlapping prefixes or suffixes that could match the same object key.

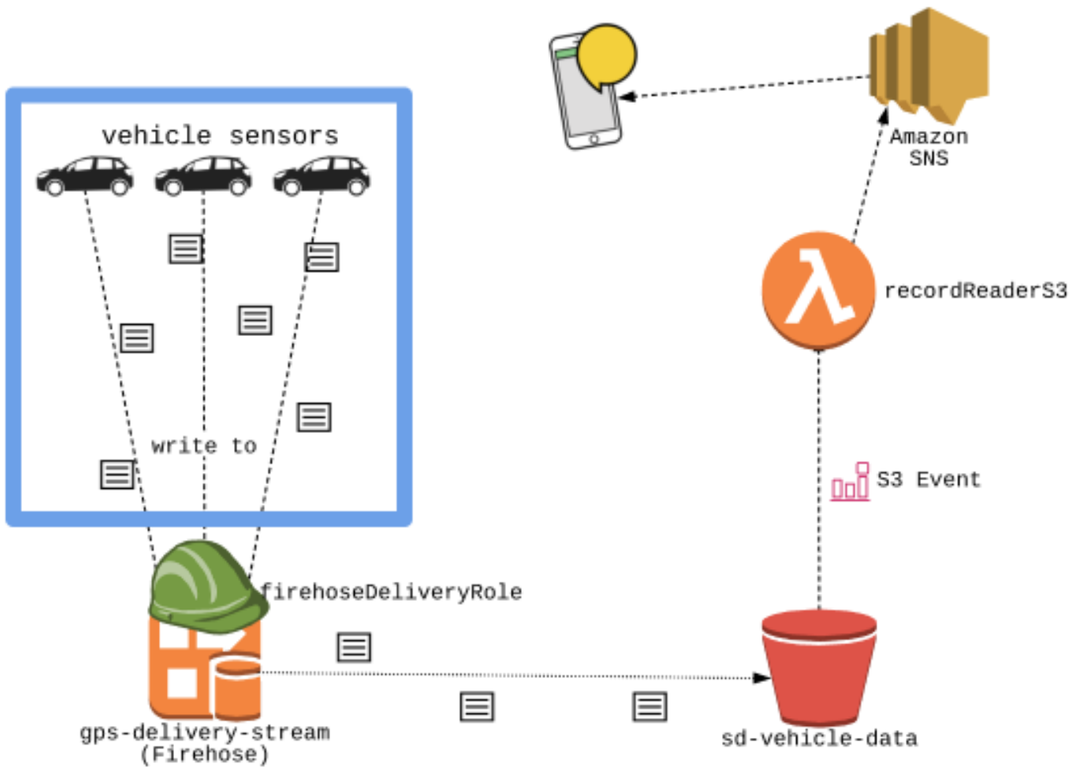
All object create events

Prefix - *optional*

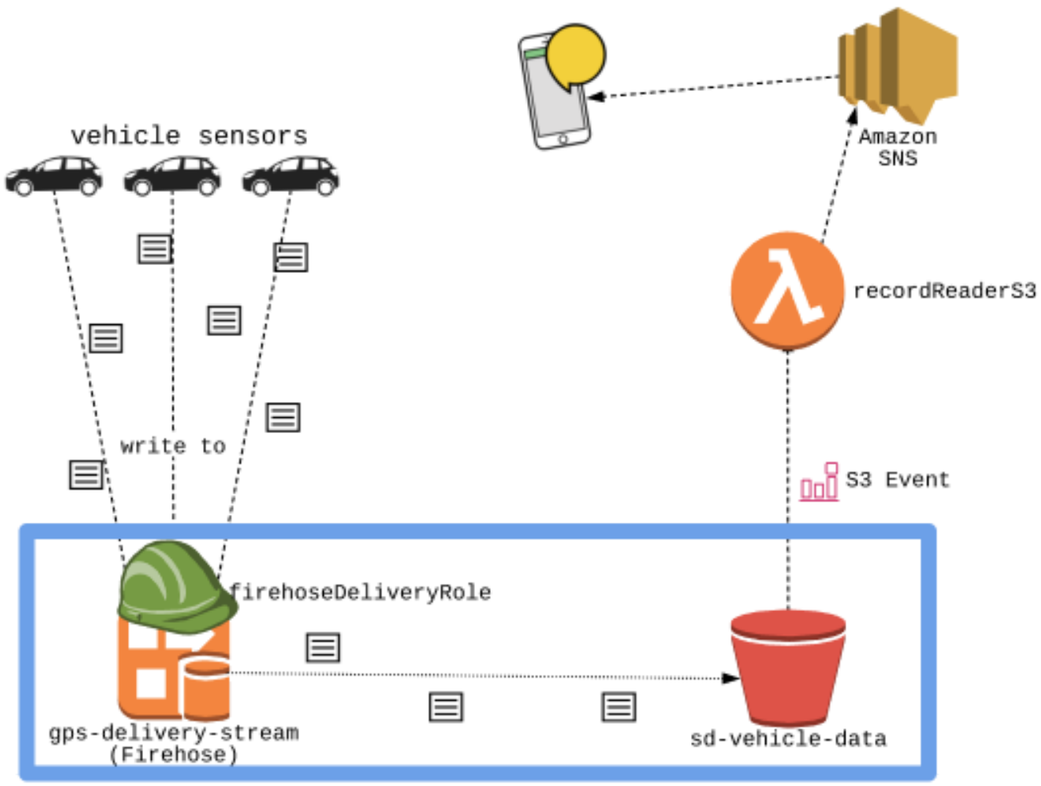
Adding a trigger



Review


vehicle sensors
write to
Amazon SNS
recordReaderS3
S3 Event
firehoseDeliveryRole
gps-delivery-stream (Firehose)
sd-vehicle-data

Review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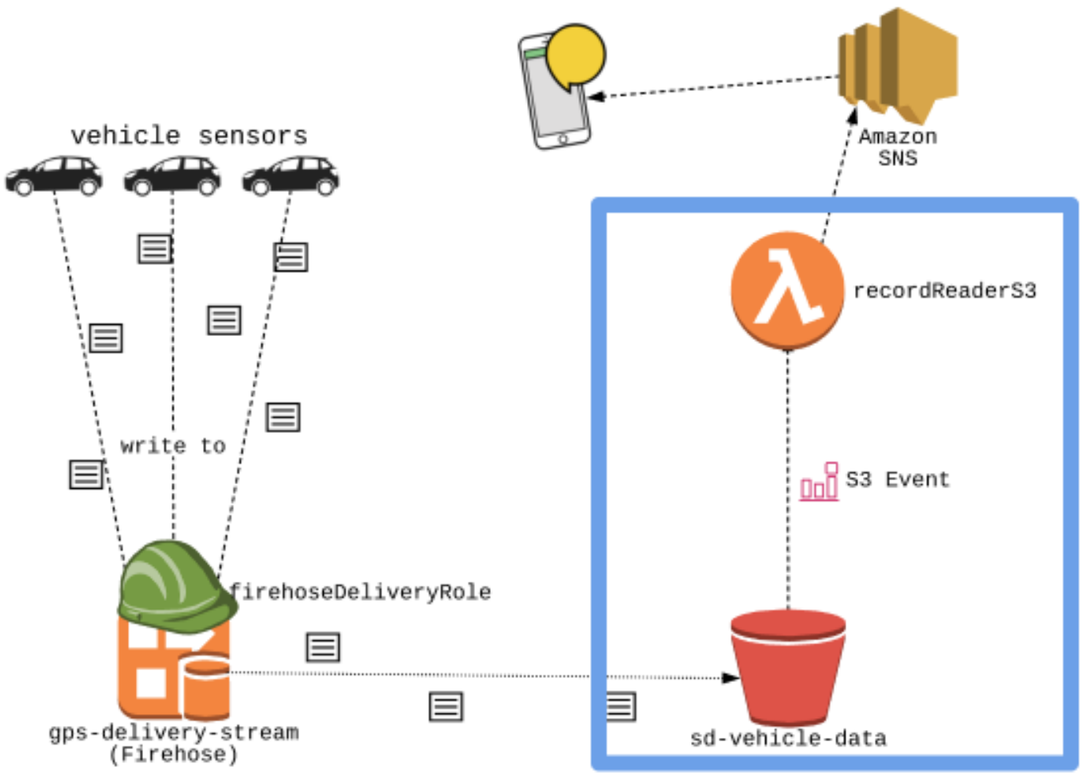
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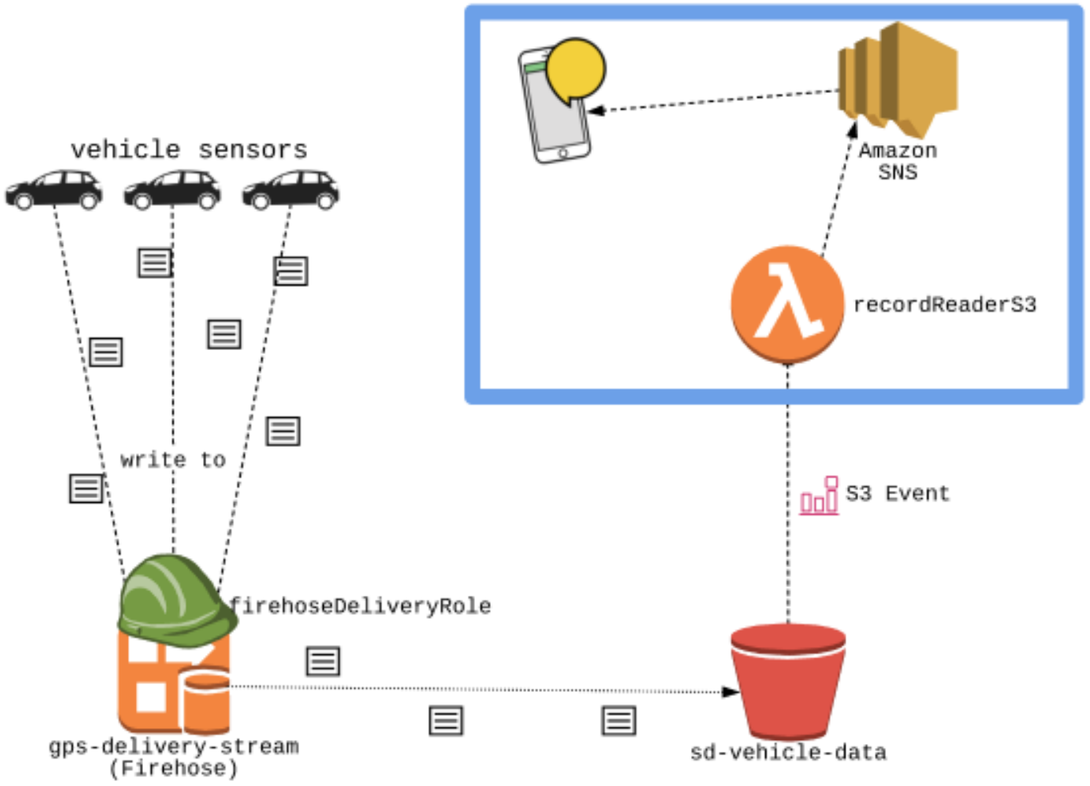
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Let's practice!

STREAMING DATA WITH AWS KINESIS AND LAMBDA

Adding a lambda layer

STREAMING DATA WITH AWS KINESIS AND LAMBDA

Maksim Pecherskiy
Data Engineer

Let's practice!

STREAMING DATA WITH AWS KINESIS AND LAMBDA

Serverless data workflow

STREAMING DATA WITH AWS KINESIS AND LAMBDA

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Data Engineer

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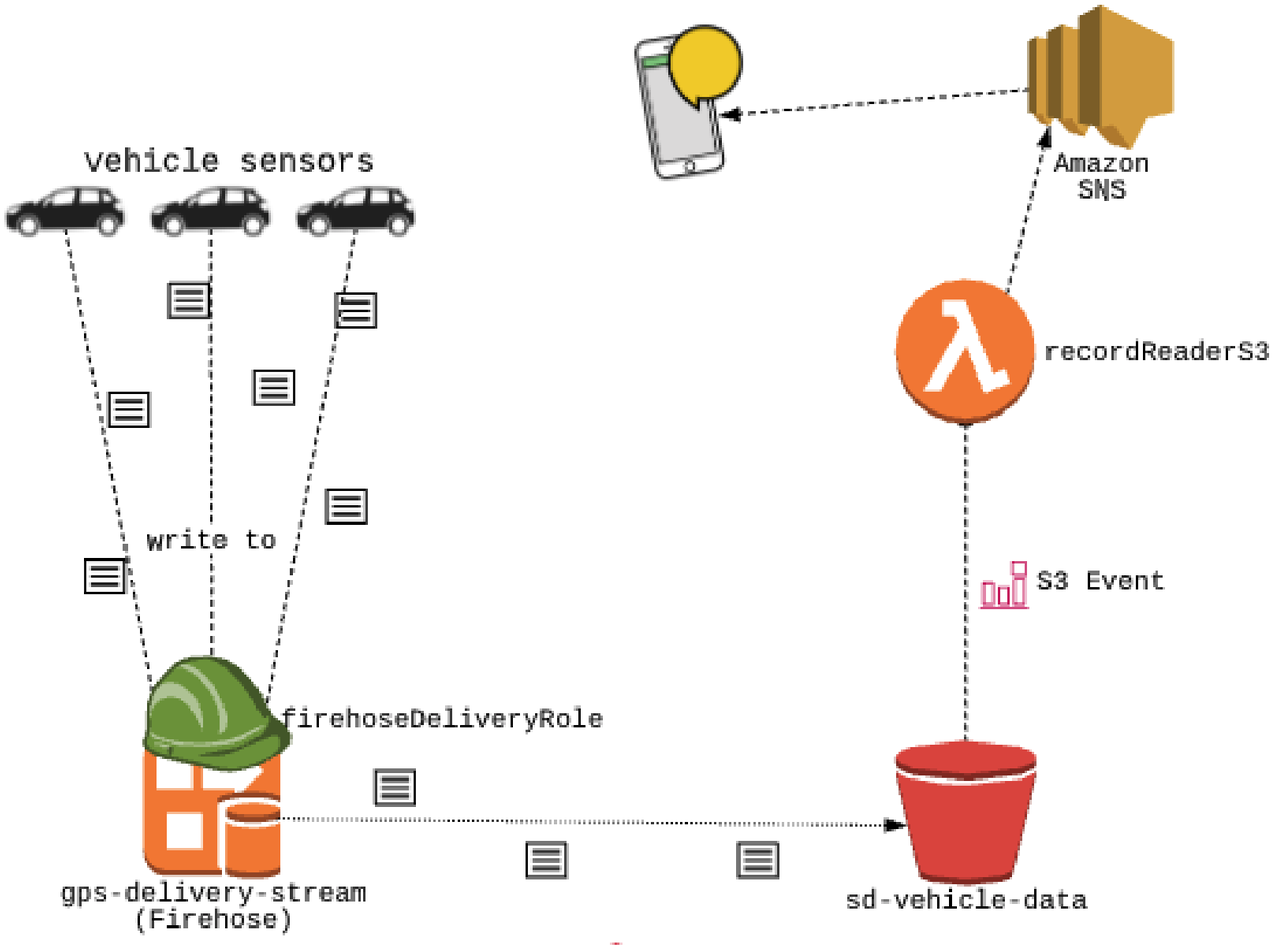
A look back


