

PostNL

Event-Driven Architecture at PostNL Scale

Luc van Donkersgoed



Quick introduction

Luc van Donkersgoed



 @donkersgood

Lead Engineer Integration Team

12x AWS certified

AWS Hero

Current responsibility: design and build
a self-service event broker on AWS



PostNL in figures

End 2020



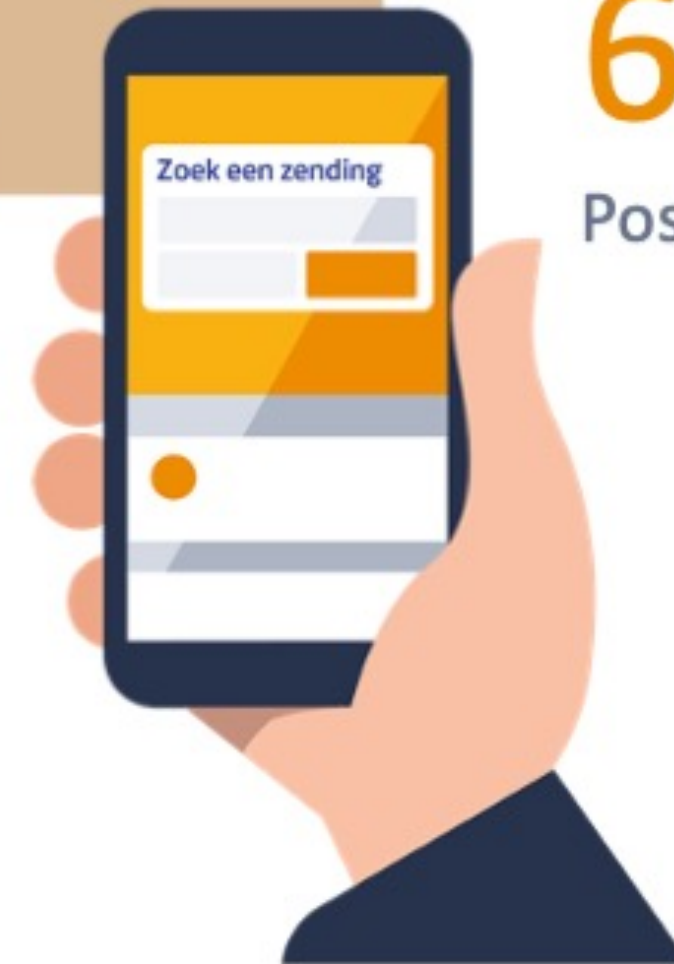
4,285

PostNL retail locations



40,540

Employees



6.0 million

PostNL app users



PostNL in figures

End 2020

8.1 million

Mail items per day 

€ 3.2 billion

Revenue

-9.6%

Reduction in mail volume* 

1.1 million

Parcels per day



19.2%

Growth in parcels 

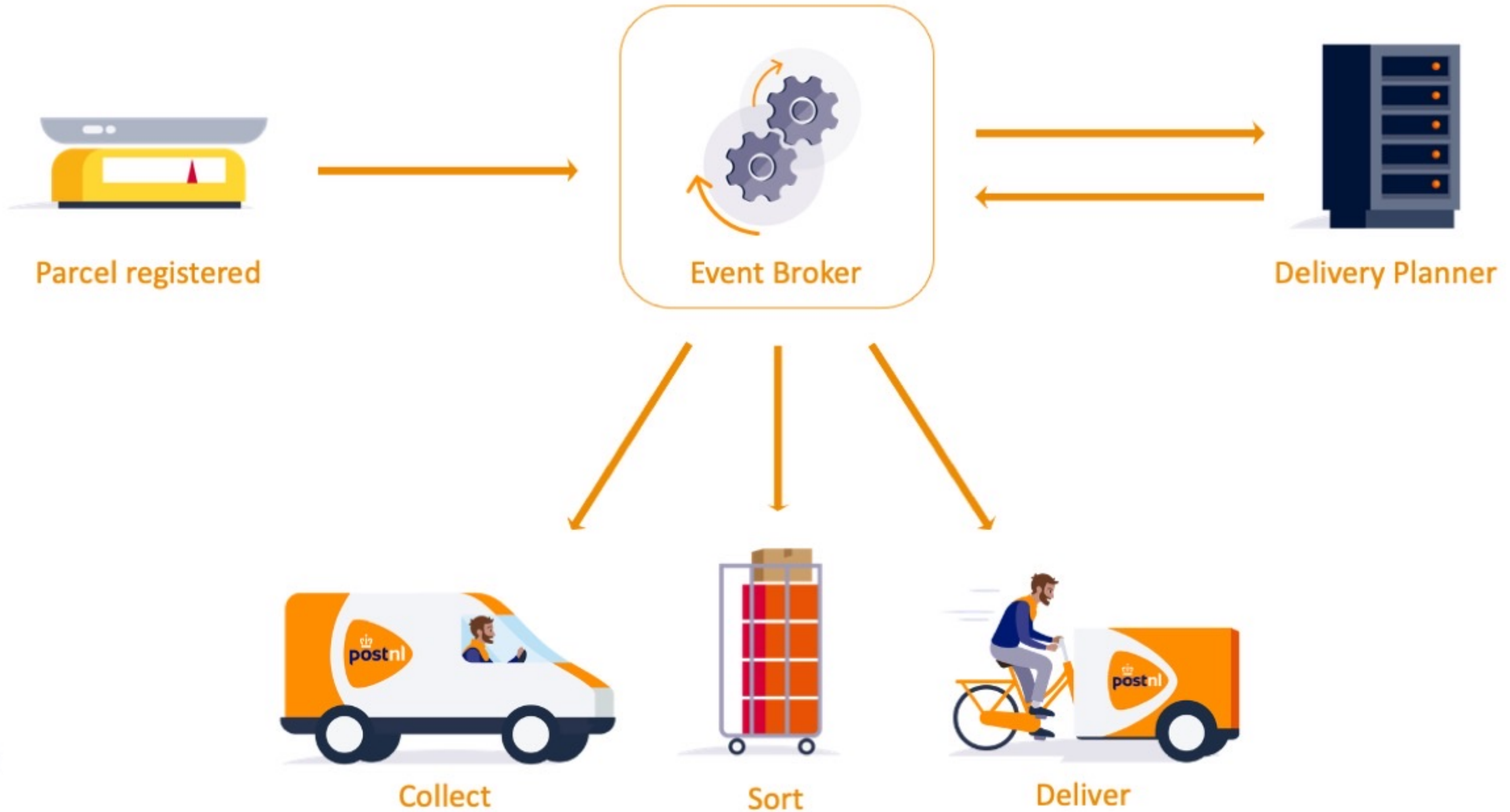


* The total amount of mail in 2020 decreased by 9.6 percent compared to all mail from Sandd and PostNL in 2019

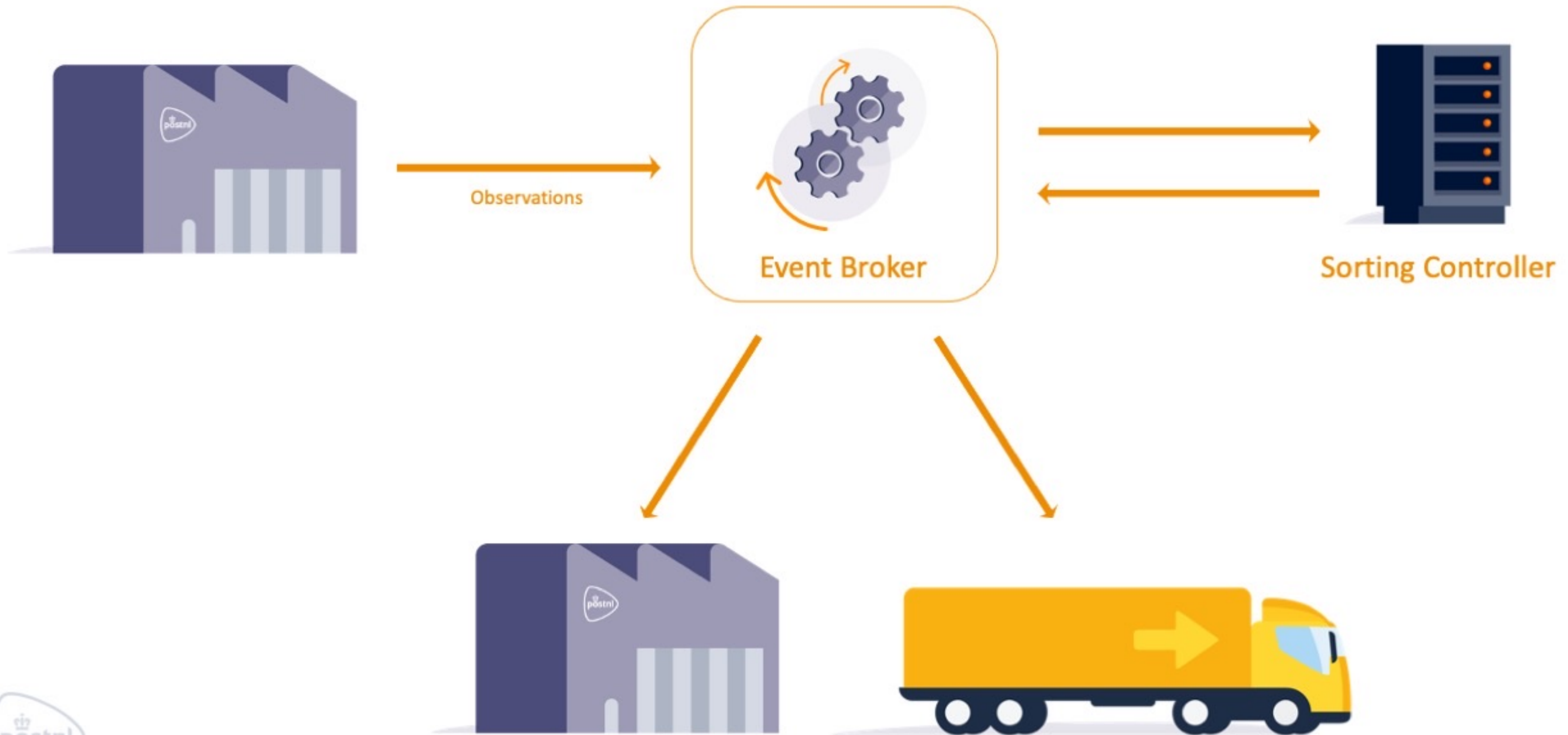


Event-Driven Architectures

Parcel registered



Parcel arrives at distribution center



Billions upon billions of events

PostNL scale

June 2021



3,500,000,000

Events processed / month



170,000,000

Peak events / day



~ 6000

Peak events / second



December 2020



5,700,000,000

Events processed / month
(+63%)



280,000,000

Peak events / day
(+65%)



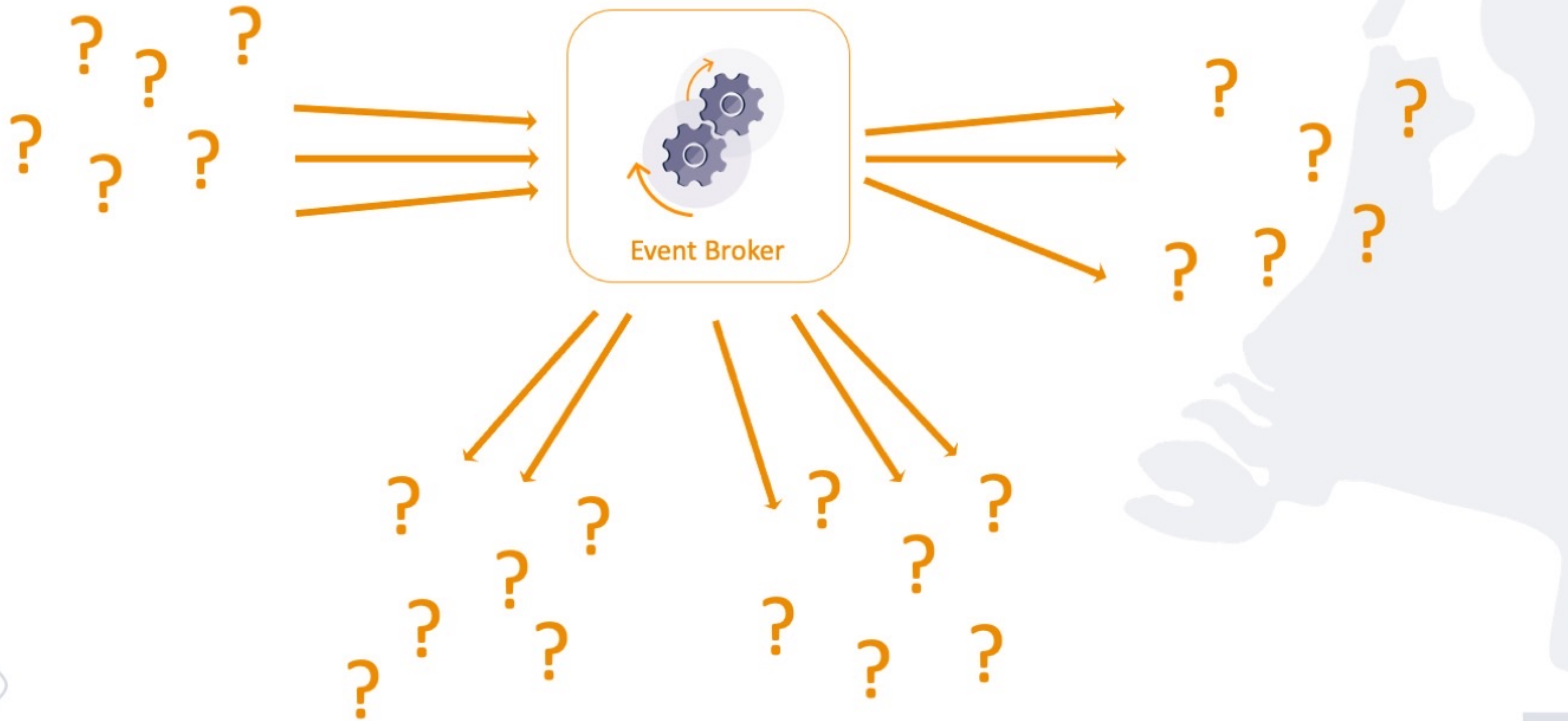
~ 10,000

Peak events / second
(+67%)



1 in 3 new
features requires
integration

More producers, more subscribers



Billions upon billions of events

PostNL scale

December 2022?



14,000,000,000

Events processed / month



560,000,000

Peak events / day



~ 20,000

Peak events / second





Speed up
innovation,
maintain
reliability



Pakket- en briefautomaat

24 uur per dag,
ophalen en versturen

Ophalen

U kunt uw online bestelling naar deze automaat laten versturen en het pakket hier ophalen wanneer u dat wilt. Dit kan 24 uur per dag, 7 dagen in de week. Kijk voor meer info op postnl.nl/pba

Versturen

U kunt de brievenbussen gebruiken om uw post te verzenden. Ook kunt u pakketten versturen. Via postnl.nl kunt u thuis vooraf bepalen wat u wilt versturen. U bepaalt de verzendwijze en de verzendkosten van uw pakket.

Our primary objective is self-service

No compromise
on reliability

Quick terminology intermezzo

What are we talking about



Producer

Any application *sending* events to the Event Broker



Quick terminology intermezzo

What are we talking about

Consumer

Any application *receiving* events from the Event Broker

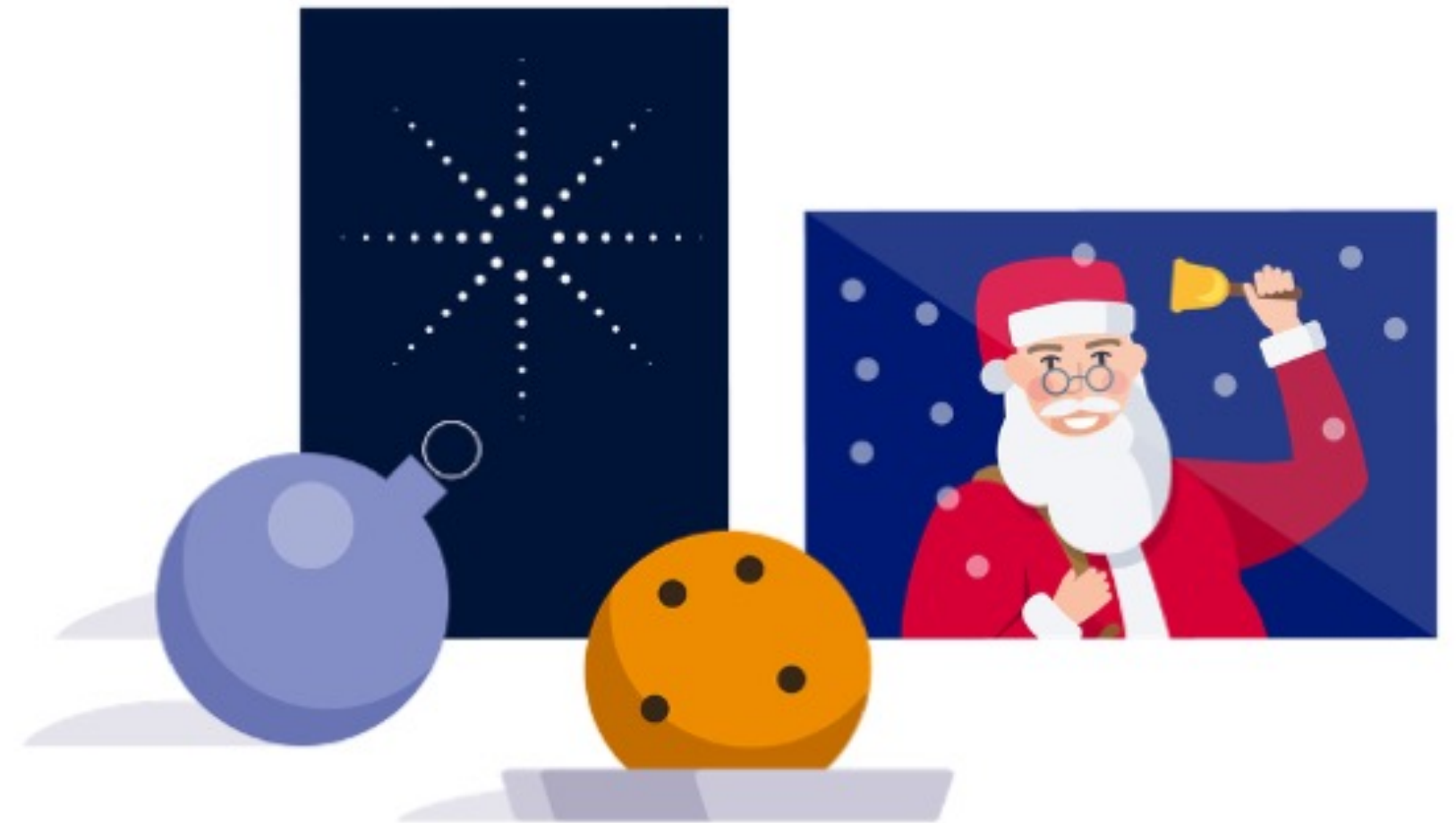


Quick terminology intermezzo

What are we talking about

Event / message

An immutable, self-describing set of data published onto the Event Broker

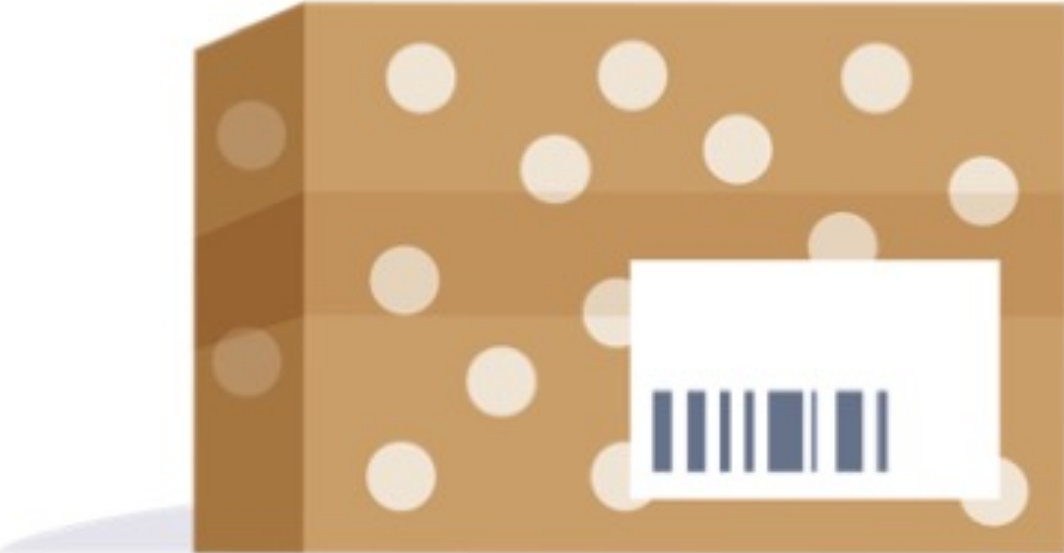


Quick terminology intermezzo

What are we talking about

Schema

The definition of an event's structure



Event broker goals

What do we want to achieve?



Reliability: guaranteed event delivery and structure



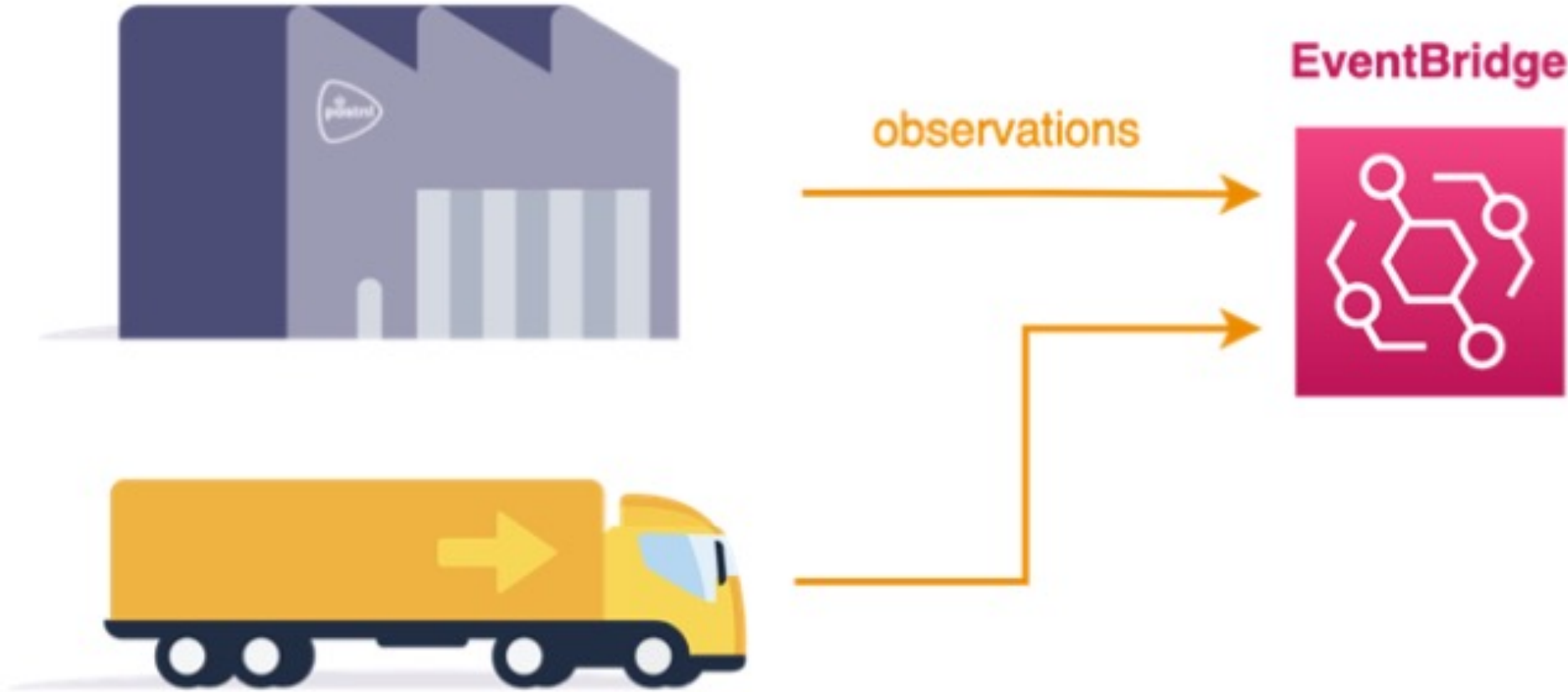
Flexibility: dynamically add producers and consumers






Insight: what is being produced and consumed?