vehicle sensors
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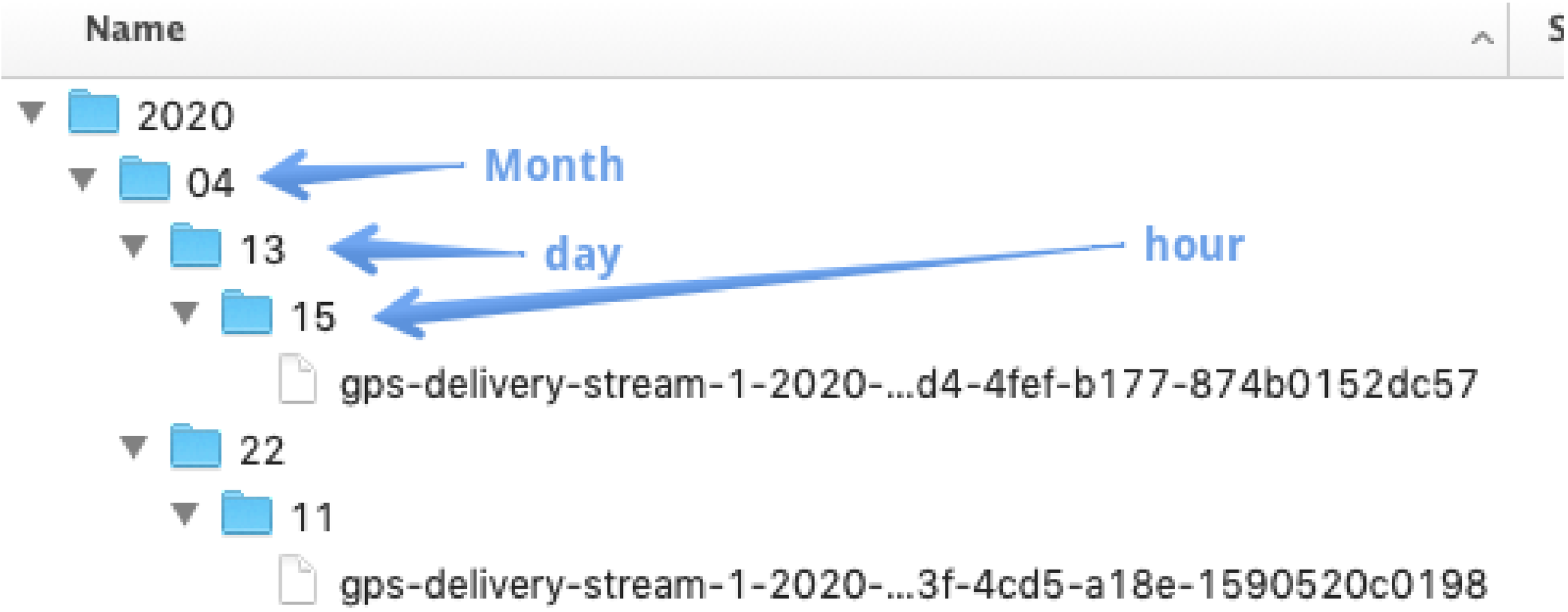
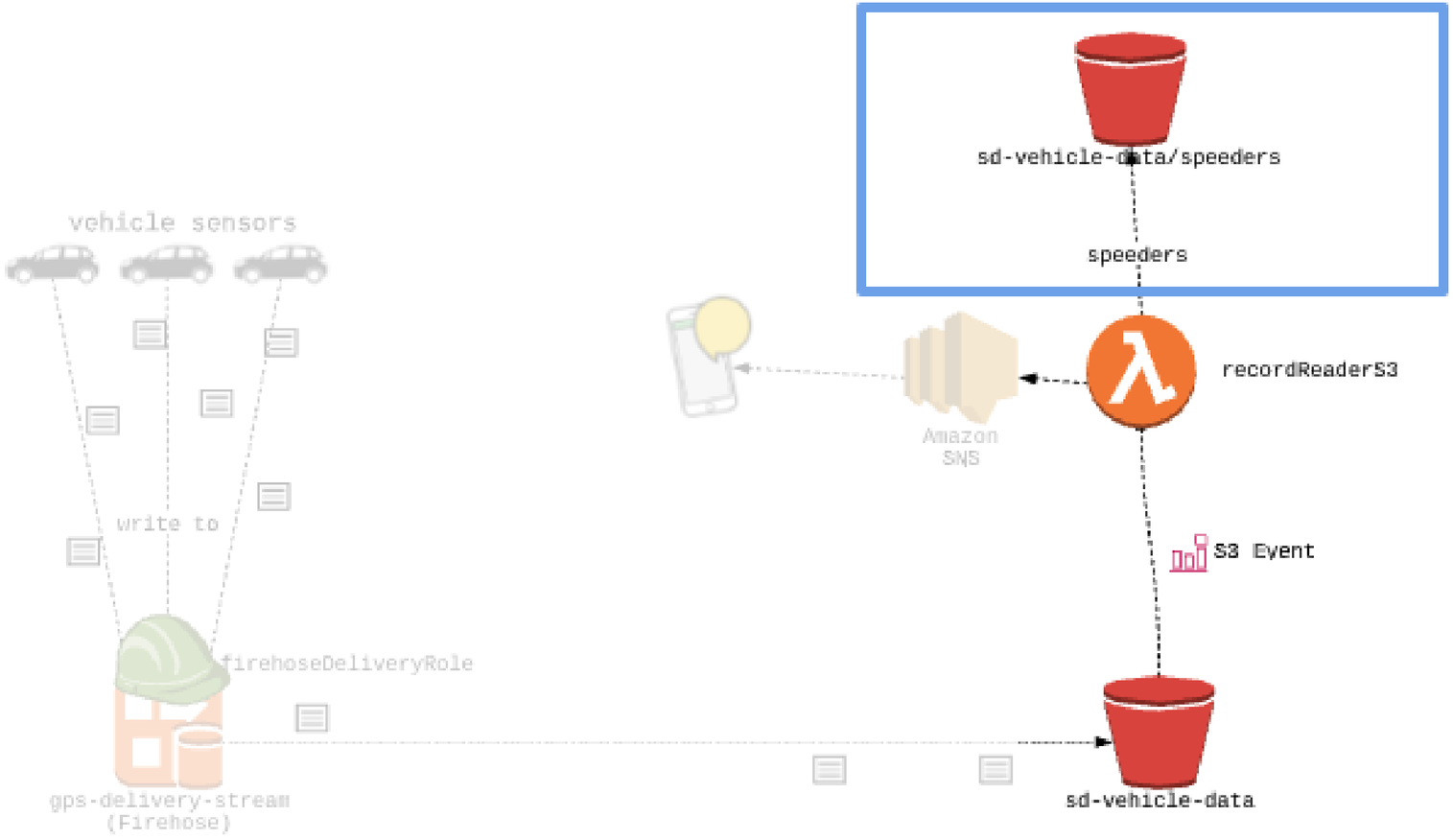
sd-vehicle-data