Self-service in practice

The simple solution: EventBridge

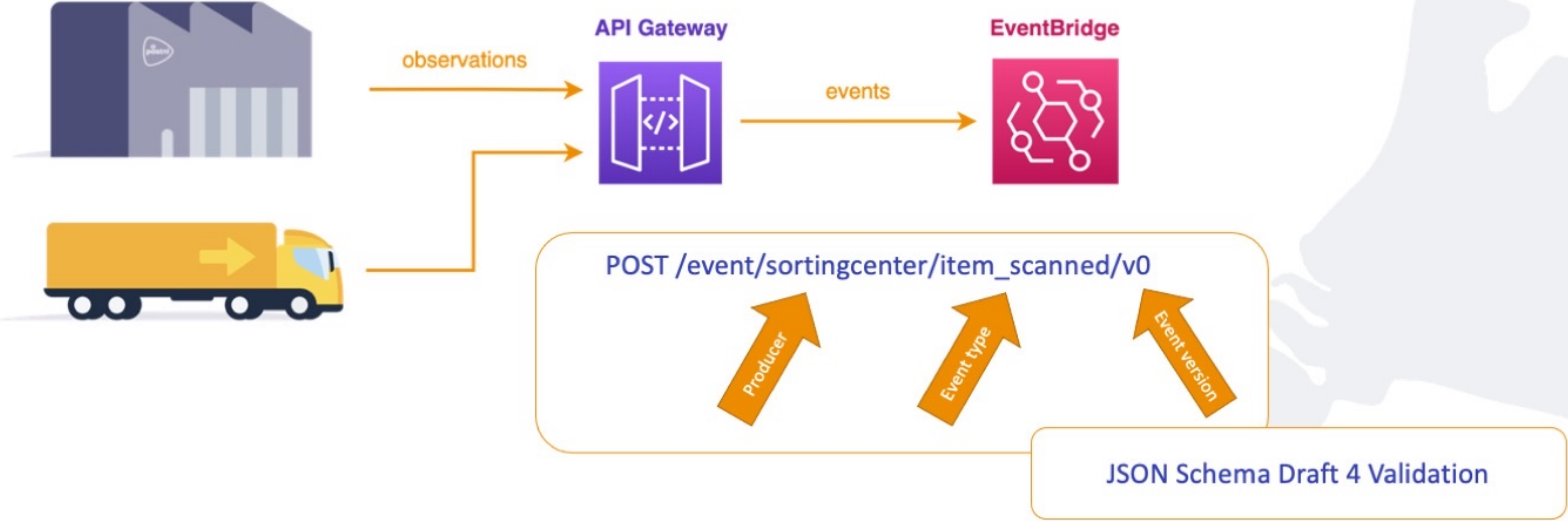


 Reliability	 Flexibility	 Insight
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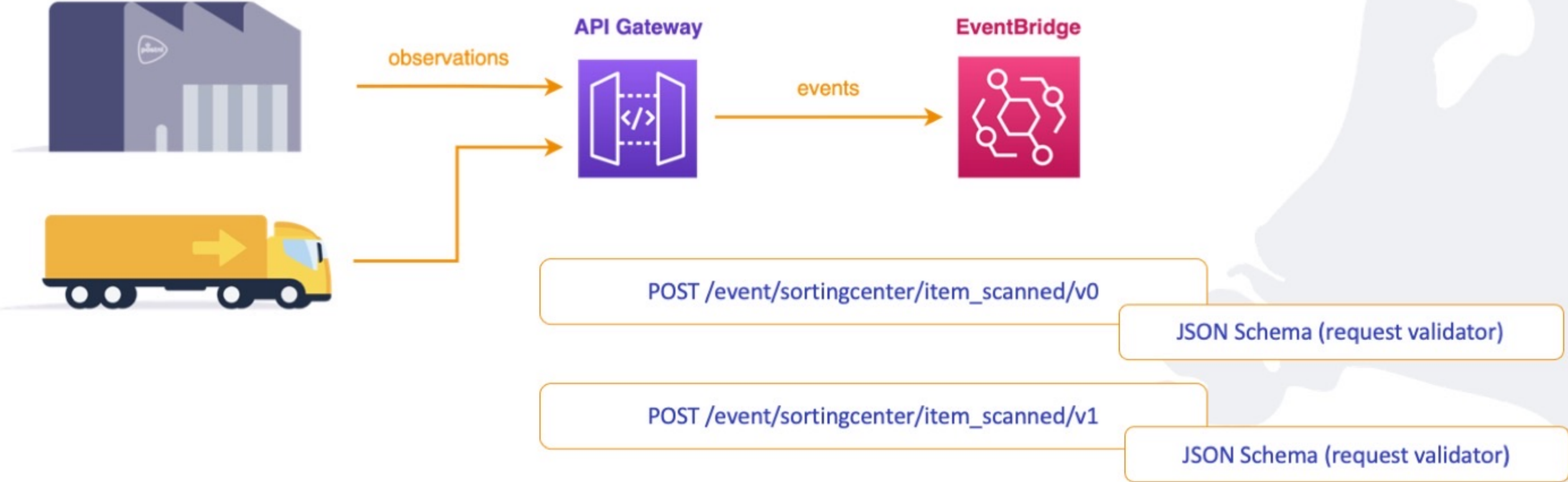
Self-service in practice

Adding API Gateway endpoints



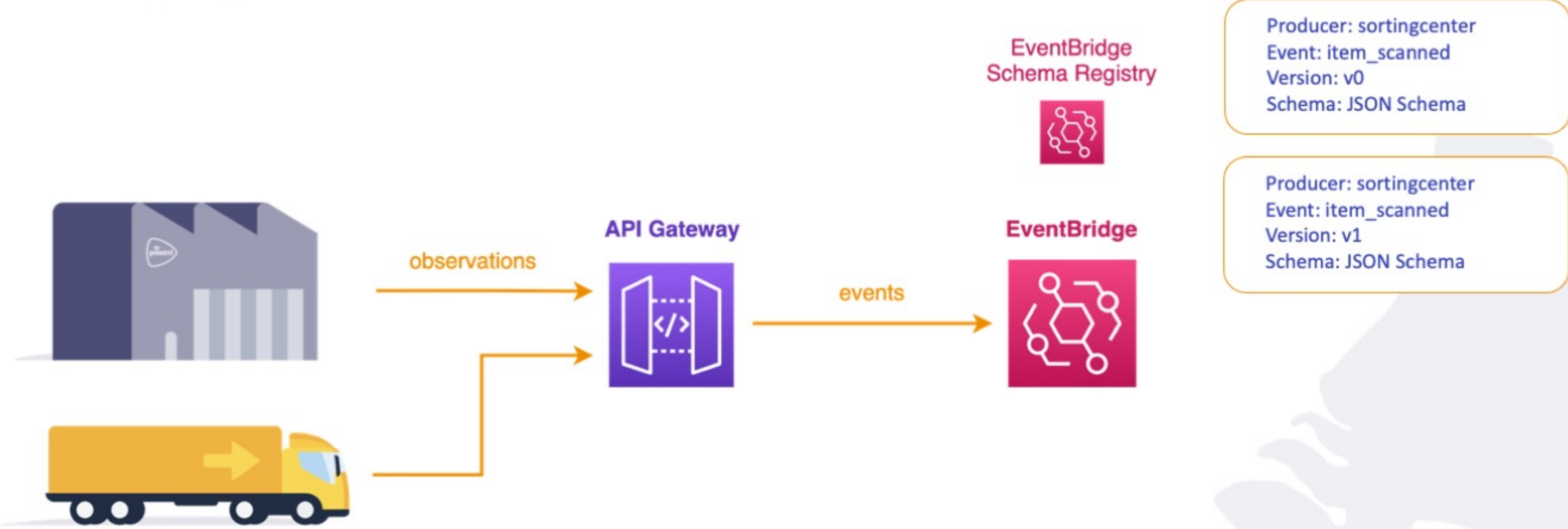
Self-service in practice

API Gateway endpoints



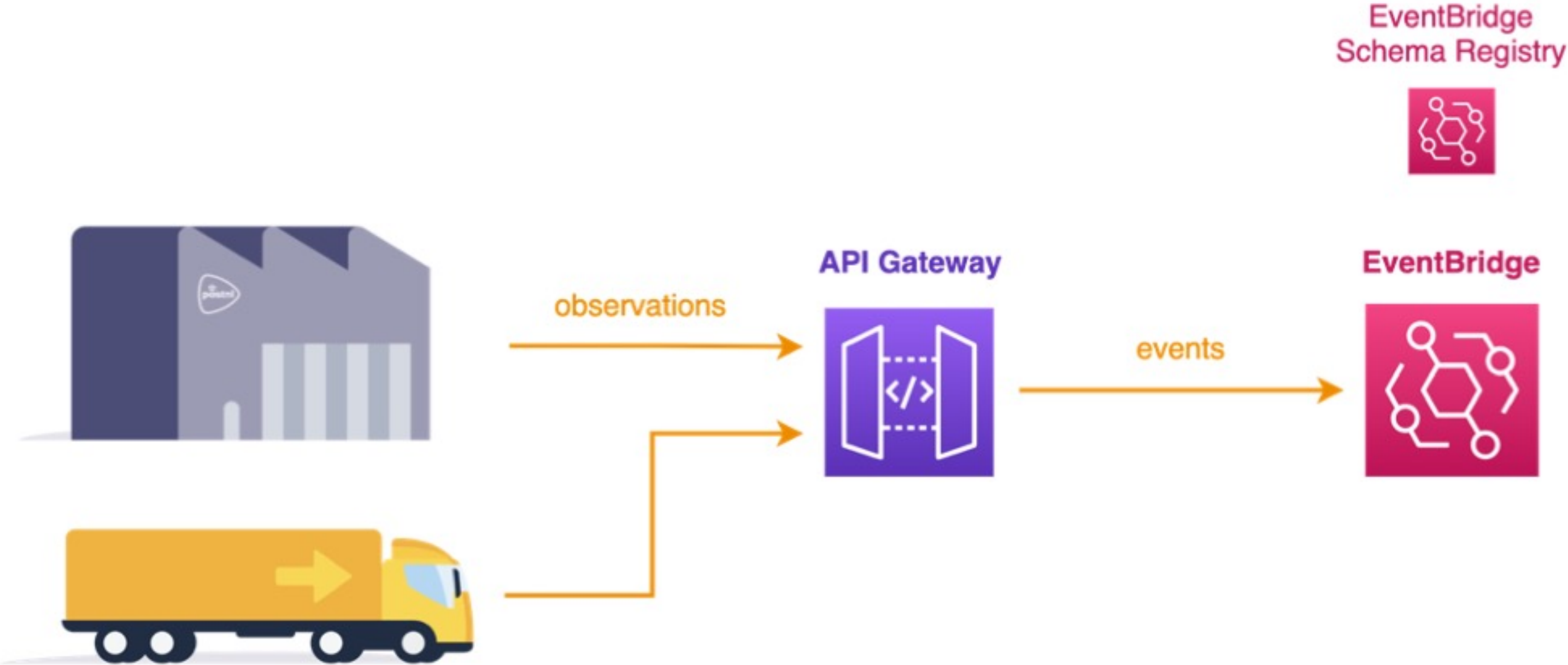
Self-service in practice

API Gateway endpoints



Self-service in practice

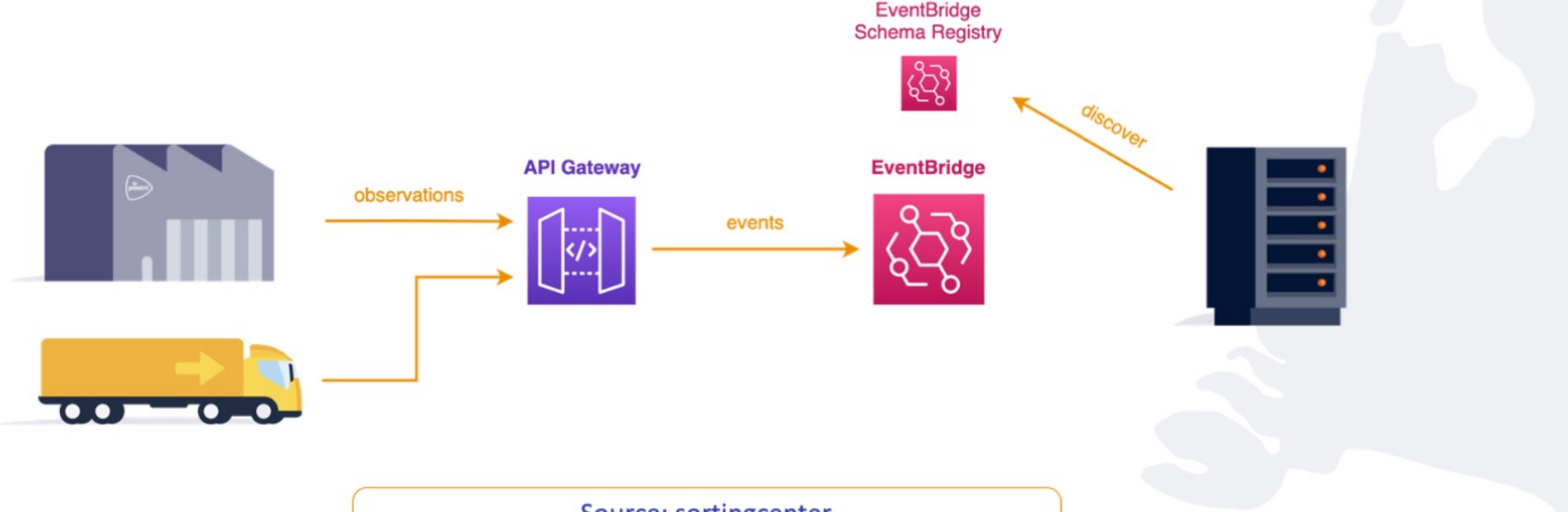
API Gateway endpoints



 Reliability	 Flexibility	 Insight
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Self-service in practice