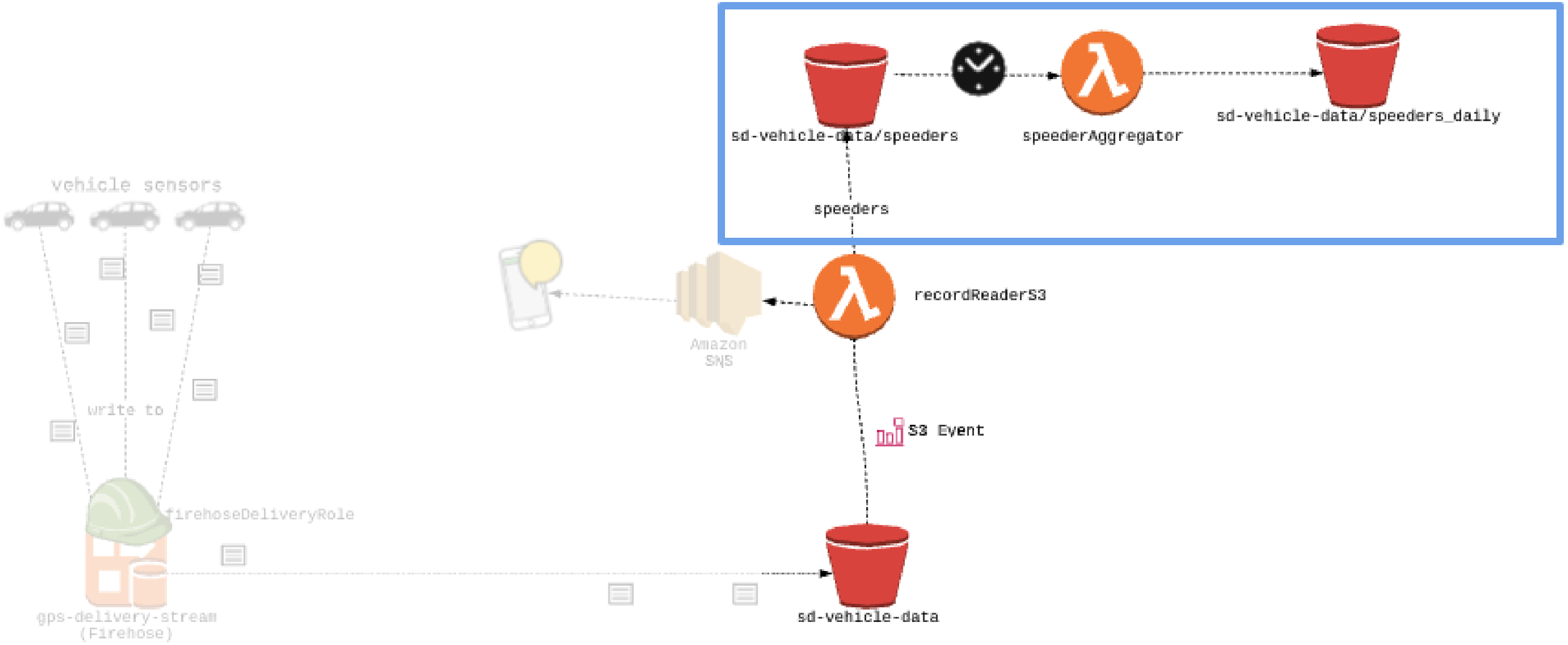
Current partitioning



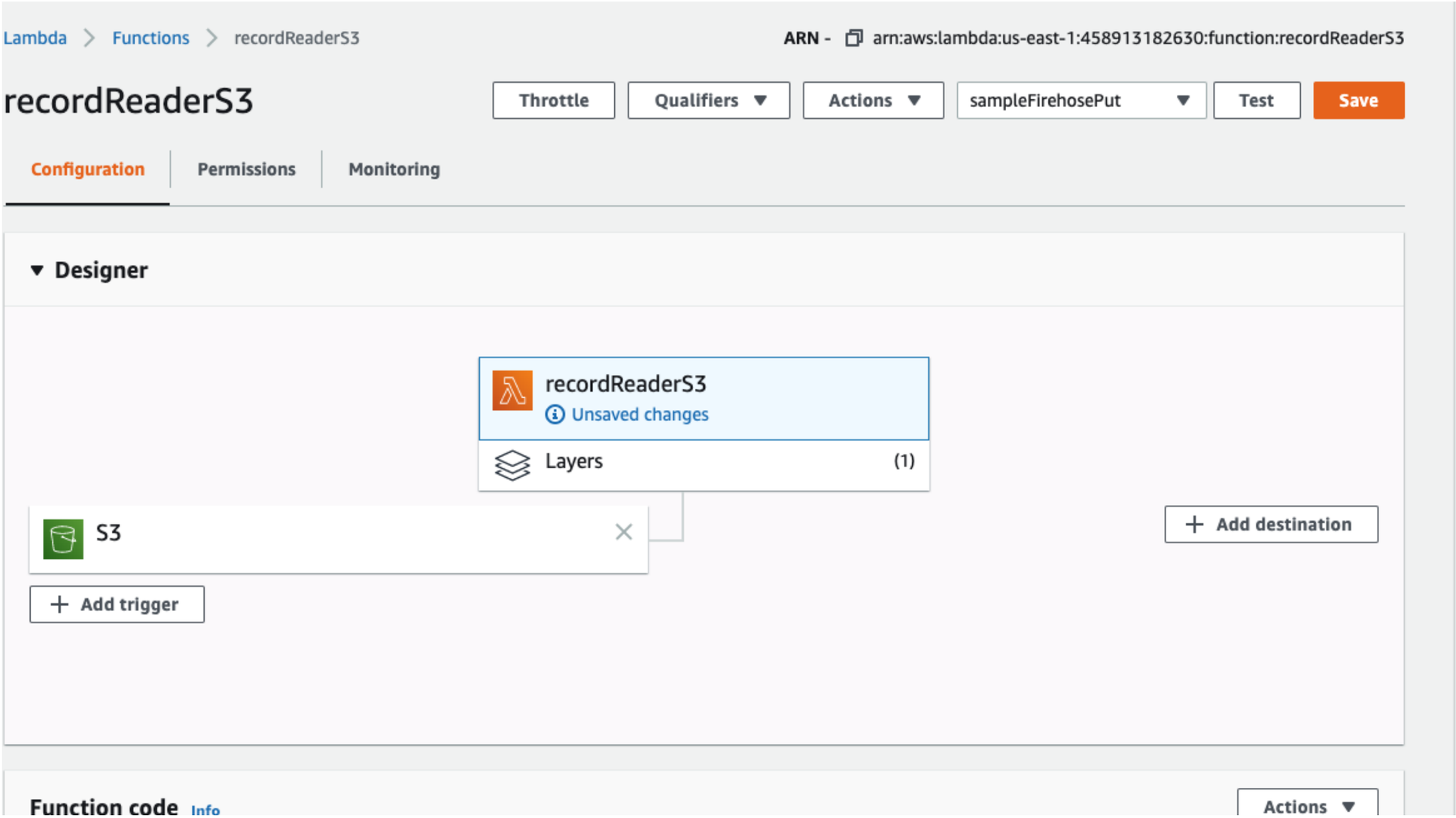
Filtering out speeders



Aggregating by day



Open recordReaderS3



Editing recordReaderS3

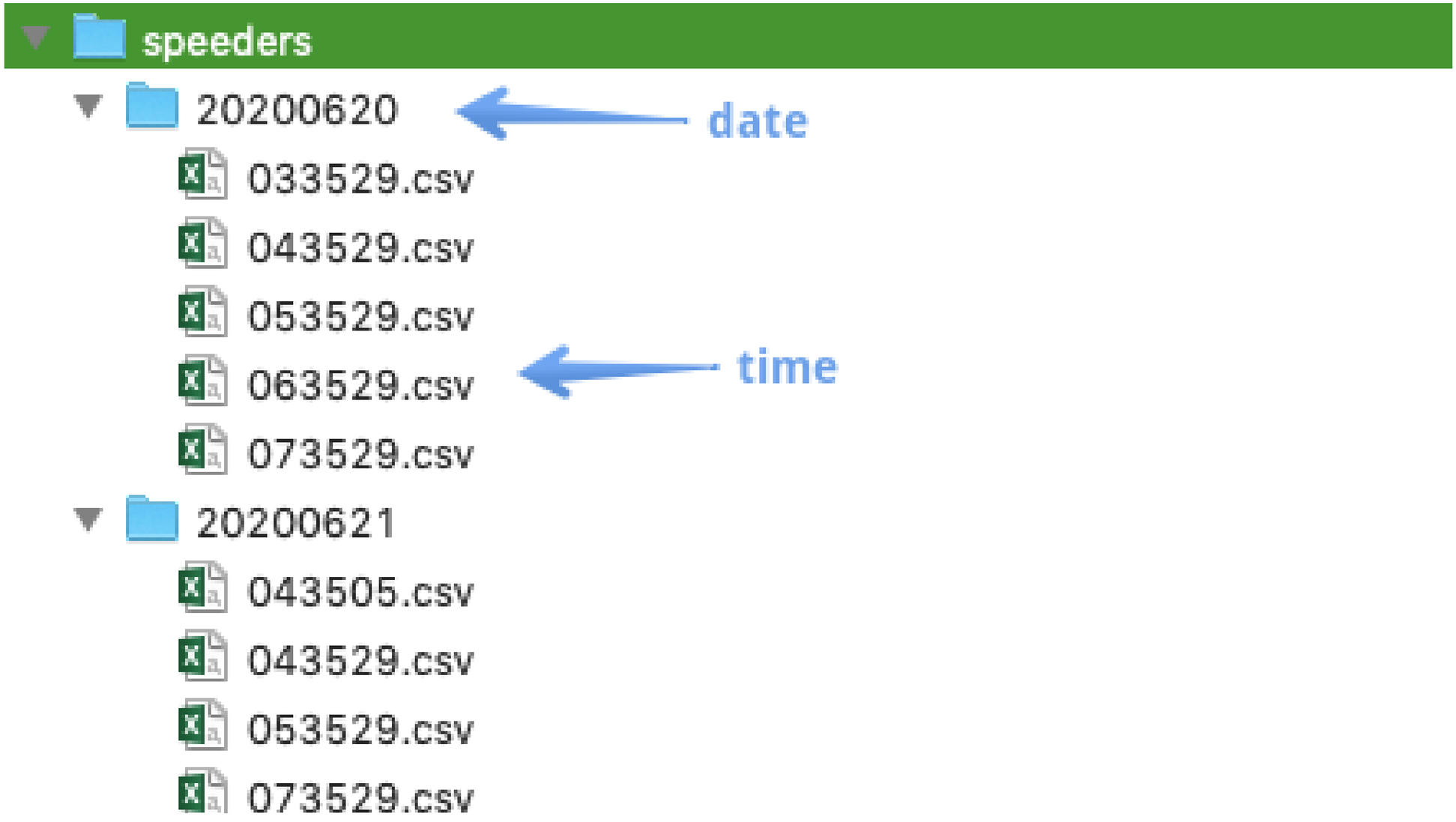
```
...
import pytz
from datetime import datetime
tz = pytz.timezone('America/Los_Angeles')
```

Editing recordReaderS3

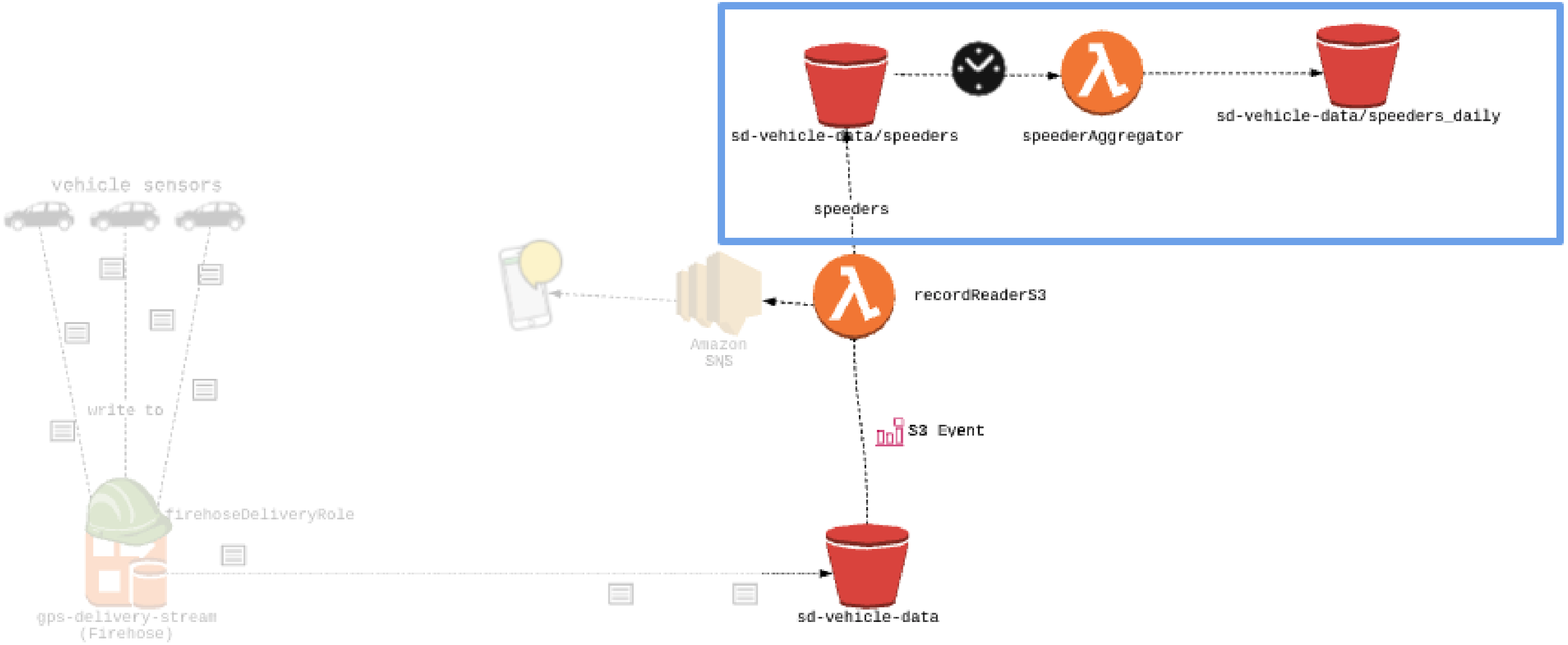
```
def record_created_handler(event, context):
    ...
    ## Get top speeds that exceed the limit of 45
    too_fast = top_speeds.loc[top_speeds.speed > SPEED_ALERT_THRESHOLD :]
    ## Generate object key
    fdate = datetime.now(tz).strftime("%Y%m%d/%HH%MM%SS")
    obj_key = f"speeders/{fdate}.csv" # filename in speeders folder

    ## Write the object to S3
    s3.put_object(Bucket='sd-vehicle-data',
                  Key=obj_key,
                  Body=too_fast.to_csv(sep=" ", index=False)
    )
```

Writing speeders by date and time



speederAggregator



Create speederAggregator

Basic information

Function name
Enter a name that describes the purpose of your function.

speederAggregator

Use only letters, numbers, hyphens, or underscores with no spaces.

Runtime Info
Choose the language to use to write your function.

Python 3.8

Permissions Info

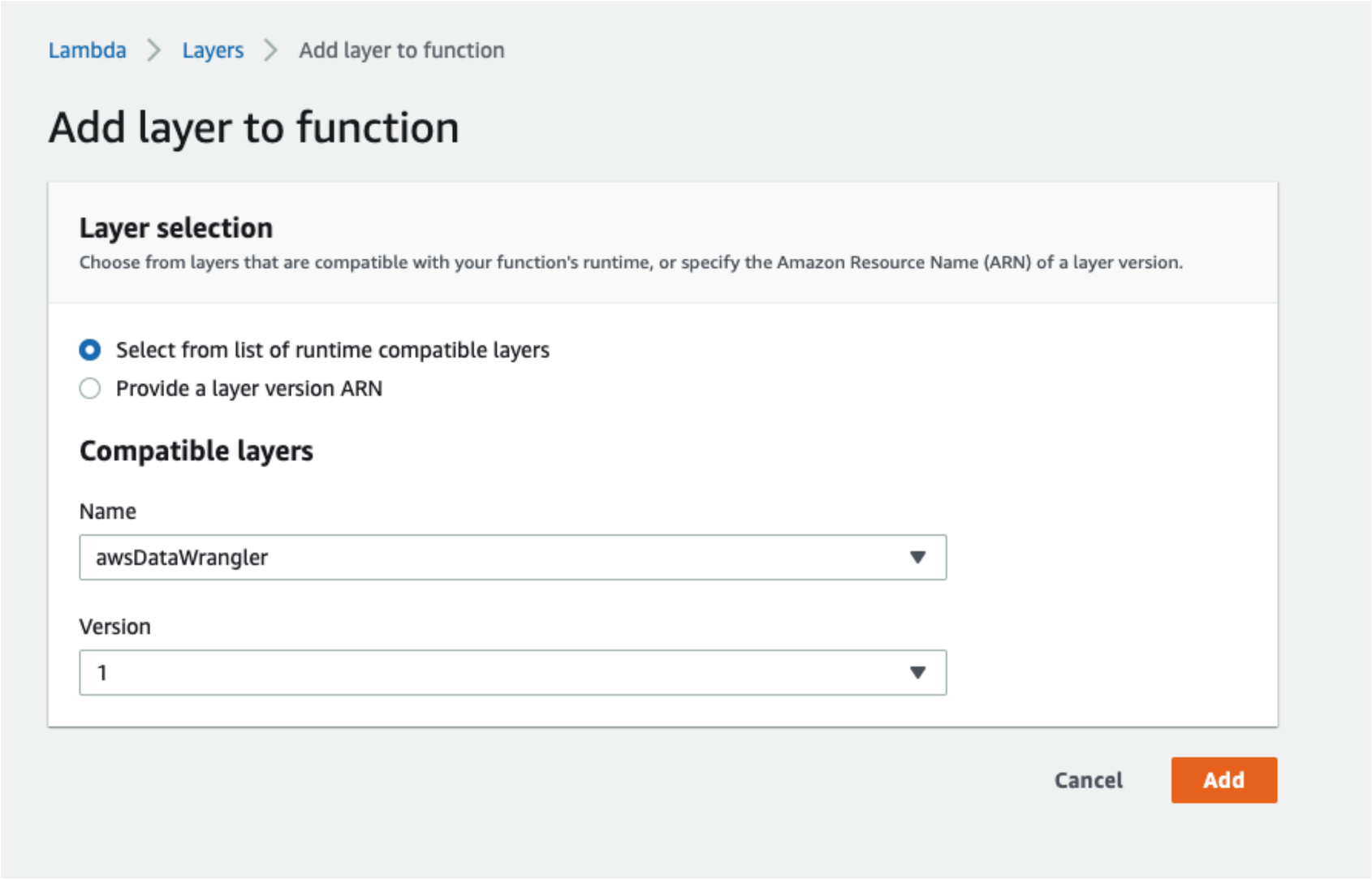
Lambda will create an execution role with permission to upload logs to Amazon CloudWatch Logs. You can configure and modify permissions further when you add triggers.