Consumers discover event types

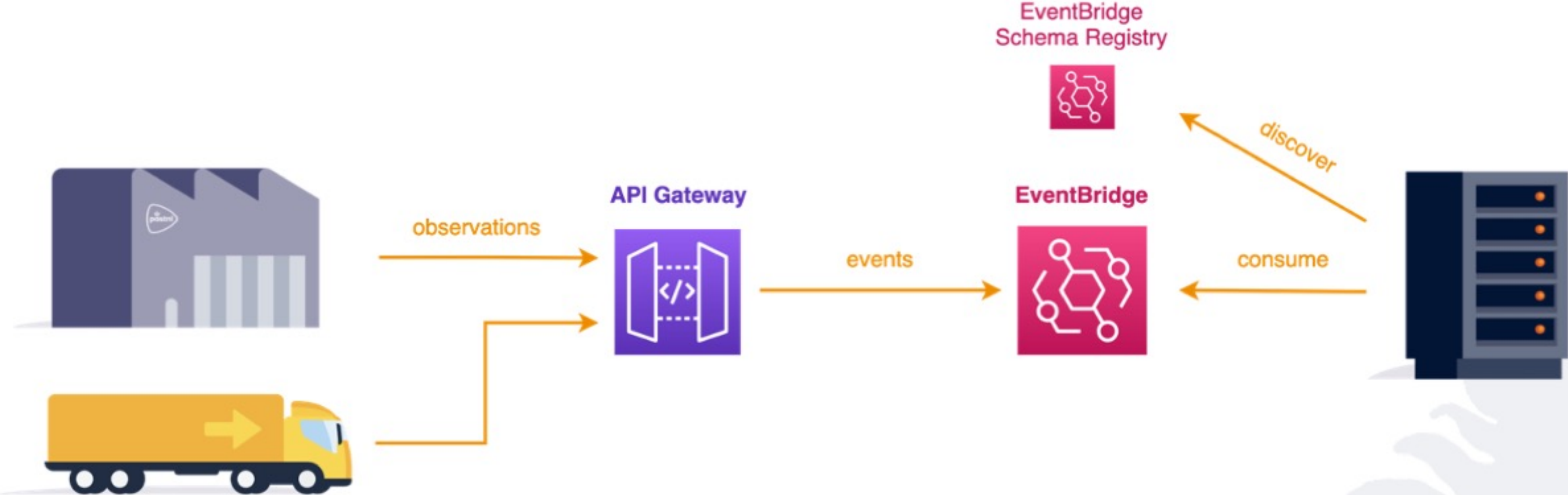


Source: sortingcenter
EventType: item_scanned-v1



Self-service in practice

Consumers create eventbridge rules

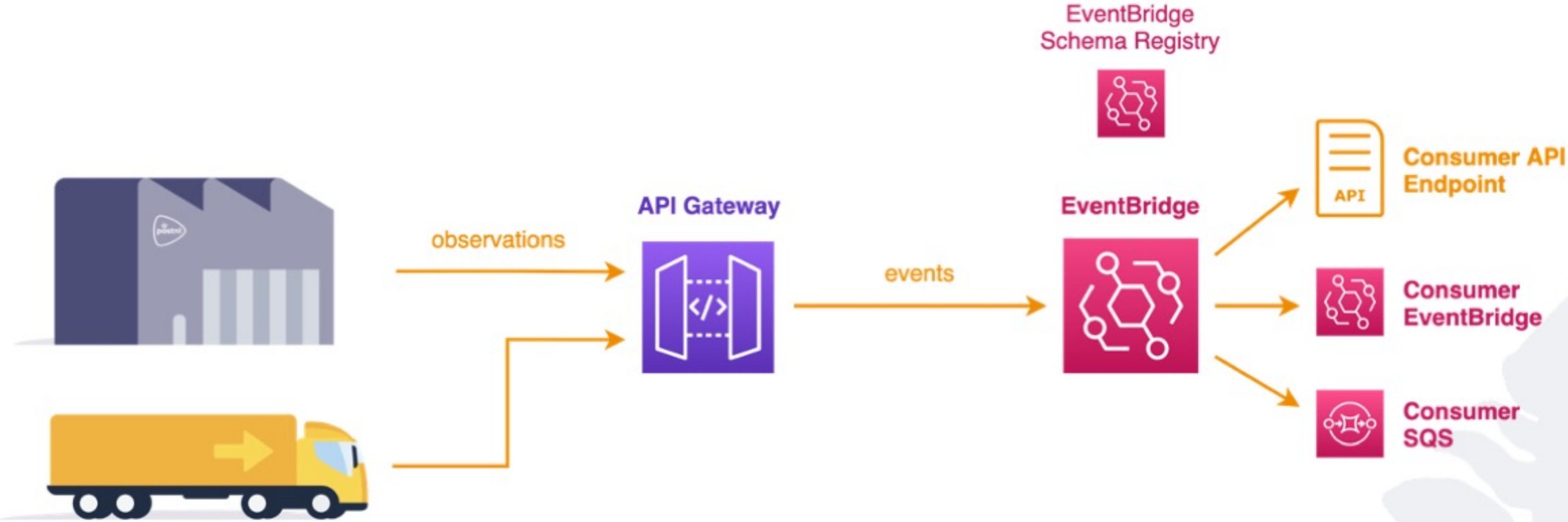


Source: sortingcenter
EventType: item_scanned-v1



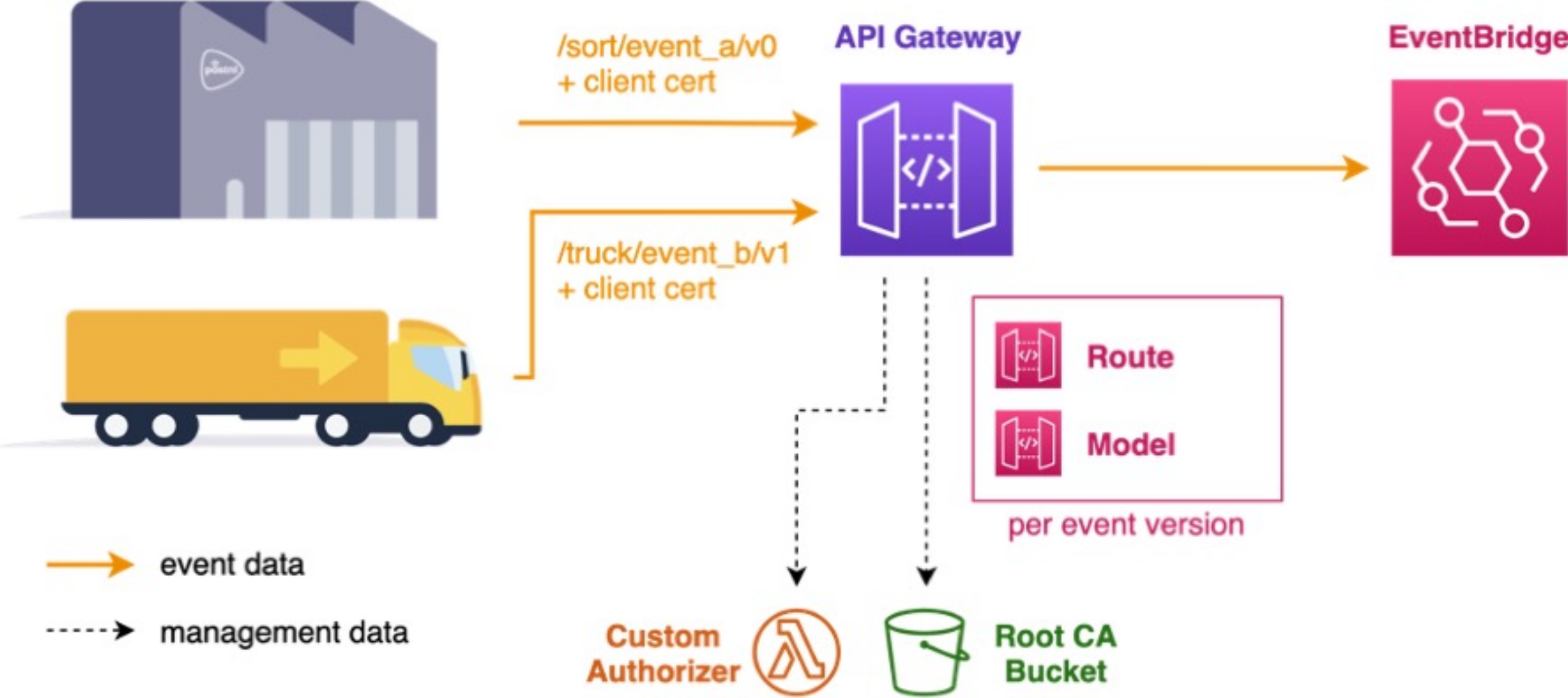
Self-service in practice

Three supported targets



Authorization and Authentication

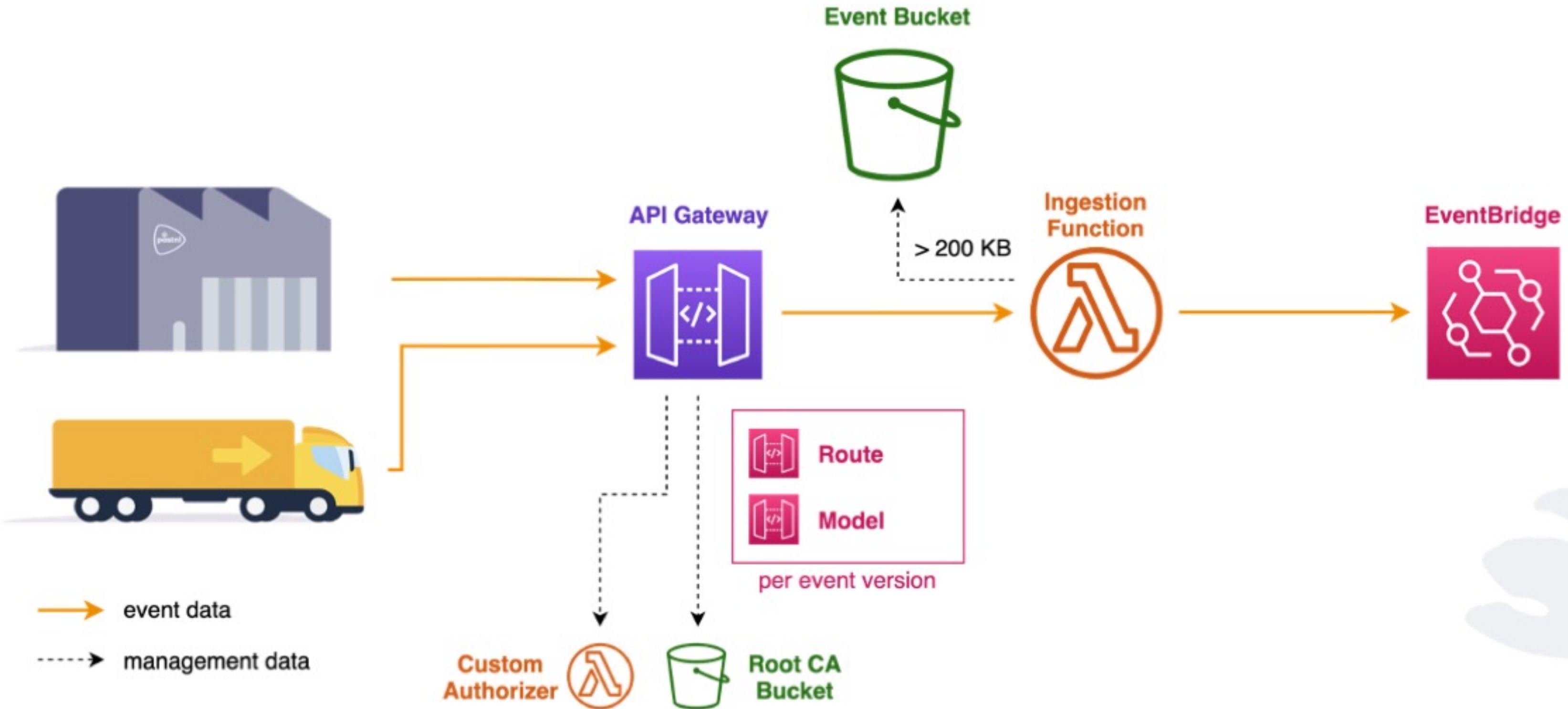
Client Certificates



Reliability	Flexibility	Insight
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Large event bodies