▼ **Choose or create an execution role**

Execution role
Choose a role that defines the permissions of your function. To create a custom role, go to the **IAM console**.

- (●) Create a new role with basic Lambda permissions
- ( ) Use an existing role
- ( ) Create a new role from AWS policy templates

Add AWS data wrangler layer



speederAggregator Resources

Lambda > Functions > speederAggregator > Edit basic settings

Edit basic settings

Basic settings

Description - *optional*

Runtime

Python 3.8

Handler Info

lambda_function.speeder_aggregator

Memory (MB) Info

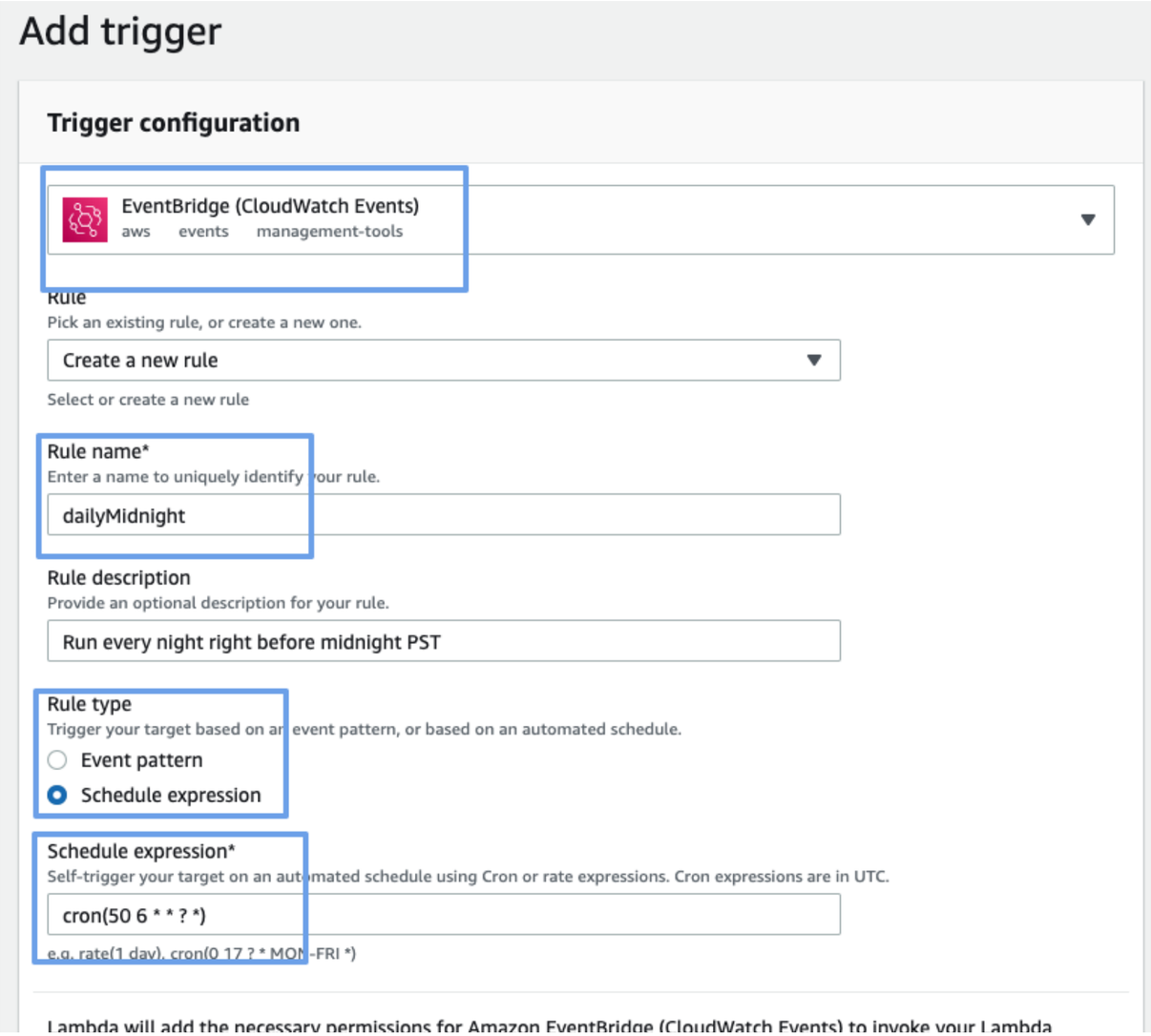
Your function is allocated CPU proportional to the memory configured.

512 MB

Timeout Info

0 min 15 sec

Create the timed trigger



```
cron(Minutes Hours Day-of-month Month Day-of-week Year)
```

```
cron(50 6 * * ? *)
```

- On Minute 50
- Of the 6th hour (UTC)
- Of Every Day of the Month
- Of Every Month
- Of Every Day of the Week
- Of Every Year

speederAggregator callback

```
import boto3, pytz, pandas as pd


s3 = boto3.client("s3" ...)
...
def speeder_aggregator(event, context):
    tz = pytz.timezone('America/Los_Angeles')
    filter_date = datetime.now(tz).strftime("%Y%m%d")
```

speederAggregator callback

```
def speeder_aggregator(event, context):
  ...
  objects = s3.list_objects_v2(
      Bucket='sd-vehicle-data', Prefix=f'speeders/{filter_date}')
  day_data = []

  for obj in objects['Contents']:
      print(obj['Key'])
      day_record = s3.get_object(Bucket='sd-vehicle-data', Key = obj['Key'])
      day_data.append(
          pd.read_csv(day_record['Body'], delimiter = " "))

  # Concatenate new records into a single dataframe.
  data = pd.concat(day_data)
  data.columns = ["record_id", "timestamp", "vin", "lon", "lat", "speed"]
```

awswrangler package

```
import awswrangler as wr
session = boto3.Session(aws_access_key_id = AWS_KEY,
                        aws_secret_access_key = AWS_SECRET, region_name="us-east-1")
df = wr.s3.read_csv(f"s3://sd-vehicle-data/speeders/{filter_date}")
df.head()
```

Old way vs awswrangler

```
def speeder_aggregator(event, context):
  ...
  objects = s3.list_objects_v2(
      Bucket='sd-vehicle-data', Prefix=f'speeders/{filter_date}')
  day_data = []

  for obj in objects['Contents']:
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import awswrangler as wr

session = boto3.Session(aws_access_key_id = AWS_KEY,
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def speeder_aggregator(event, context):
    df = wr.s3.read_csv(f"s3://sd-vehicle-data/speeders/{filter_date}")
    df.head()
```
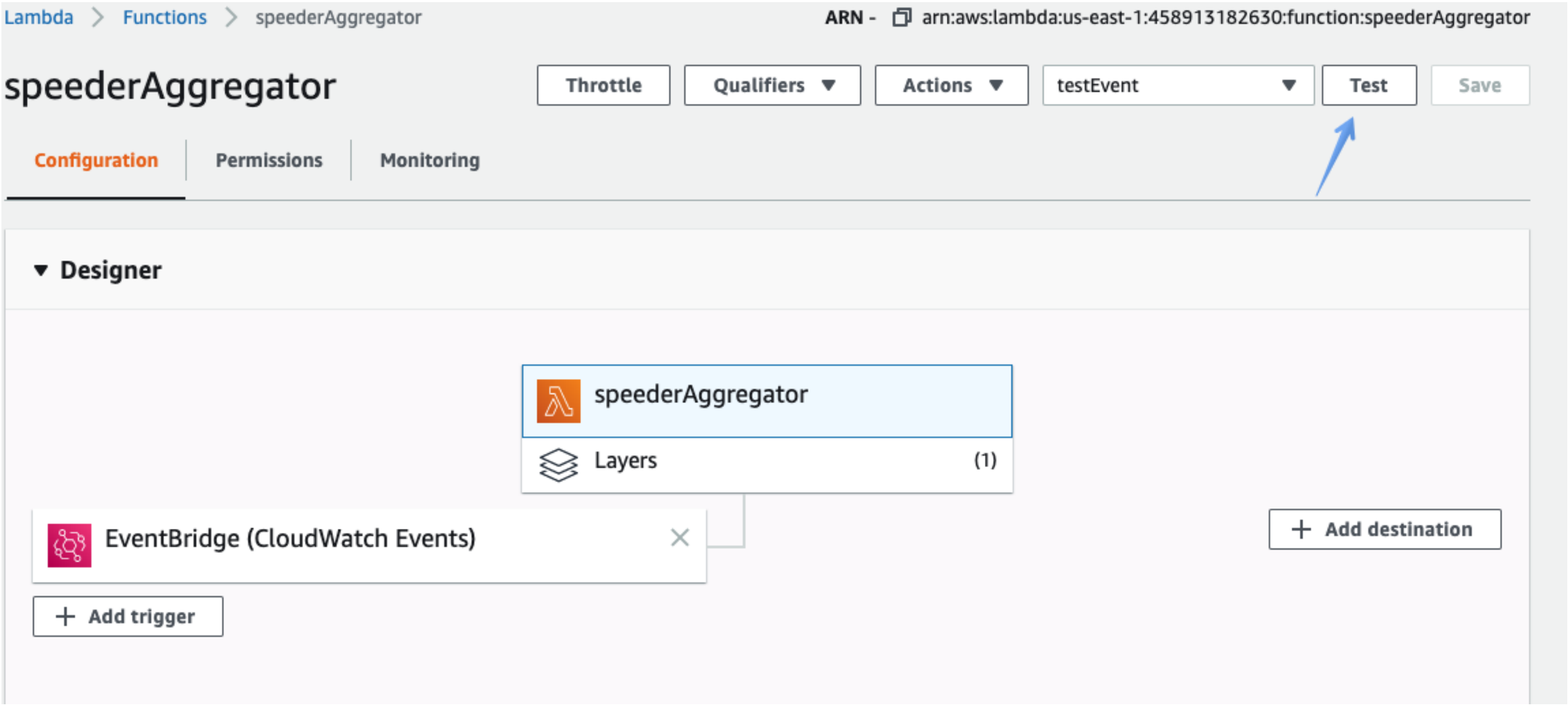
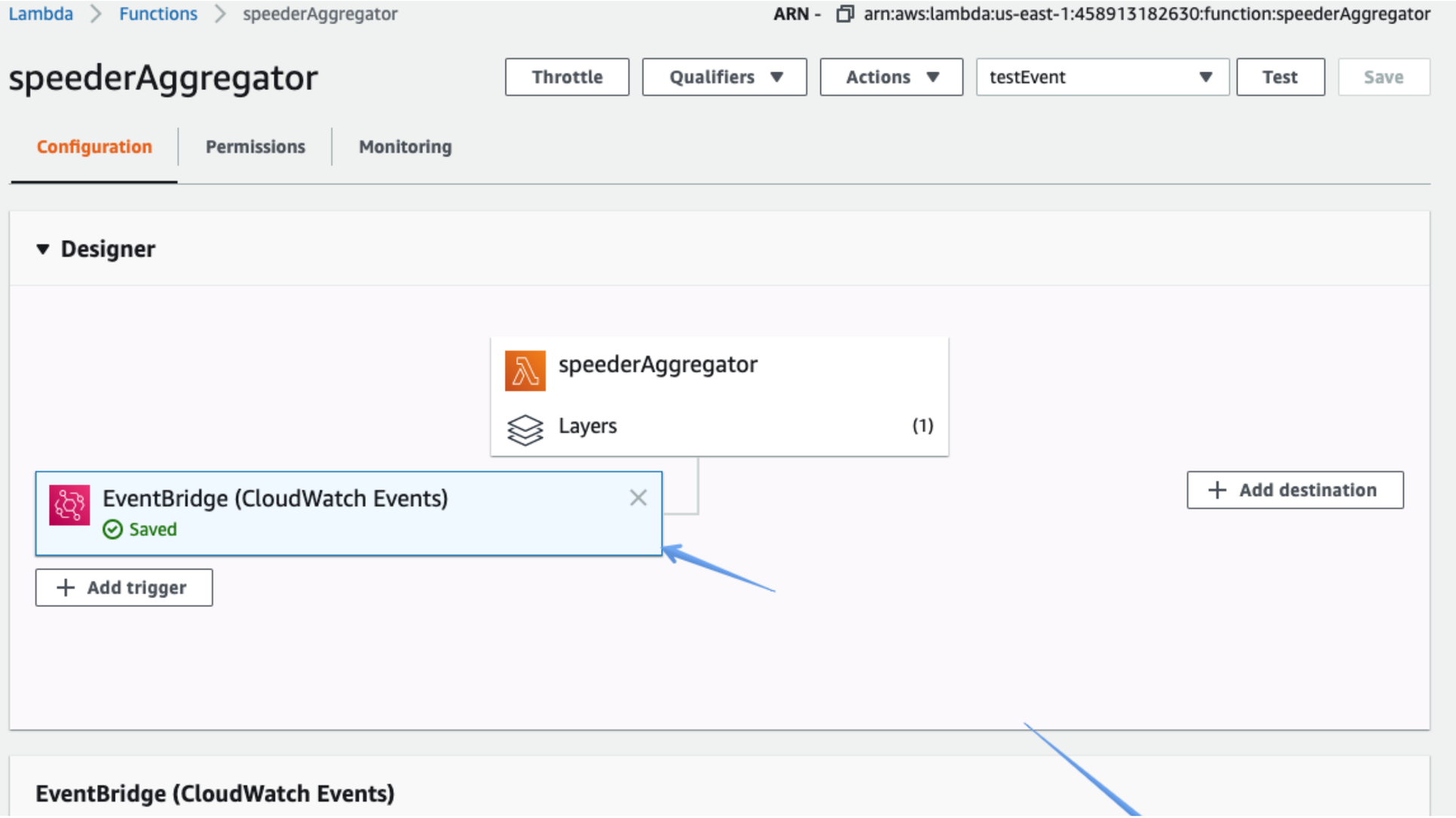

Writing aggregate speeders file

```
wr.s3.to_csv(df,
             f"s3://sd-vehicle-data/speeders_daily/{filter_date}.csv",
             boto3_session=session,
             sep=" ", index=False)
```

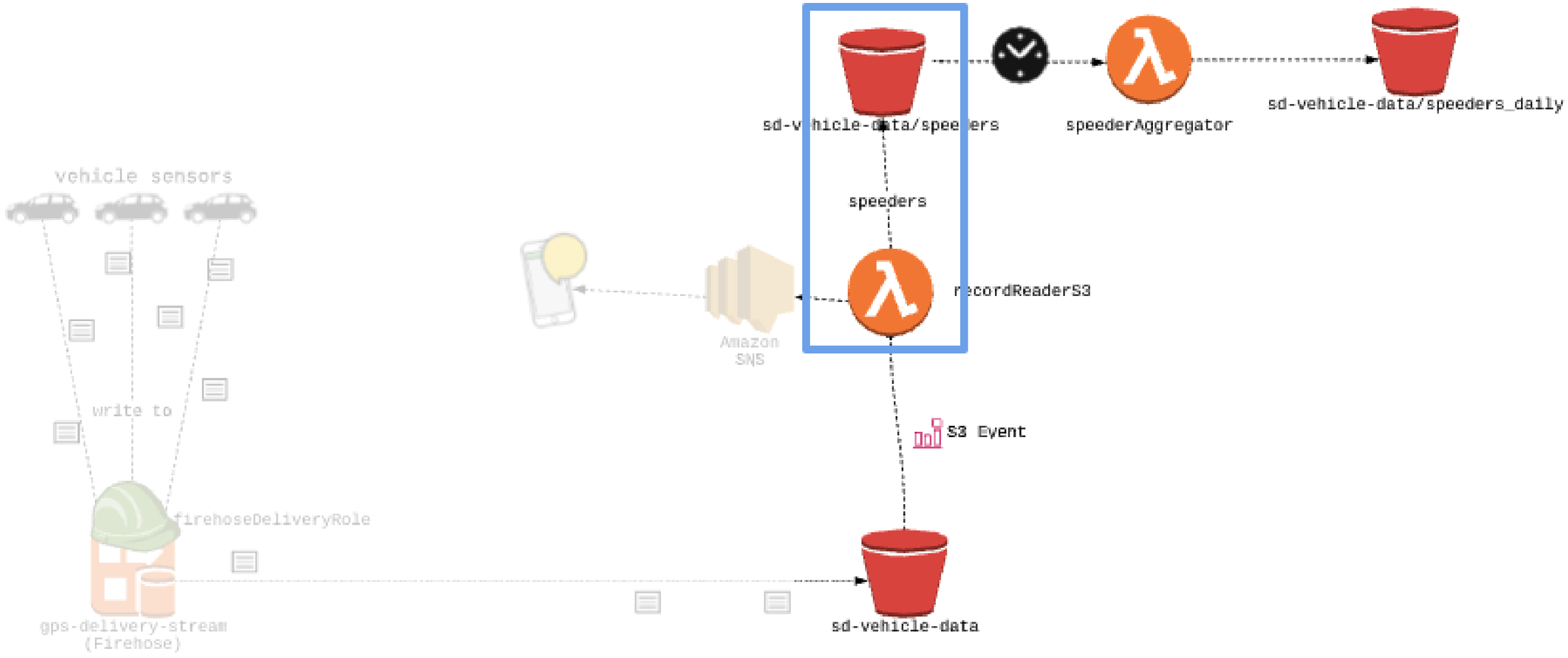
Save and test



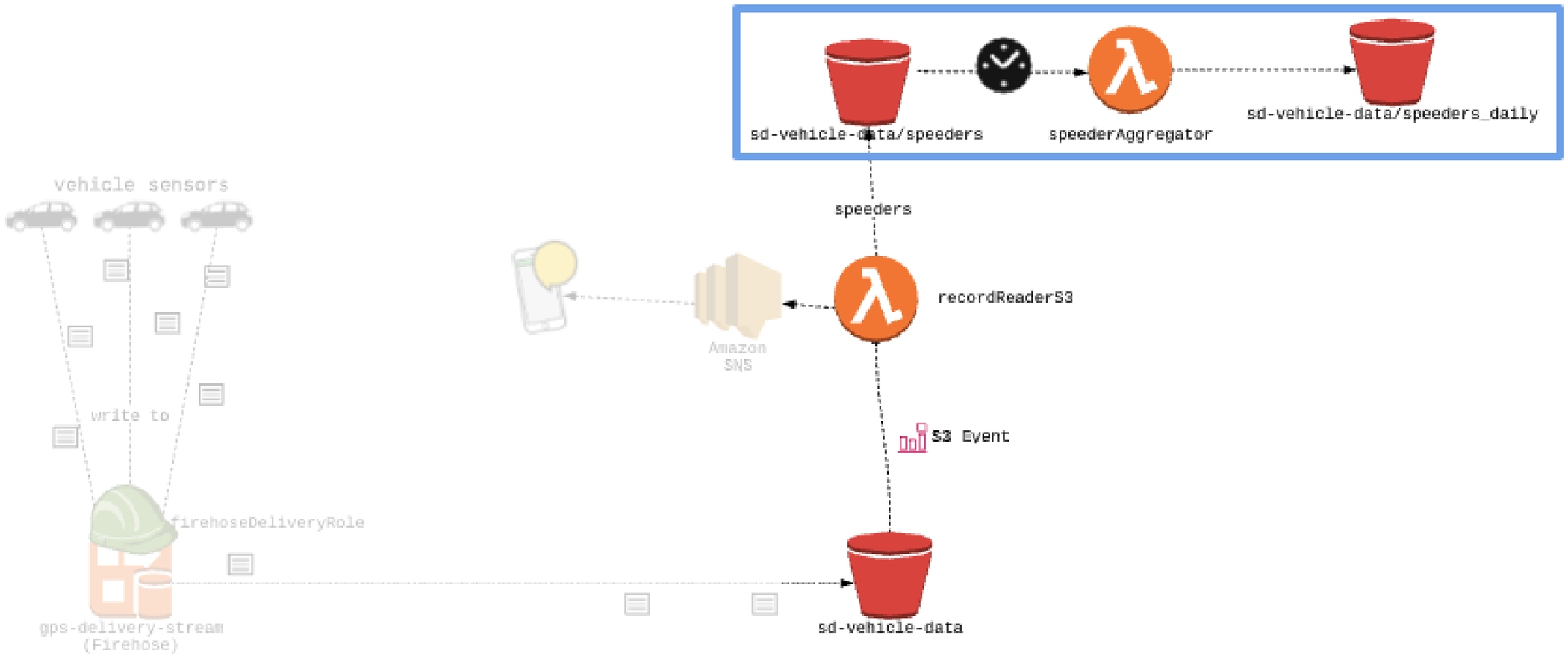
Enable the trigger



Review


sd-vehicle-data/speeders
speederAggregator
sd-vehicle-data/speeders_daily
vehicle sensors
speeders
recordReaderS3
Amazon SNS
write to
S3 Event
firehoseDeliveryRole
gps-delivery-stream (Firehose)
sd-vehicle-data

Review


sd-vehicle-data/speeders
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Review

- Cron for scheduling
- `wr.s3.read_csv()`
- `wr.s3.write_csv()`

Let's practice!

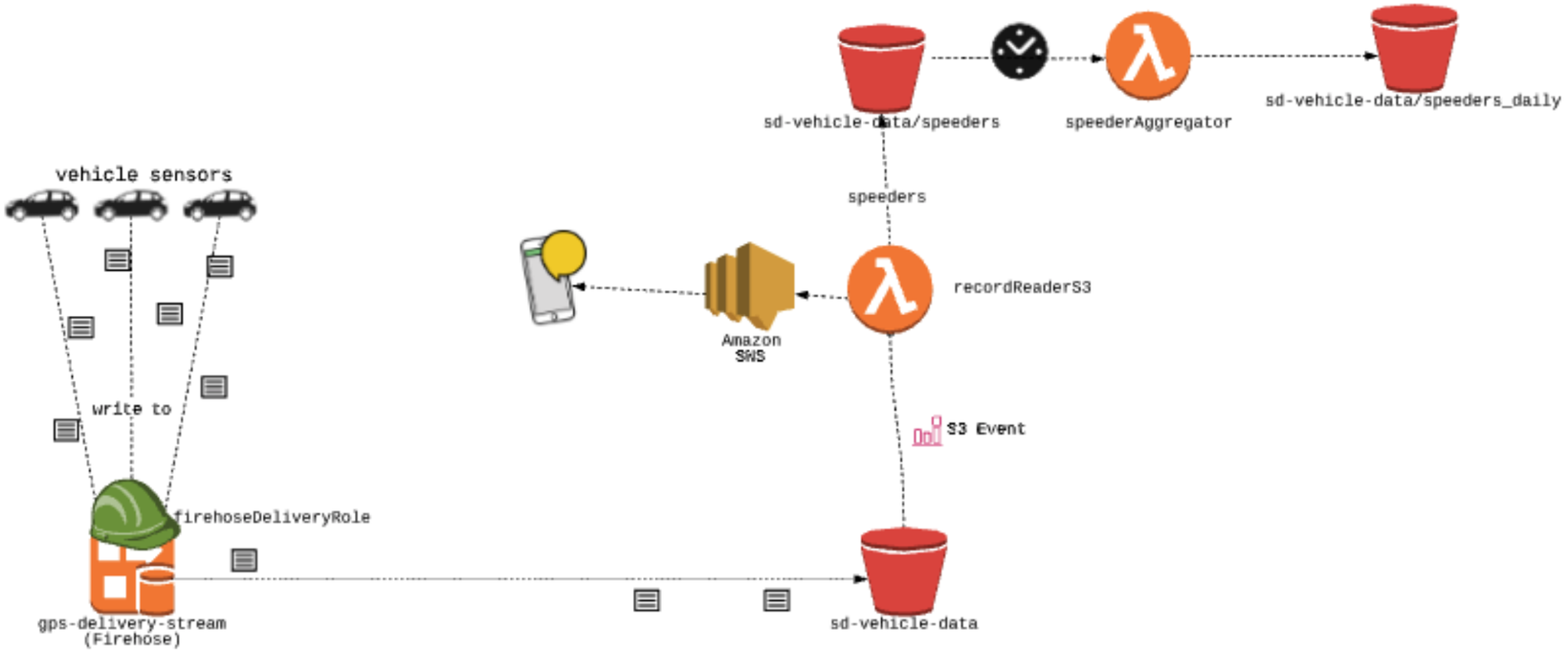
STREAMING DATA WITH AWS KINESIS AND LAMBDA