Offload to S3



Event Envelope

Structured and reliable messaging

Original Event

```
{  
  "dest_postal_code": "1234AB",  
  "dest_house_number": 10,  
  "parcel_weight": 12  
}
```



Event Envelope

Structured and reliable messaging

Original Event

```
{  
  "dest_postal_code": "1234AB",  
  "dest_house_number": 10,  
  "parcel_weight": 12  
}
```

PostNL Envelope

```
{  
  "metadata": {  
    "postnl_correlation_id": "<UUID>",  
    "event_date_time": "ISO 8601 time"  
  },  
  "data": {  
    "dest_postal_code": "1234AB",  
    "dest_house_number": 10,  
    "parcel_weight": 12  
  }  
}
```



Event Envelope

Structured and reliable messaging

Optional Fields

```
{  
  "metadata": {  
    "postnl_correlation_id": "<UUID>",  
    "event_date_time": "ISO 8601 time",  
    "event_attributes": {  
      "source_distribution_center": "AMS01",  
      "target_distribution_center": "UTR01"  
    }  
  },  
  "data": {  
    "dest_postal_code": "1234AB",  
    "dest_house_number": 10,  
    "parcel_weight": 12  
  }  
}
```



Event Envelope

Structured and reliable messaging



Small event header

```
{
  "metadata": {
    "postnl_correlation_id": "<UUID>",
    "event_date_time": "ISO 8601 time",
    "event_attributes": {
      "source_distribution_center": "AMS01",
      "target_distribution_center": "UTR01"
    },
    "event_truncation": {
      "event_truncated": false
    }
  },
  "data": {
    "dest_postal_code": "1234AB",
    "dest_house_number": 10,
    "parcel_weight": 12
  }
}
```



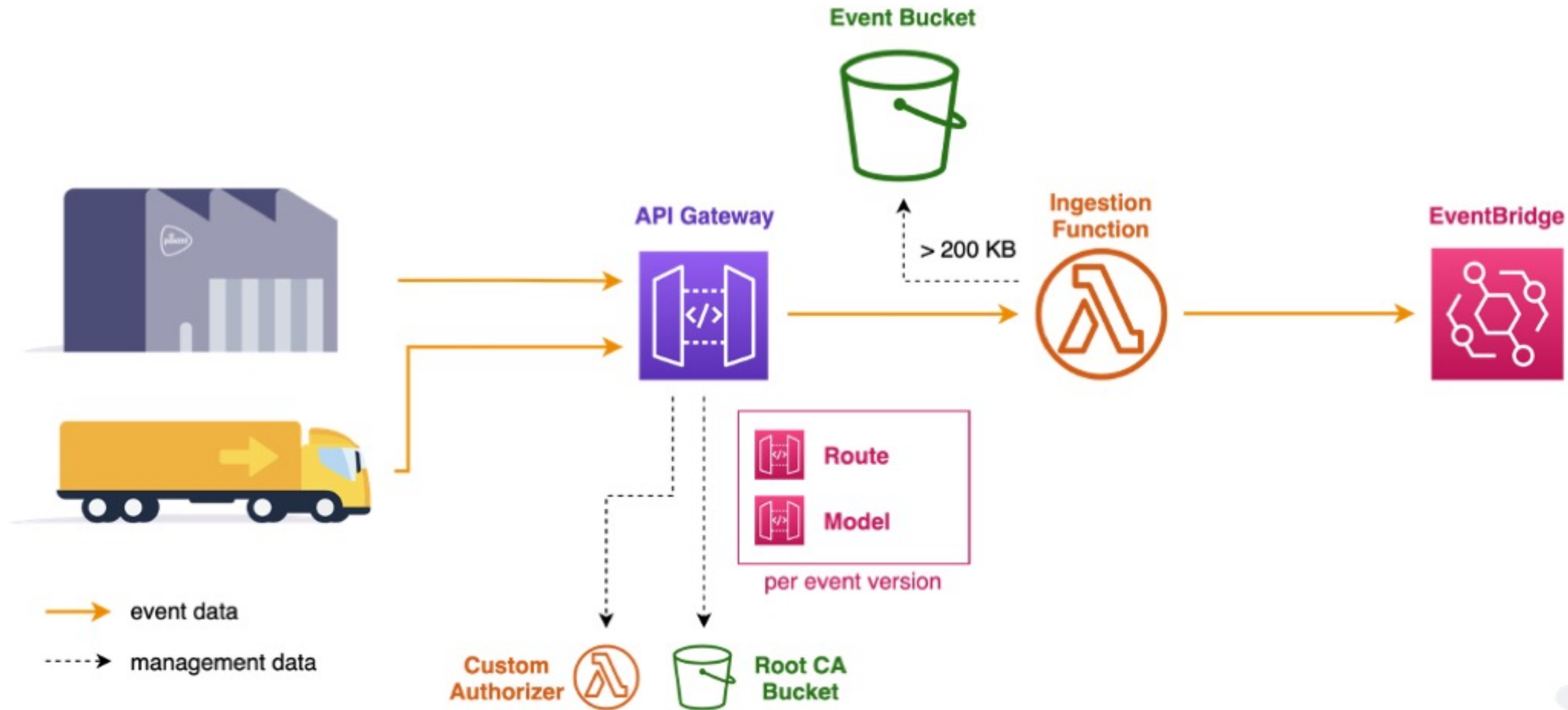
Large event header

```
{
  "metadata": {
    "postnl_correlation_id": "<UUID>",
    "event_date_time": "ISO 8601 time",
    "event_attributes": {
      "source_distribution_center": "AMS01",
      "target_distribution_center": "UTR01"
    },
    "event_truncation": {
      "event_truncated": true,
      "event_body_url": "https://signed_url...",
      "event_body_size": 514,
      "event_object_bucket": "large_body_bucket",
      "event_object_key": "<UUID>"
    }
  }
}
```



Large event bodies




Offload to S3



Reliability	Flexibility	Insight
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Good reliability and flexibility, but insights are lacking

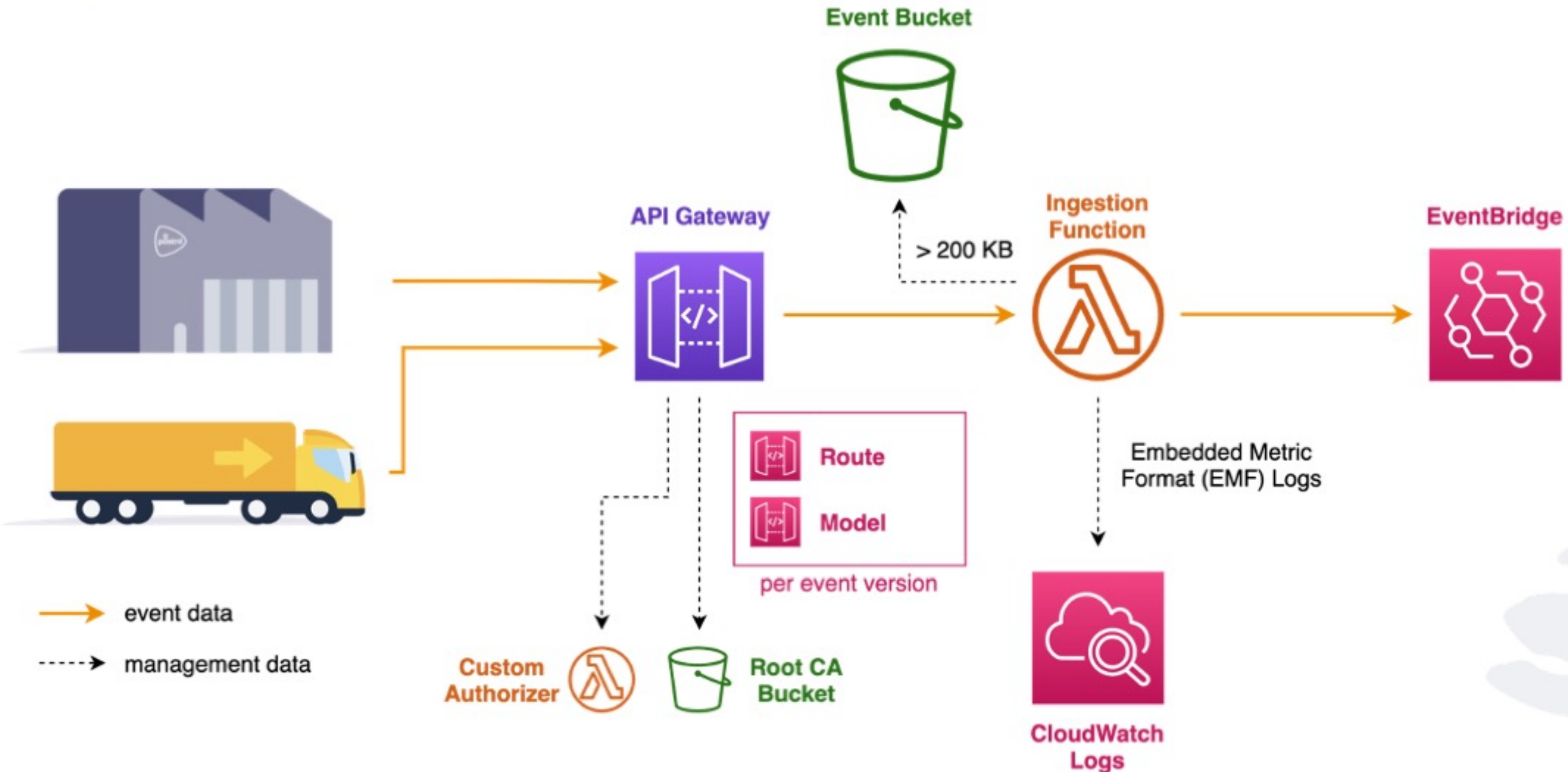
Improving insights with CloudWatch

 Reliability	 Flexibility	 Insight
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CloudWatch Logs Embedded Metric Format (EMF)

Nearly free CloudWatch Metrics



CloudWatch Logs Embedded Metric Format (EMF)

Nearly free CloudWatch Metrics

14,000,000,000

Events processed / month

\$140,000

Metric collection with
PutMetricData

\$2,000

Metric collection with EMF



CloudWatch Logs Embedded Metric Format (EMF)

Nearly free CloudWatch Metrics

98.6% cost savings!



CloudWatch Logs Embedded Metric Format (EMF)

Nearly free CloudWatch Metrics

For the same metrics!



CloudWatch Logs Embedded Metric Format (EMF)

Nearly free CloudWatch Metrics

```
{
  "_aws": {
    "Timestamp": 1626682587668,
    "CloudWatchMetrics": [
      {
        "Namespace": "EventBrokerEcommerce",
        "Dimensions": [
          [
            "ProducerID",
            "EventType",
          ]
        ],
        "Metrics": [
          {
            "Name": "Size",
            "Unit": "Bytes"
          }
        ]
      }
    ]
  },
  "ProducerID": "truck",
  "EventType": "event_b",
  "Size": 526
}
```

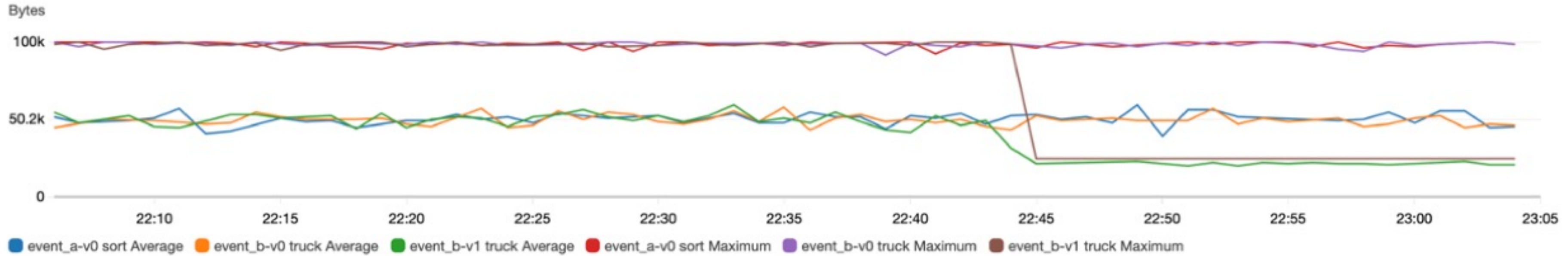
▼ Custom Namespaces

EventBrokerEcommerce	7
EventType, ProducerID	5

<input type="checkbox"/>	EventType (3)	▲ ProducerID	▲ Metric Name
<input type="checkbox"/>	event_a-v0 ▼	sort ▼	Size ▼
<input type="checkbox"/>	event_b-v0 ▼	truck ▼	Size ▼
<input type="checkbox"/>	event_b-v1 ▼	truck ▼	Size ▼