Serverless APIs

STREAMING DATA WITH AWS KINESIS AND LAMBDA

Maksim Pecherskiy
Data Engineer

Last lesson


sd-vehicle-data/speeders
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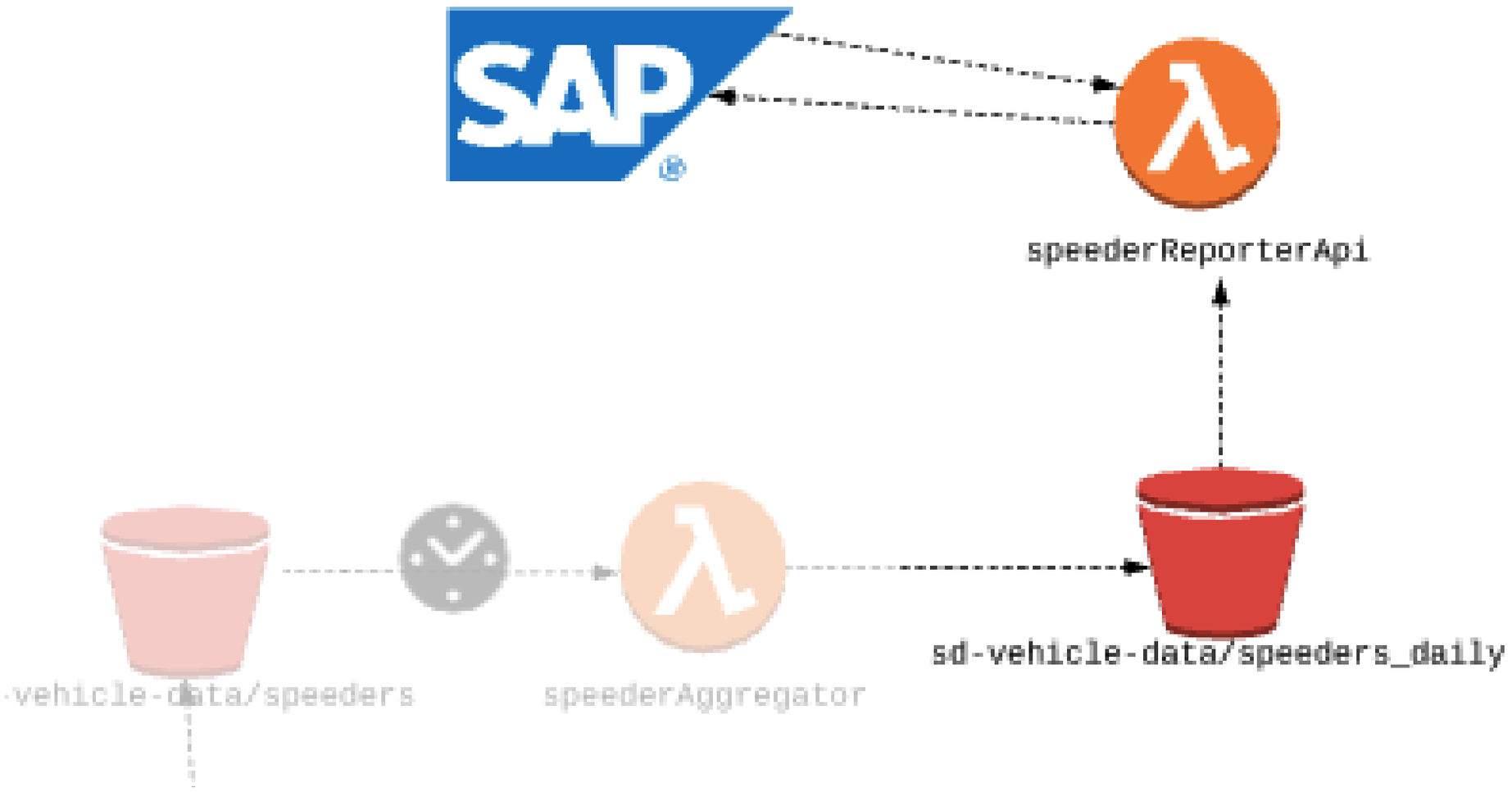
Giving access to data

2020	--	
speeders	--	
speeders_daily	--	
20200620.csv	29.3 KB	Today at 10:32:37
20200621.csv	29.3 KB	Today at 10:32:34

Simple API


SAP
speederReporterApi
sd-vehicle-data/speeders_daily
vehicle-data/speeders
speederAggregator

Simple API

Basic information

Function name
Enter a name that describes the purpose of your function.

speederReporterApi

Use only letters, numbers, hyphens, or underscores with no spaces.

Runtime Info
Choose the language to use to write your function.

Python 3.8

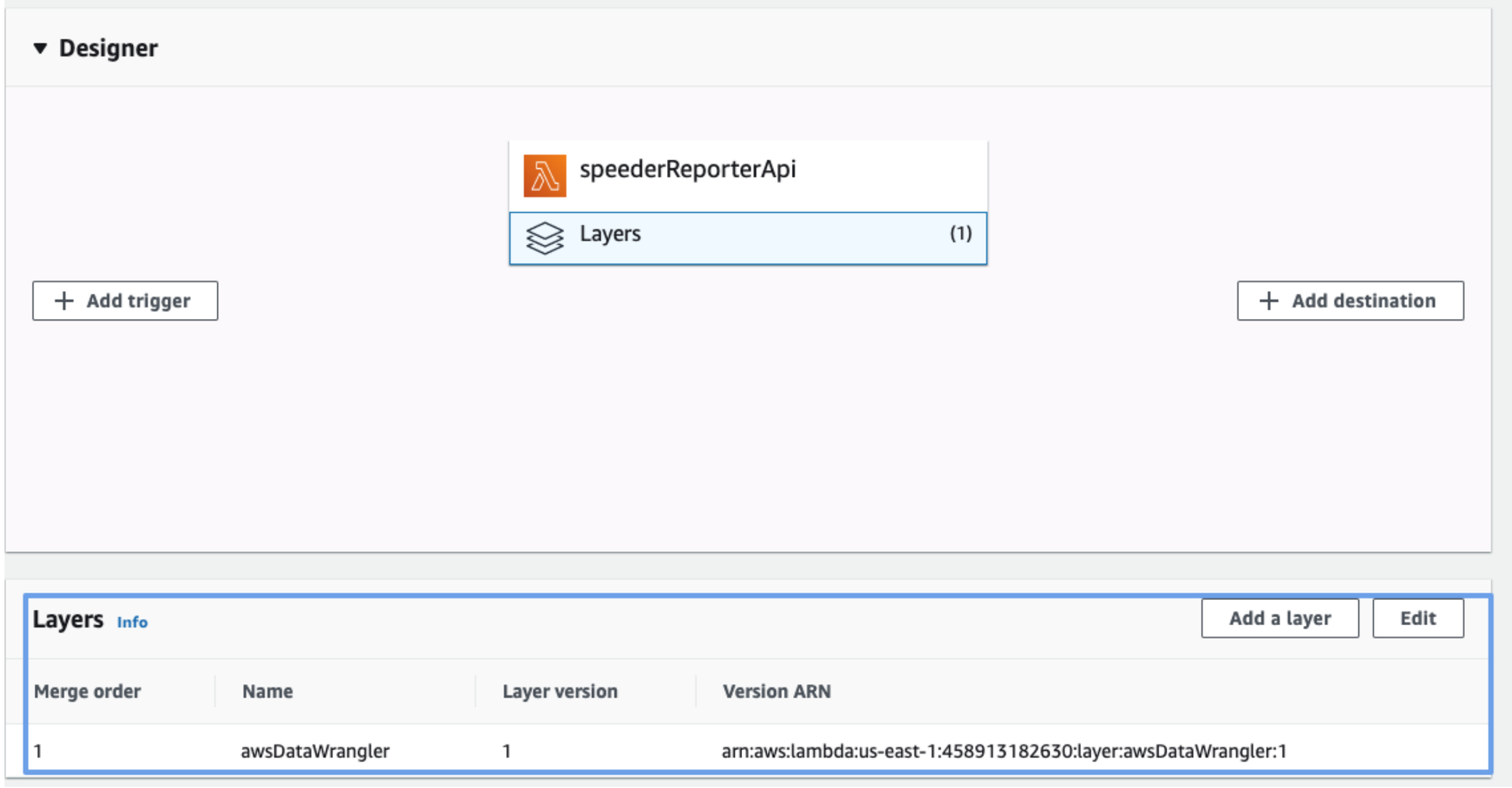
Permissions Info
Lambda will create an execution role with permission to upload logs to Amazon CloudWatch Logs. You can configure and modify permissions further when you add triggers.

▼ Choose or create an execution role

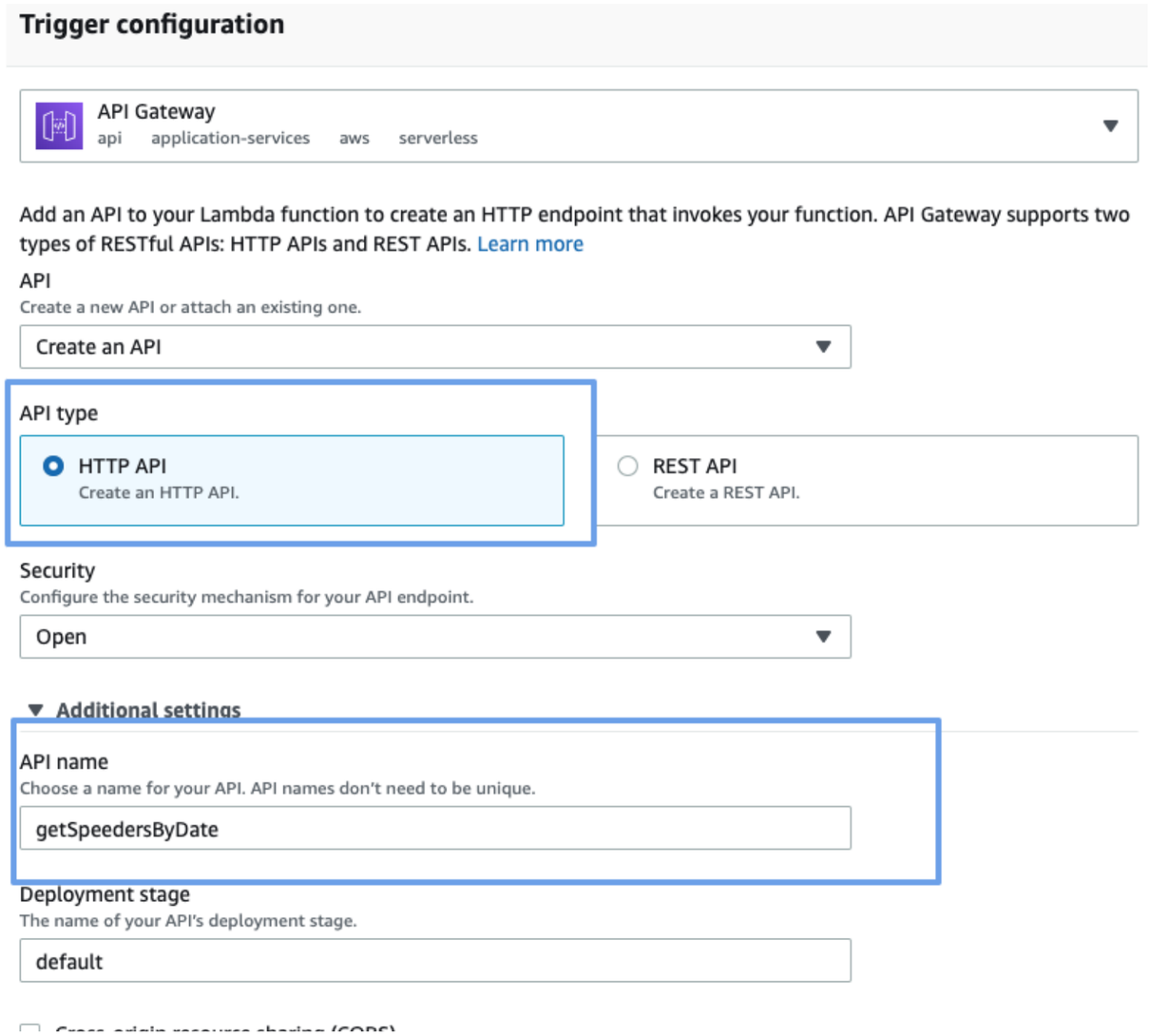
Execution role
Choose a role that defines the permissions of your function. To create a custom role, go to the IAM console.

- (●) Create a new role with basic Lambda permissions
- ( ) Use an existing role
- ( ) Create a new role from AWS policy templates

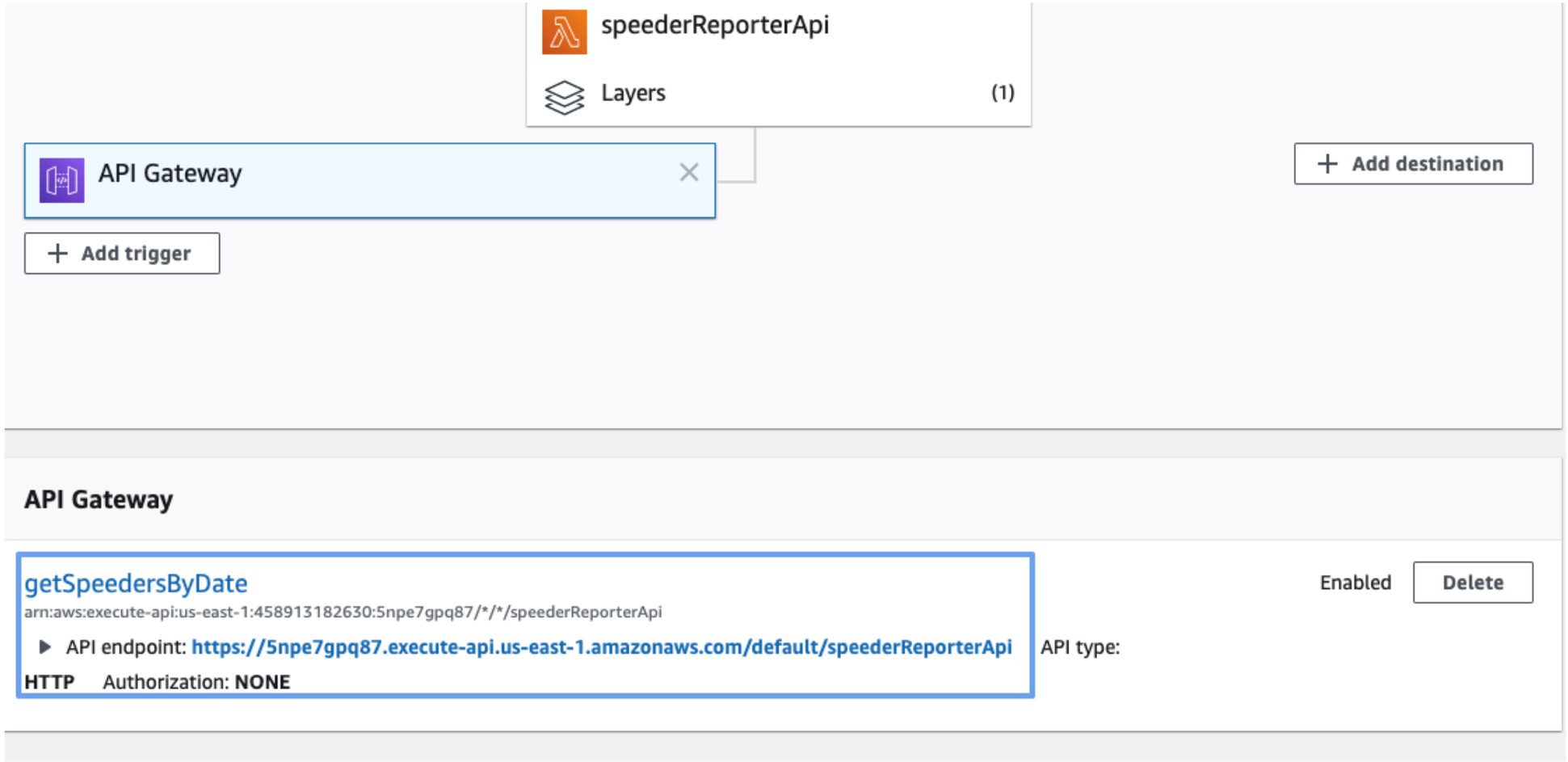
Simple API


Designer
speederReporterApi
Layers (1)
Add trigger
Add destination
Layers Info
Add a layer
Edit
Merge order
Name
Layer version
Version ARN
1
awsDataWrangler
1
arn:aws:lambda:us-east-1:458913182630:layer:awsDataWrangler:1

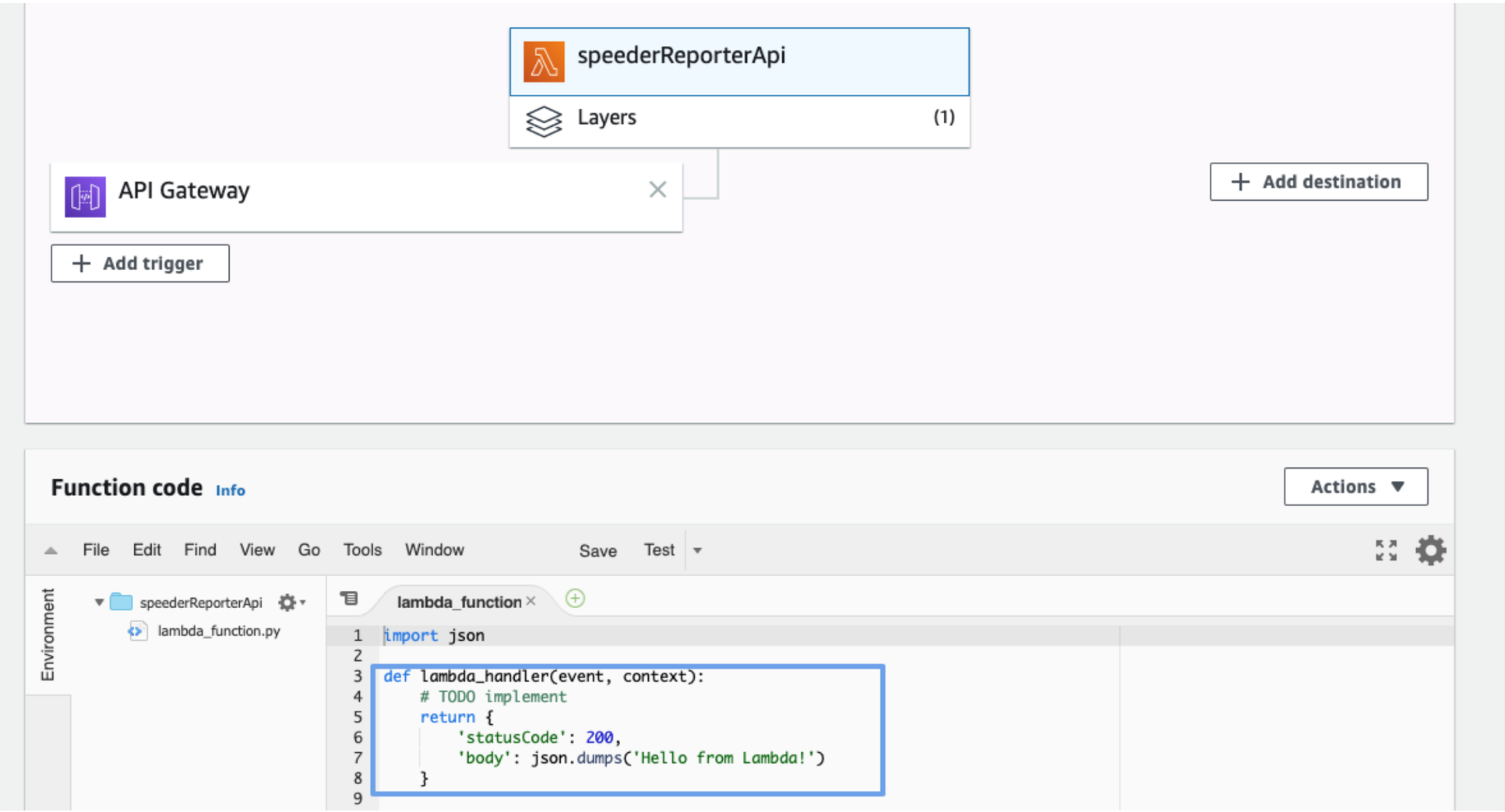
Add a trigger



Test your new API



Our first API



API parameters

Sample request

```
https://.../speederReporterApi?date=20200620
```

Sample event

```
{
  "queryStringParameters": {
    "date": "20200620"
  },
  "isBase64Encoded": false
}
```

Lambda handler

```
import json, boto3
import awswrangler as wr
import pandas as pd
session = boto3.Session(aws_access_key_id = AWS_KEY,
                        aws_secret_access_key = AWS_SECRET,
                        region_name="us-east-1")
```

Lambda handler

```
def lambda_handler(event, context):
    filter_date = event['queryStringParameters']['date']
    df = wr.s3.read_csv(
        f"s3://sd-vehicle-data/speeders_daily/{filter_date}.csv",
        boto3_session=session,
        delimiter=" ")
```

Respond with data

```
def lambda_handler(event, context):
    ...
    return {
        'statusCode': 200,
        'headers': {
            "content-type" : "application/json"
        },
        'body': df.to_json()
    }
```

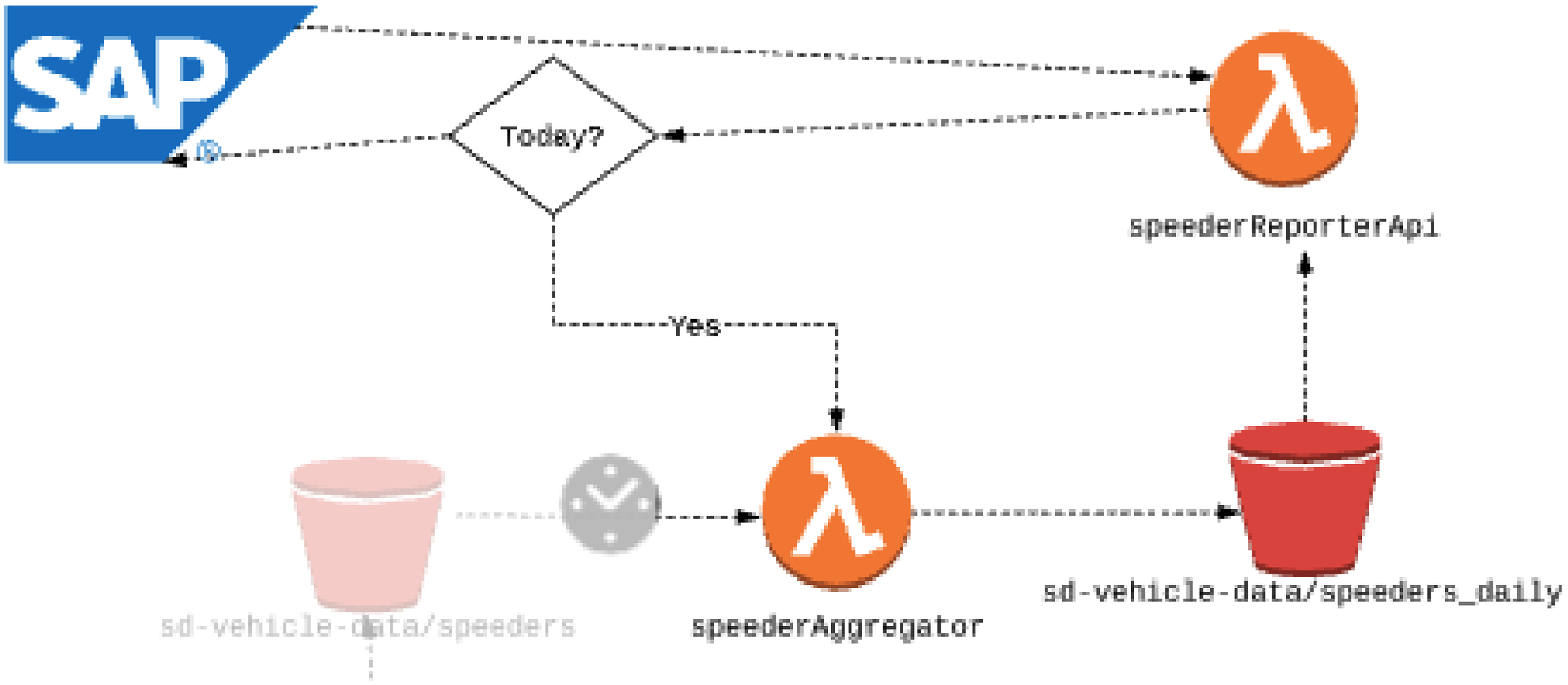
Live response

```
https://.../default/speederReporterApi?date=20200621
```


```
[
  {
      "record_id":"939ed1d1-1740-420c-8906-445278573c7f",
      "timestamp":"4:25:06.000",
      "vin":"4FTEX4944AK844294",
      "lon":106.9447146,
      "lat":-6.3385652,
      "speed":25
  },
  {
      "record_id":"f29a5b3d-d0fa-43c0-9e1a-e2a5cdb8be7a",
      ...
  },

  ...
]
```

Trigger another Lambda

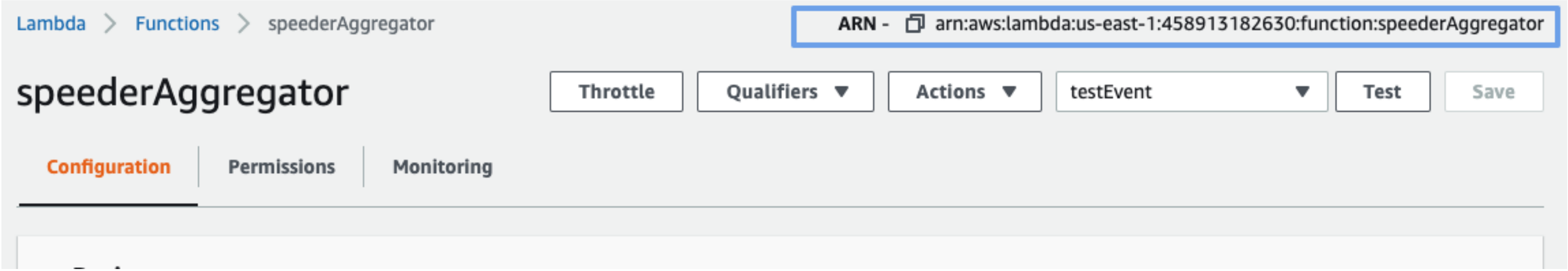


Trigger another Lambda

```
def trigger_recalc():
  lambda_client = boto3.client("s3",
                               aws_access_key_id = AWS_KEY,
                               aws_secret_access_key = AWS_SECRET,
                               region_name = 'us-east-1')

def lambda_handler(event, context):
  ...
```