CloudWatch Logs Embedded Metric Format (EMF)

Nearly free CloudWatch Metrics



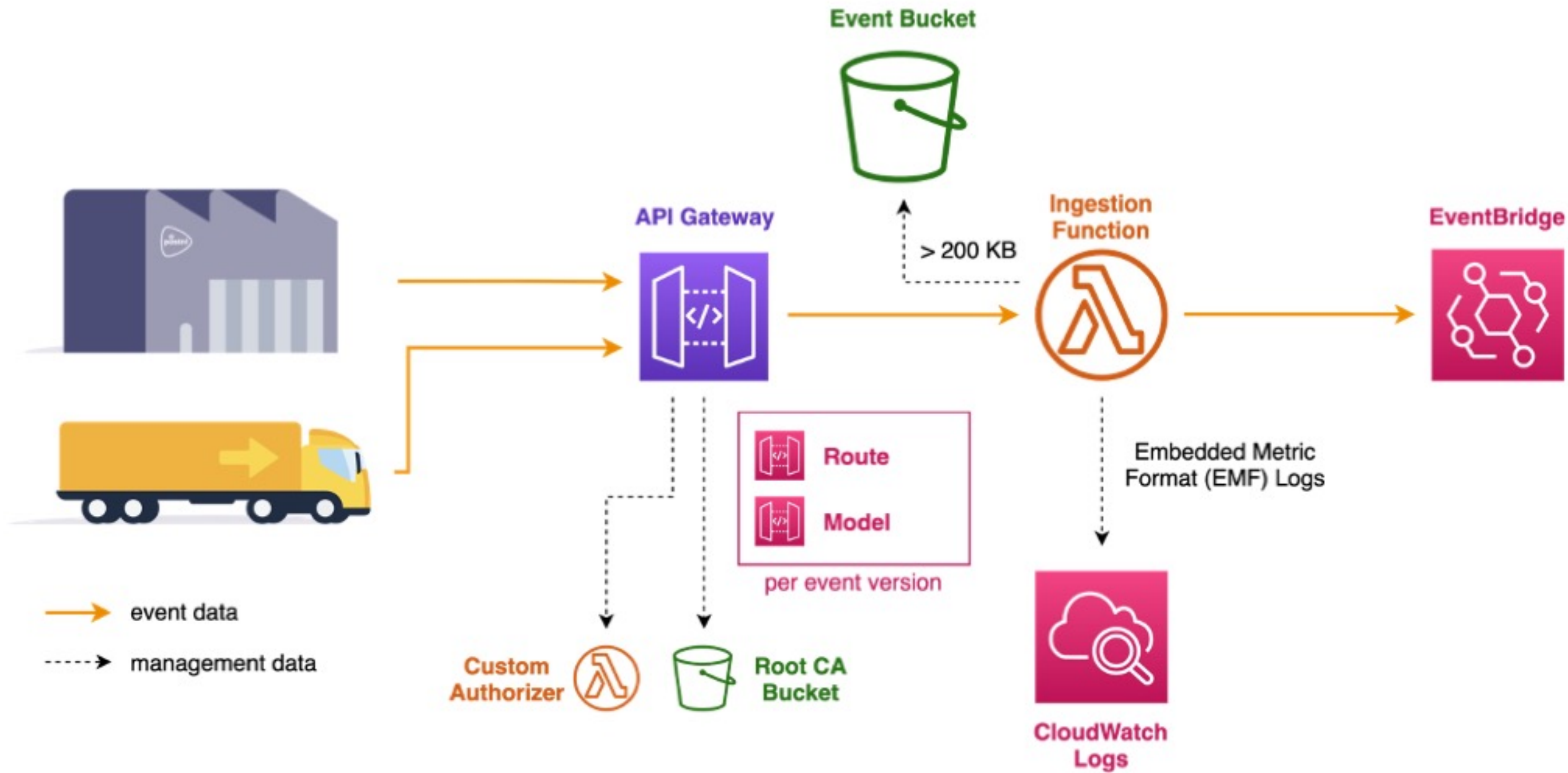
Math expression Dynamic labels Statistic: (multiple) Period: 1 Minute Remove all

<input checked="" type="checkbox"/>	Label	Details	Statistic	Period	Y Axis	Actions
<input checked="" type="checkbox"/>	event_a-v0 sort Average	EventBrokerEcommerce • Size • EventType: event_a-v0 • ProducerID: sort	Average	1 Minute	< >	
<input checked="" type="checkbox"/>	event_b-v0 truck Average	EventBrokerEcommerce • Size • EventType: event_b-v0 • ProducerID: truck	Average	1 Minute	< >	
<input checked="" type="checkbox"/>	event_b-v1 truck Average	EventBrokerEcommerce • Size • EventType: event_b-v1 • ProducerID: truck	Average	1 Minute	< >	
<input checked="" type="checkbox"/>	event_a-v0 sort Maximum	EventBrokerEcommerce • Size • EventType: event_a-v0 • ProducerID: sort	Maximum	1 Minute	< >	
<input checked="" type="checkbox"/>	event_b-v0 truck Maximum	EventBrokerEcommerce • Size • EventType: event_b-v0 • ProducerID: truck	Maximum	1 Minute	< >	
<input checked="" type="checkbox"/>	event_b-v1 truck Maximum	EventBrokerEcommerce • Size • EventType: event_b-v1 • ProducerID: truck	Maximum	1 Minute	< >	



CloudWatch Logs Embedded Metric Format (EMF)

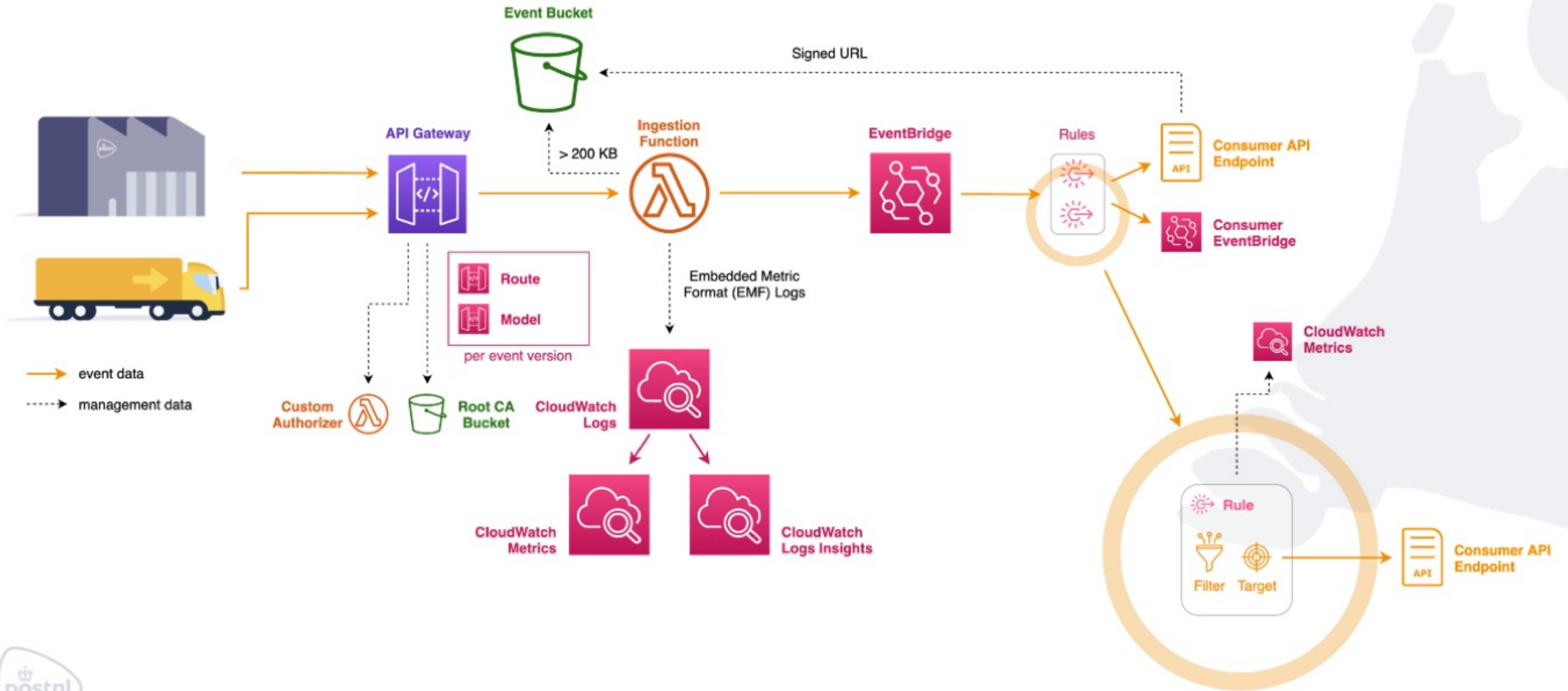
Nearly free CloudWatch Metrics



Reliability	Flexibility	Insight
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Consumer Metrics

What do the consumers receive?



Structured CloudWatch Logs

Combine the producer, event and consumer into a single log

```
▼ 2021-09-13T22:32:06.217+02:00 {"consumer_rule": "EventBridgeTestStack-EventBrokerStac-ConsumerRule2-128VNAI7L9UTJ", "applicat...
  {
    "consumer_rule": "EventBridgeTestStack-EventBrokerStac-ConsumerRule2-128VNAI7L9UTJ",
    "application": "truck",
    "event_type": "event_b-v0"
  }
▼ 2021-09-13T22:32:06.217+02:00 {"consumer_rule": "EventBridgeTestStack-EventBrokerStac-ConsumerRule0-V5Q0537XXCR0", "applicati...
  {
    "consumer_rule": "EventBridgeTestStack-EventBrokerStac-ConsumerRule0-V5Q0537XXCR0",
    "application": "truck",
    "event_type": "event_b-v0"
  }
▼ 2021-09-13T22:32:06.385+02:00 {"consumer_rule": "EventBridgeTestStack-EventBrokerStac-ConsumerRule0-V5Q0537XXCR0", "applicati...
  {
    "consumer_rule": "EventBridgeTestStack-EventBrokerStac-ConsumerRule0-V5Q0537XXCR0",
    "application": "sort",
    "event_type": "event_a-v0"
  }
```



CloudWatch Logs Insights

Query structured logs

```
2021-09-13T22:32:06.385+02:00      {"consumer_rule": "EventBridgeTestStack-EventBrokerStac-  
{  
  "consumer_rule": "EventBridgeTestStack-EventBrokerStac-ConsumerRule0-V5Q0537XXCR0",  
  "application": "sort",  
  "event_type": "event_a-v0"  
}
```

Select log group(s)

Clear

EventBridgeTestStack-EventBrokerStackNestedStackEventBrokerStackNestedStackResource848-6K5VXKG78DGE-ConsumerLogGroupA8C286BC-jNPAewqvKfc9 X

5m

30m

1h

3h

12h

Custom (15m)

```
1 fields application, event_type, consumer_rule  
2 | filter application == 'sort' and event_type == 'event_a-v0'  
3 | stats count(*) as number_of_events by application, event_type, consumer_rule  
4
```

Run query

Save

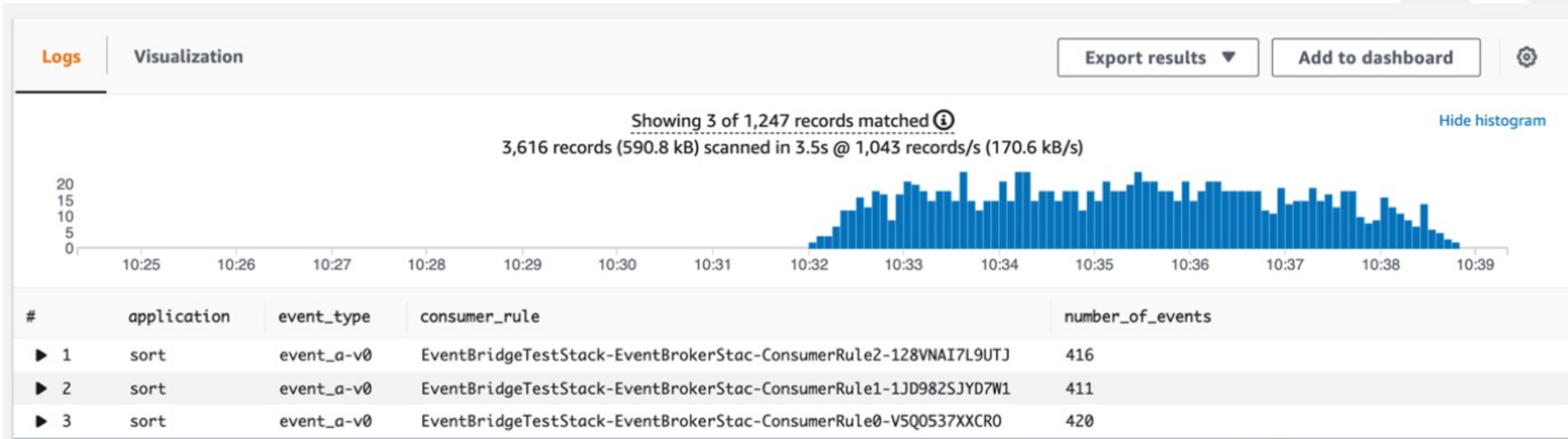
Actions

History

Queries are allowed to run for up to 15 minutes.