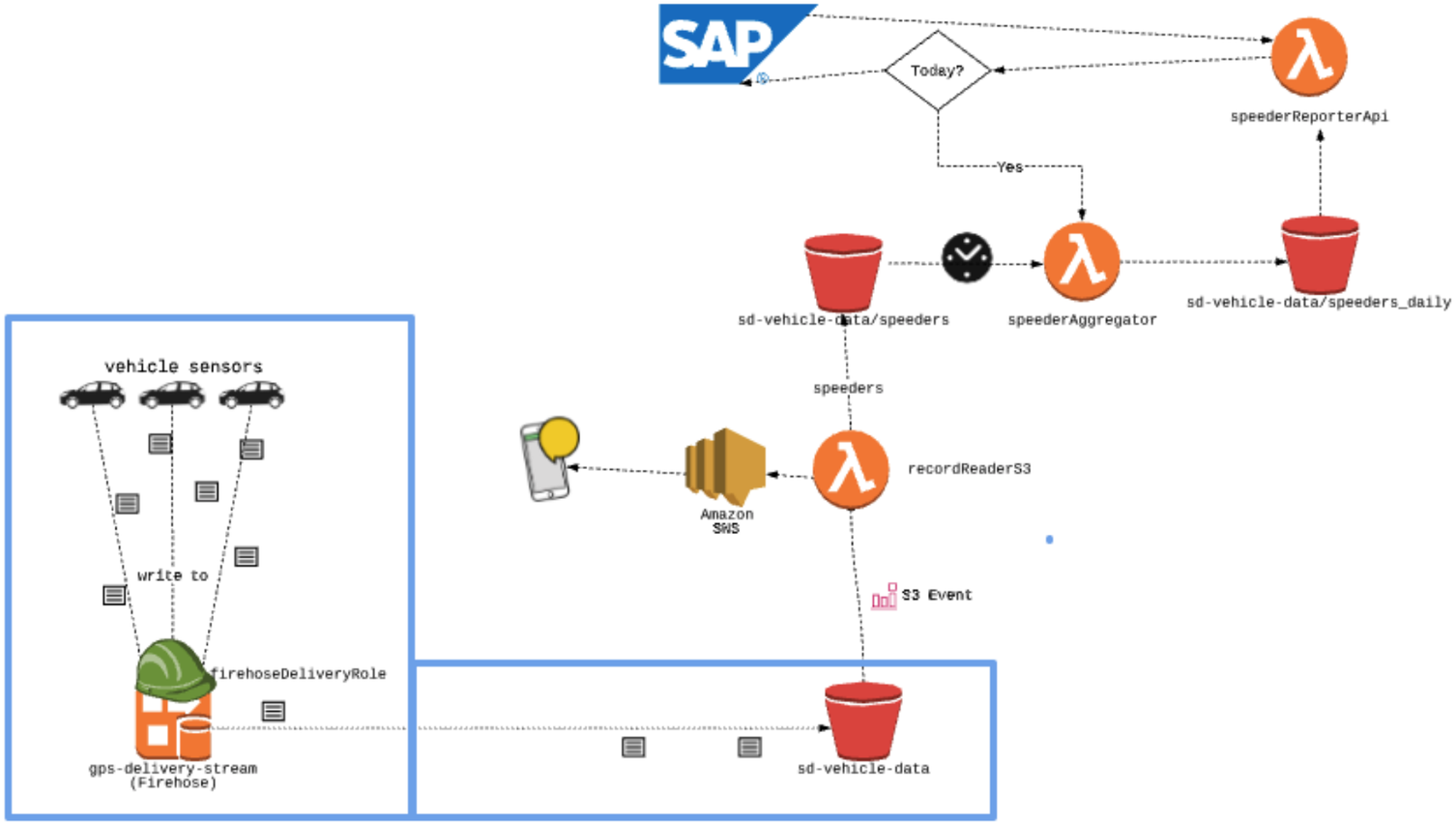
speederAggregator ARN



Invoke

```
def trigger_recalc():
  ...
  lambda_client.invoke(
    FunctionName='arn:aws:lambda:us-east-1:458913182630:function:speederAggregator',
    InvocationType='Event', # (or RequestResponse)
  )
```

Review


SAP
Today?
speederReporterApi
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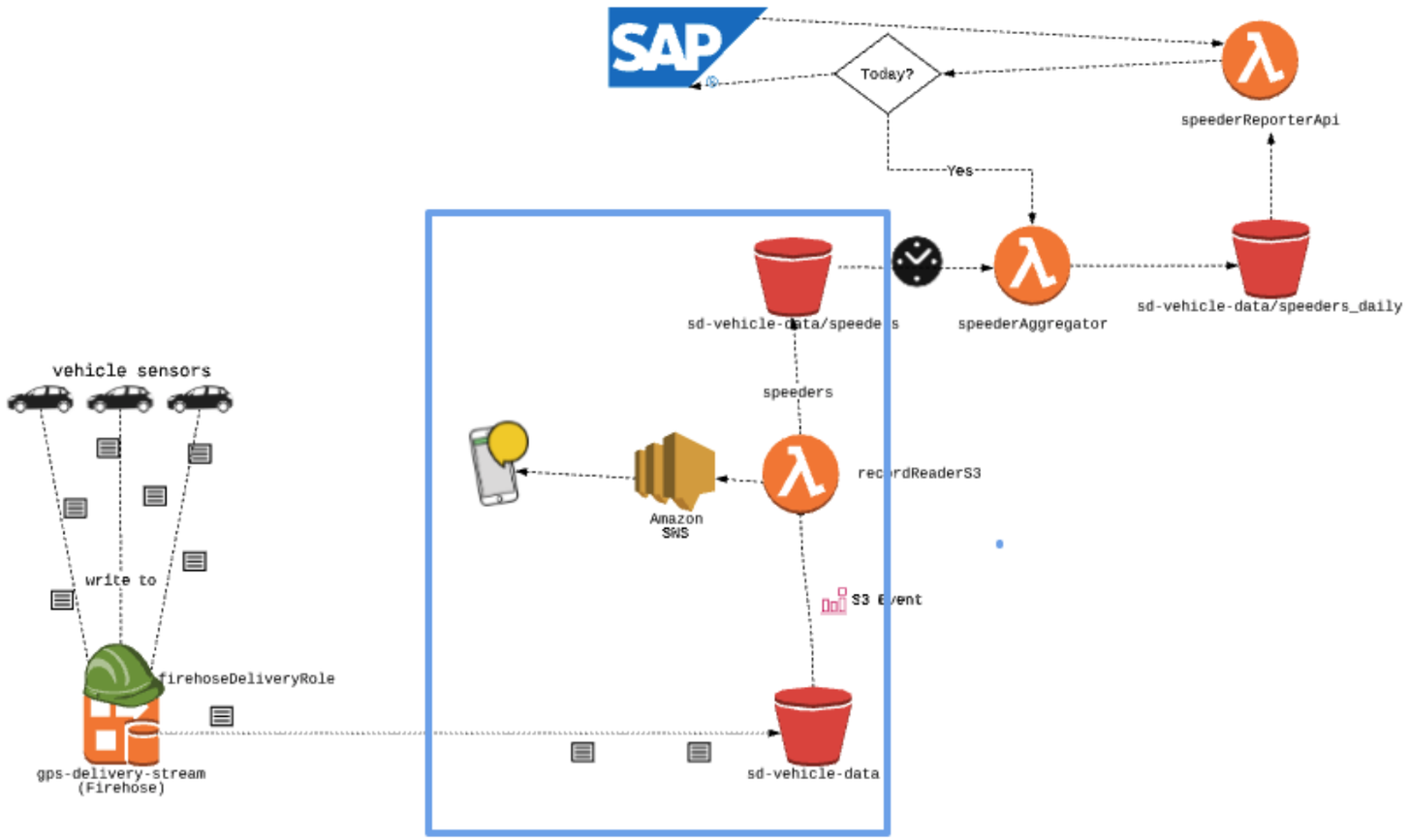
Review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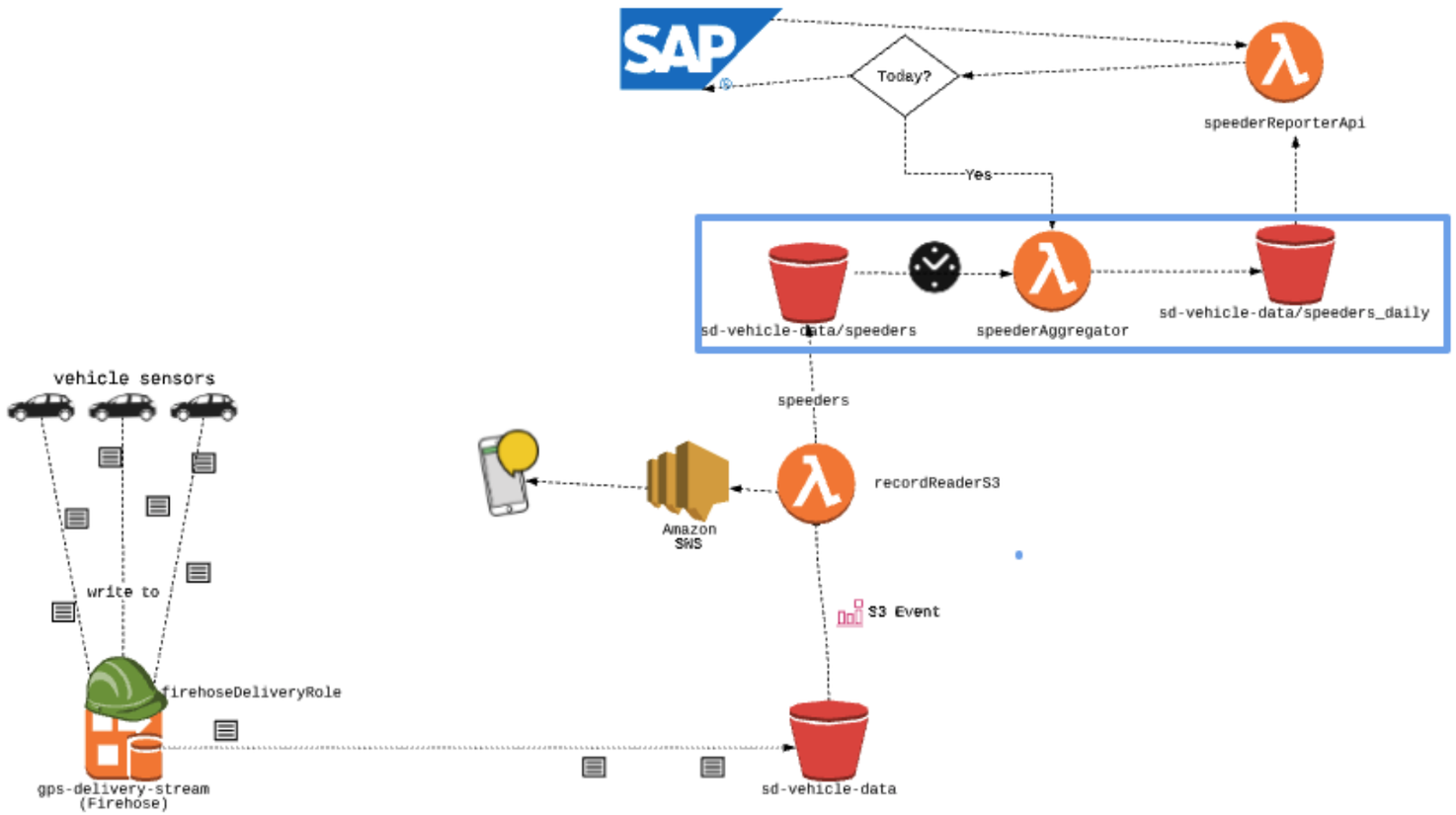
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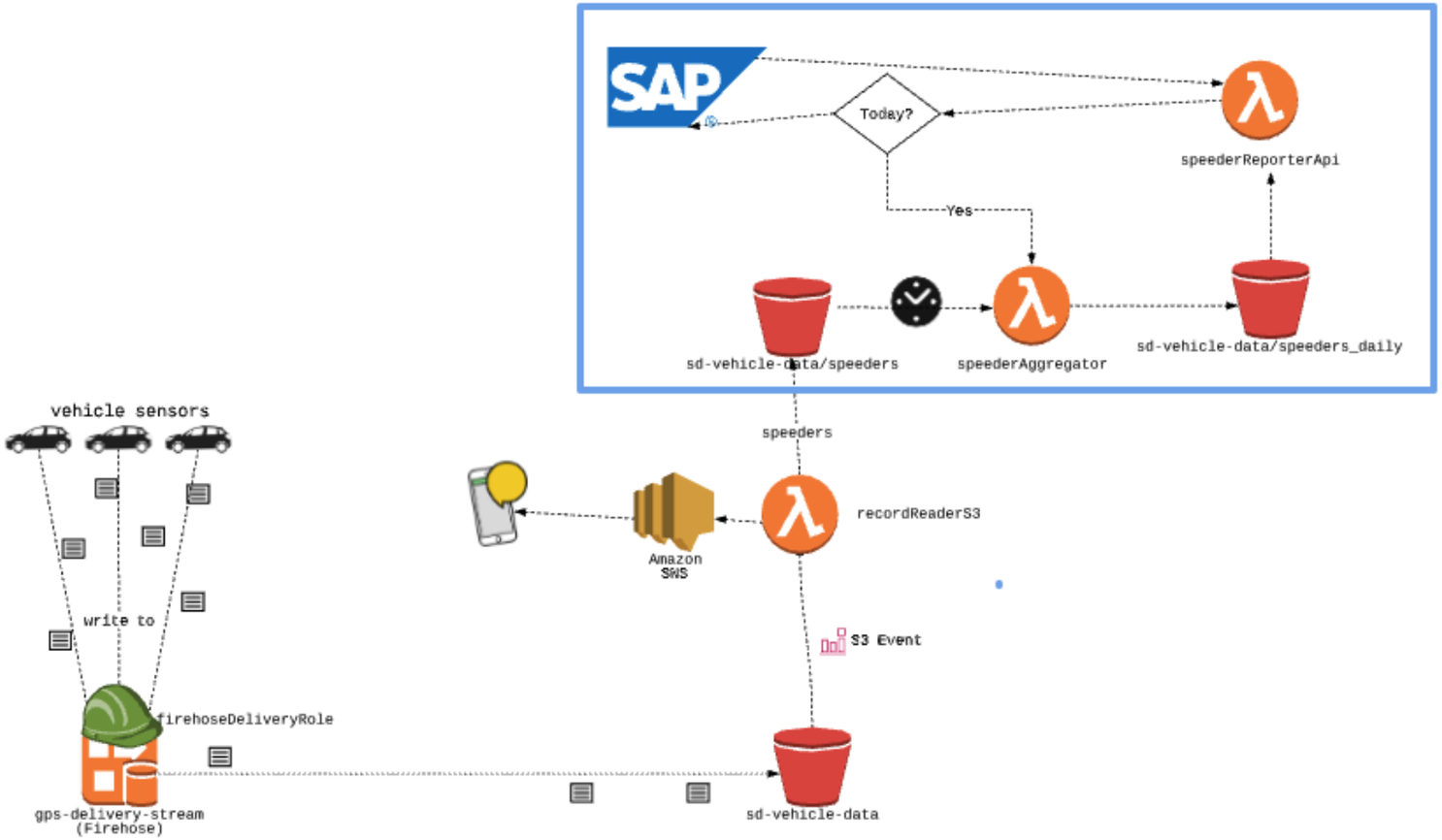
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