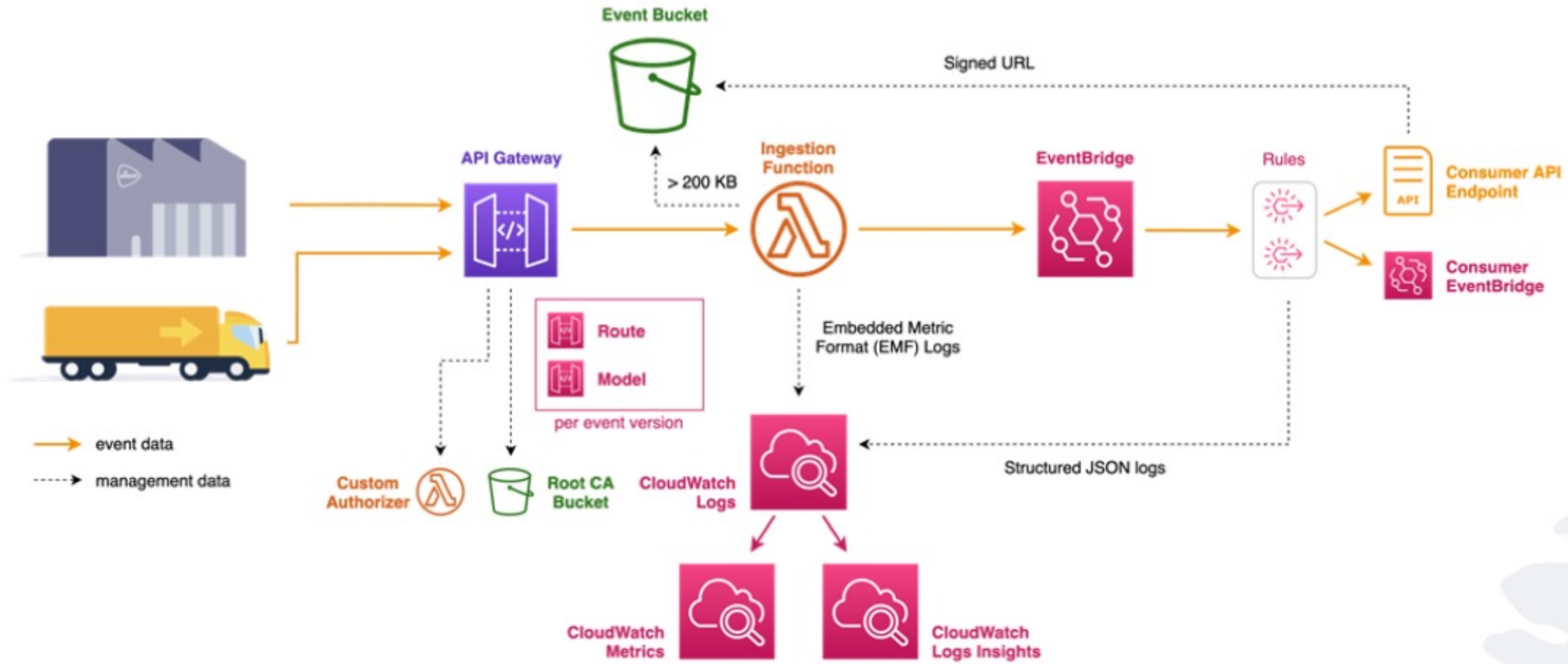
CloudWatch Logs Insights

Visualize query results



Consumer Metrics

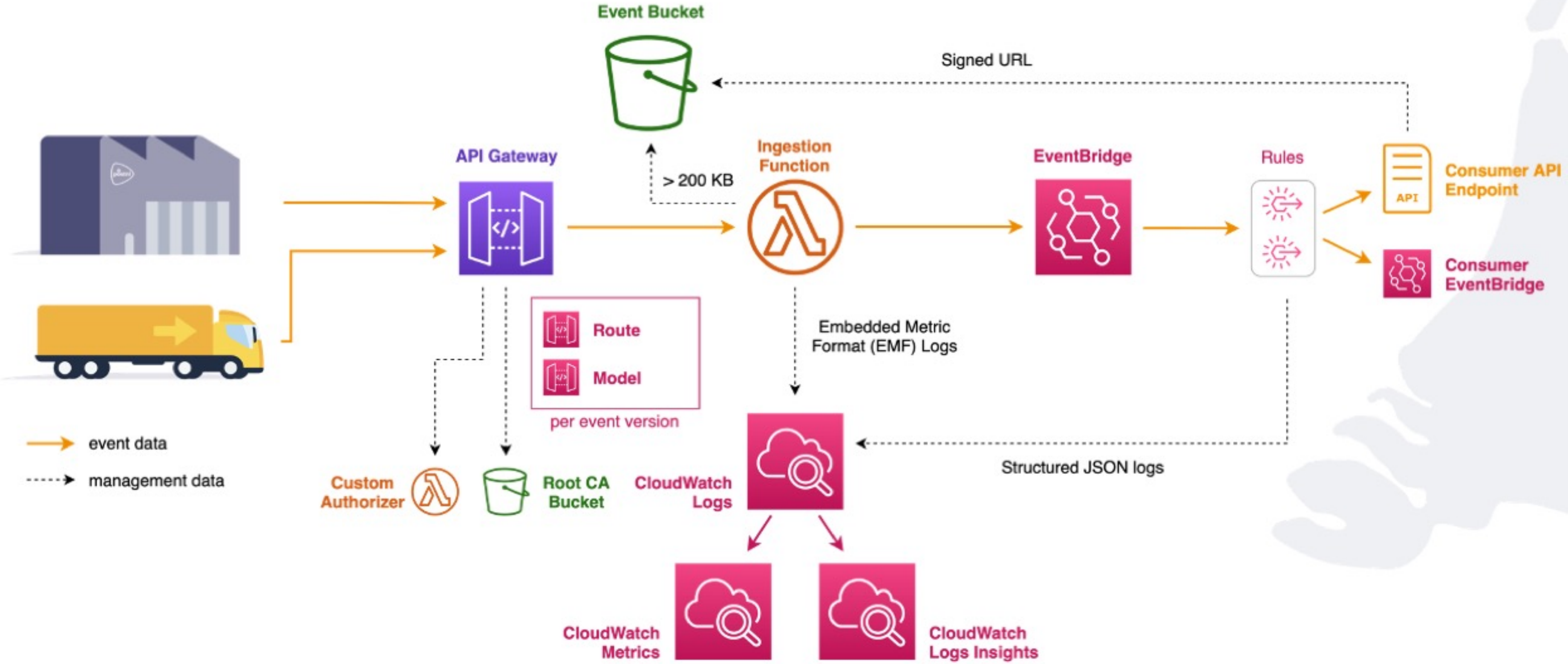
What do the consumers receive?



Reliability	Flexibility	Insight
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Architecture recap

All services combined



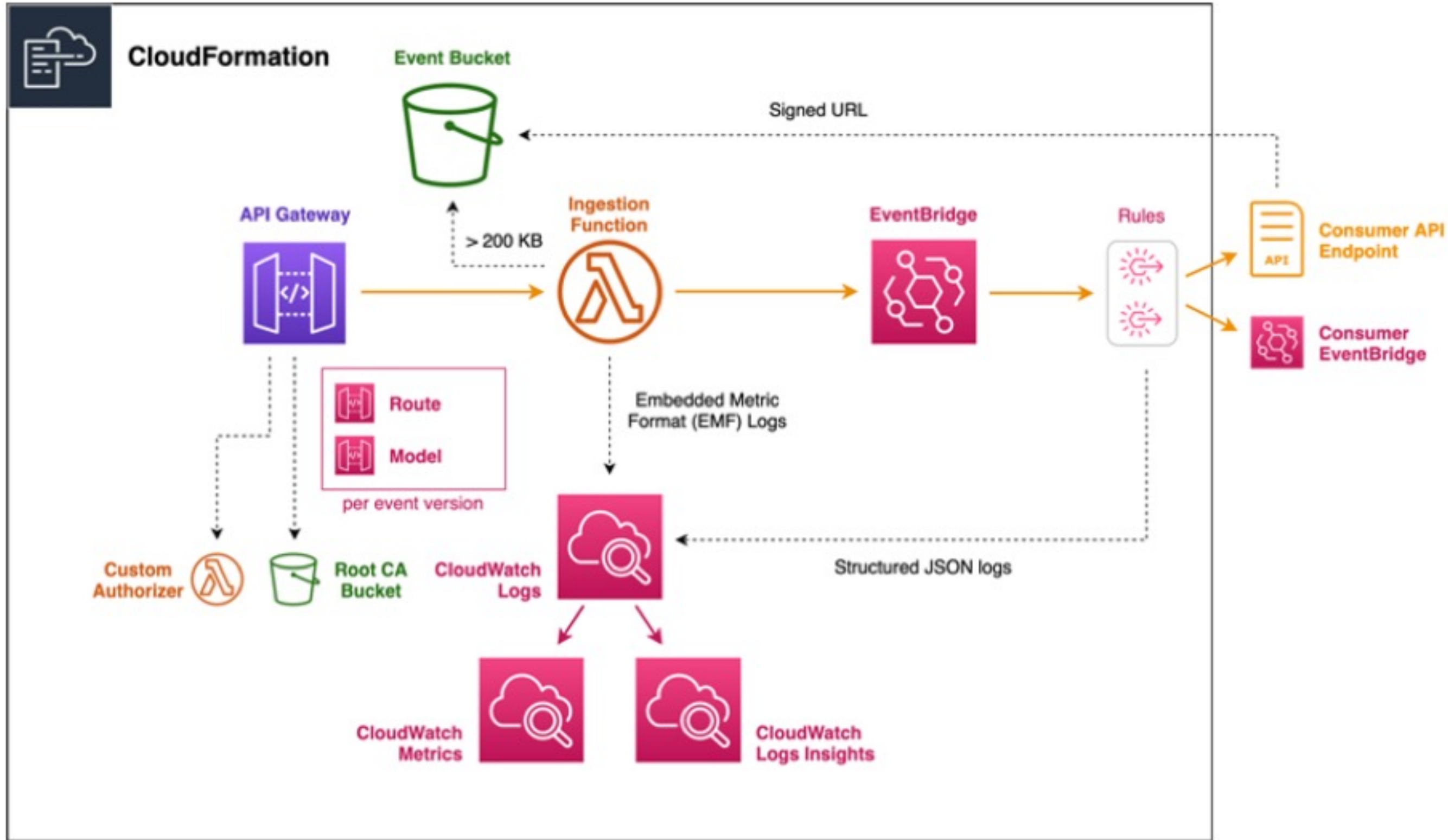
Self-service

Bringing it all together in
CloudFormation and CDK



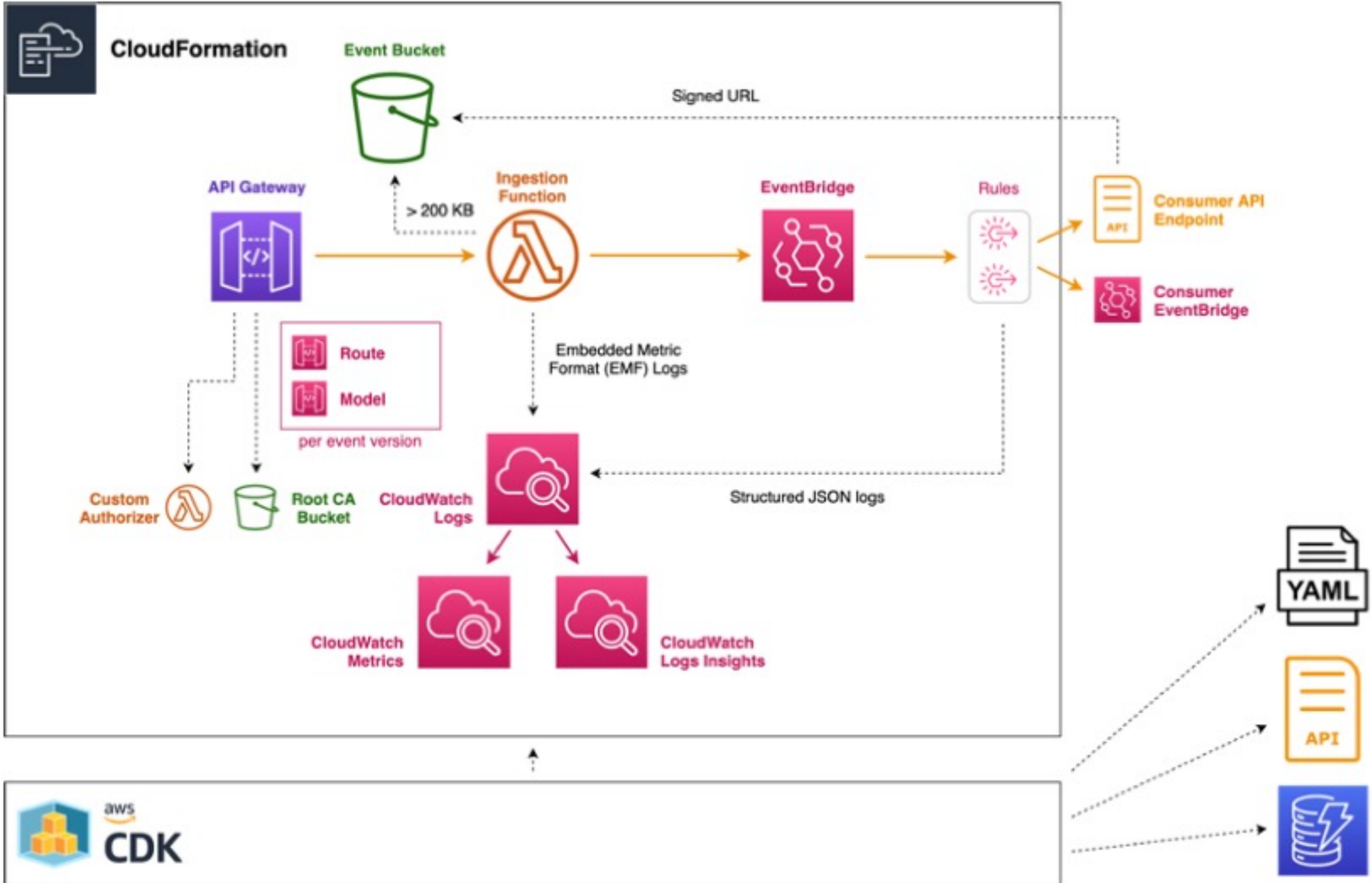
Infrastructure as code

The environment in a template



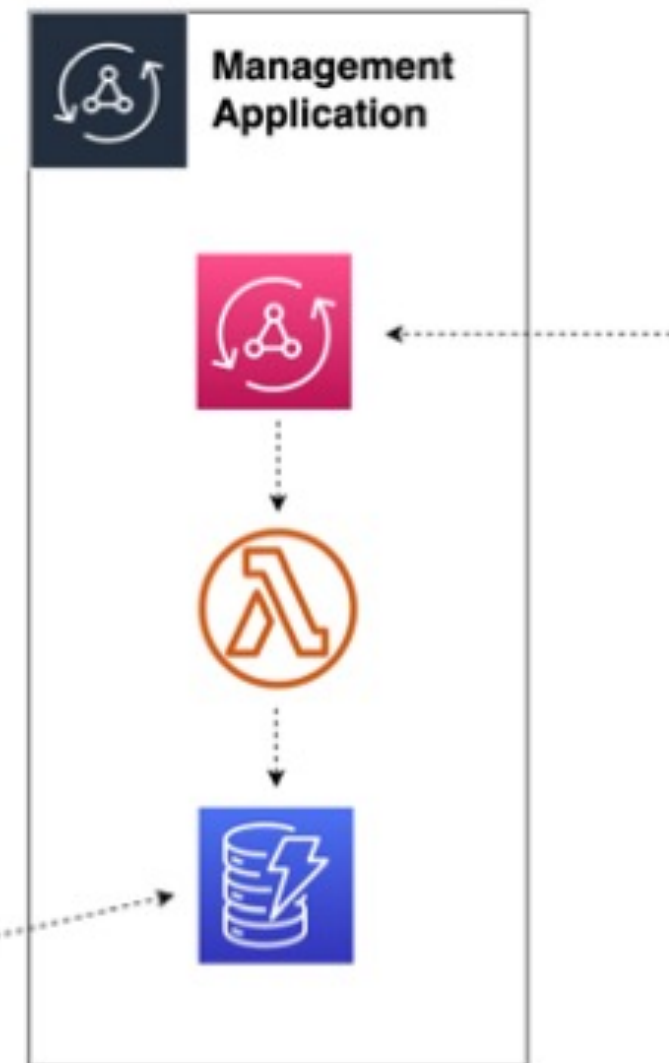
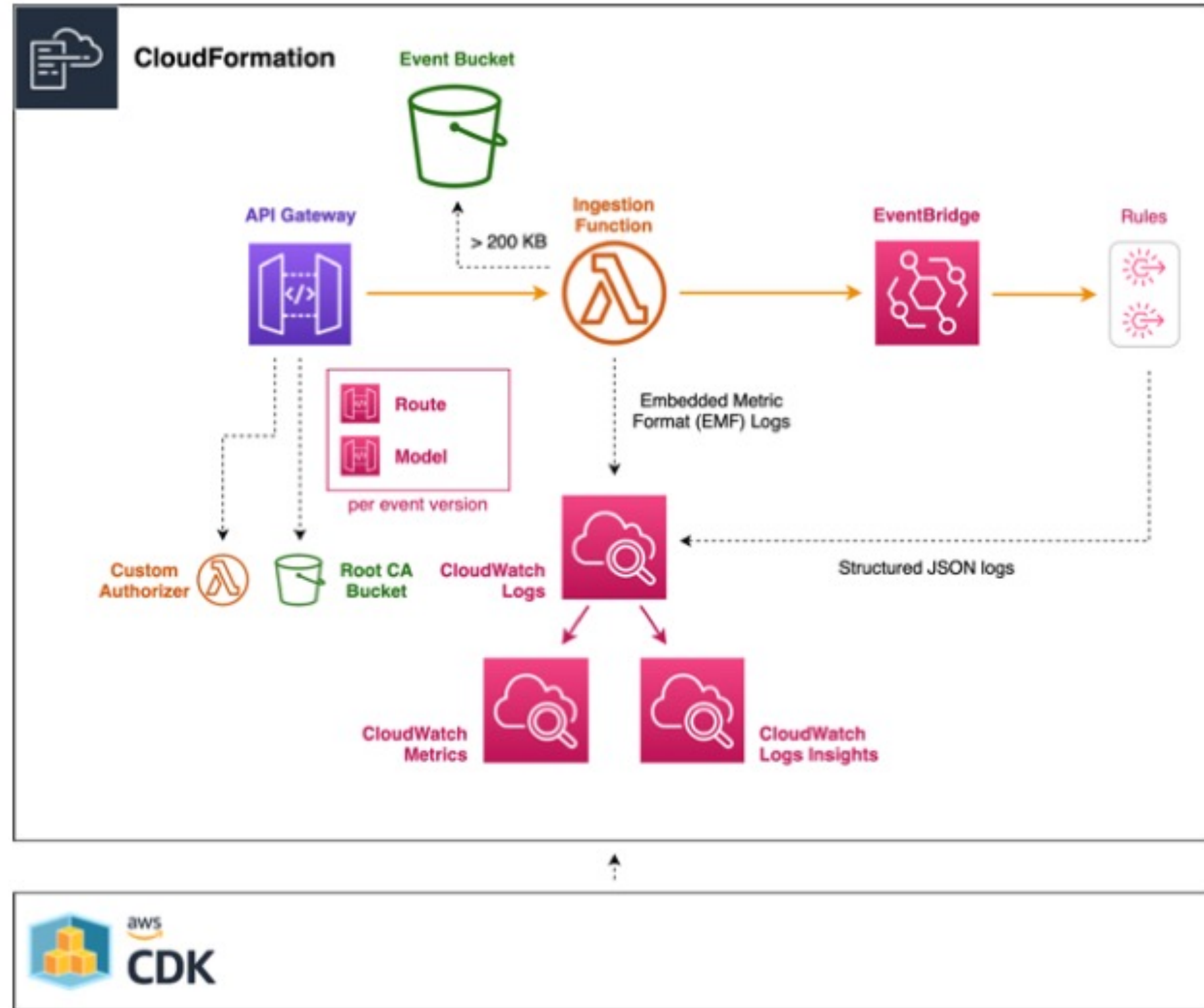
The Cloud Development Kit (CDK)

Generate templates using high-level languages



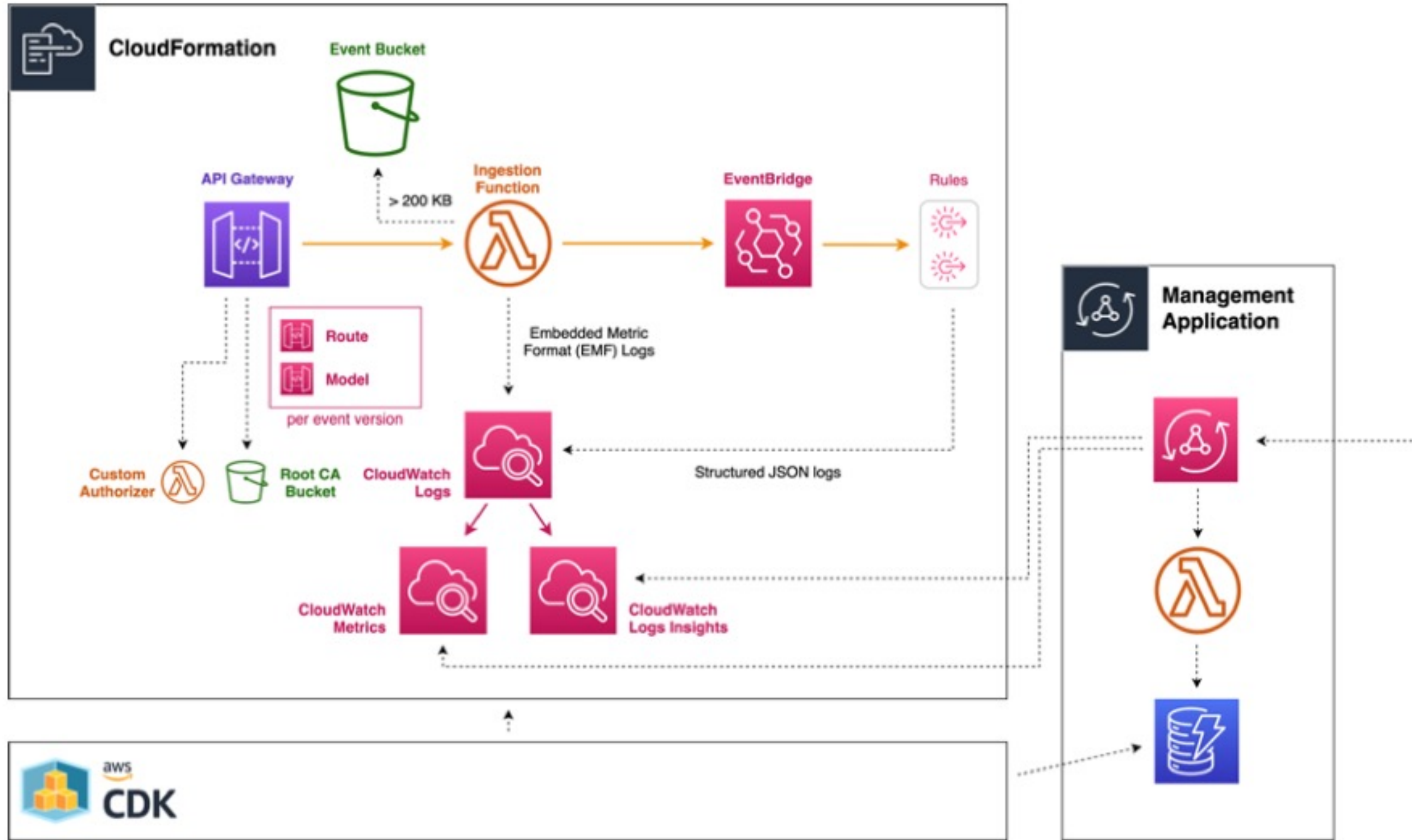
The Cloud Development Kit (CDK)

Generate templates using high-level languages



Retrieving stats and metrics

Direct interaction API – Event Broker





What's next?

Reduce latency

Reduce components

More AWS native integrations

Conclusion

AWS is like a box of Legos: it has the components, but you need to build it yourself

Thank you!



 @donkersgood

