Designing Payloads for Event-Driven Systems

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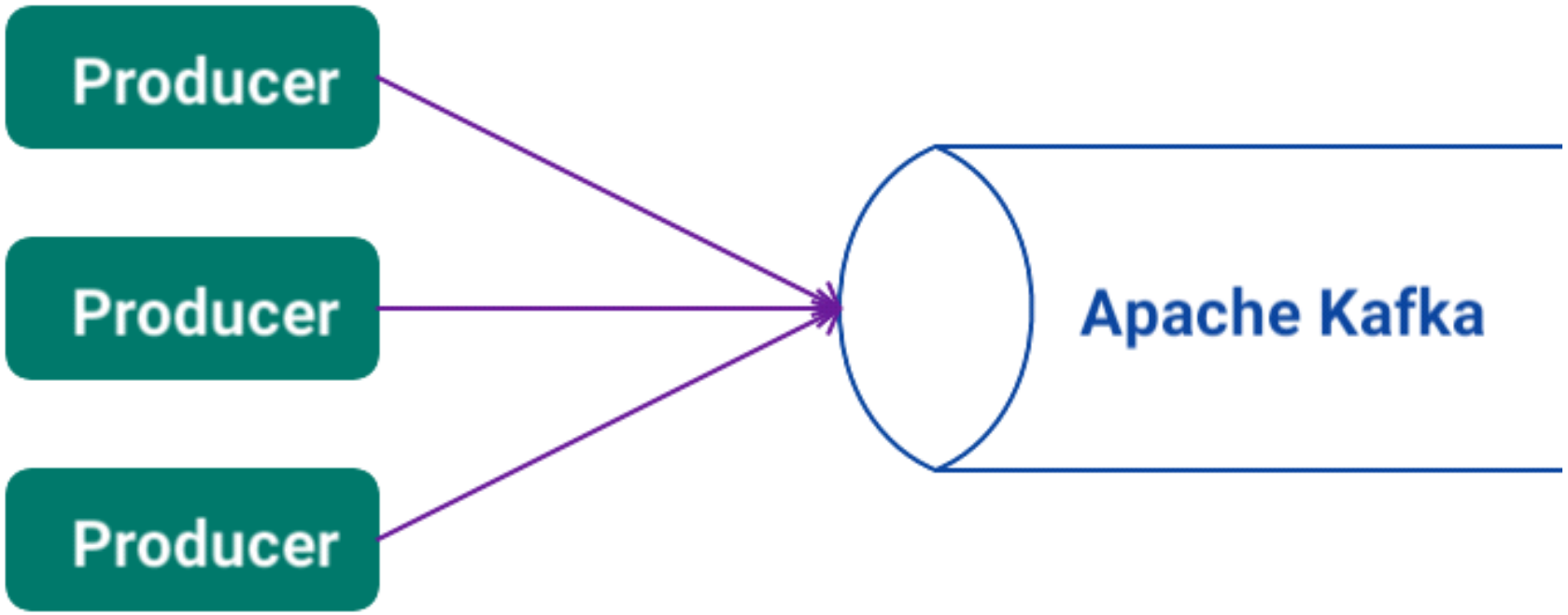
Event-Driven Systems



Apache Kafka

"Apache Kafka is an open-source distributed event streaming platform" - https://kafka.apache.org

- Storage designed for data streaming
- Messages are sent to "Topics"
- Data can be ... anything

Payloads

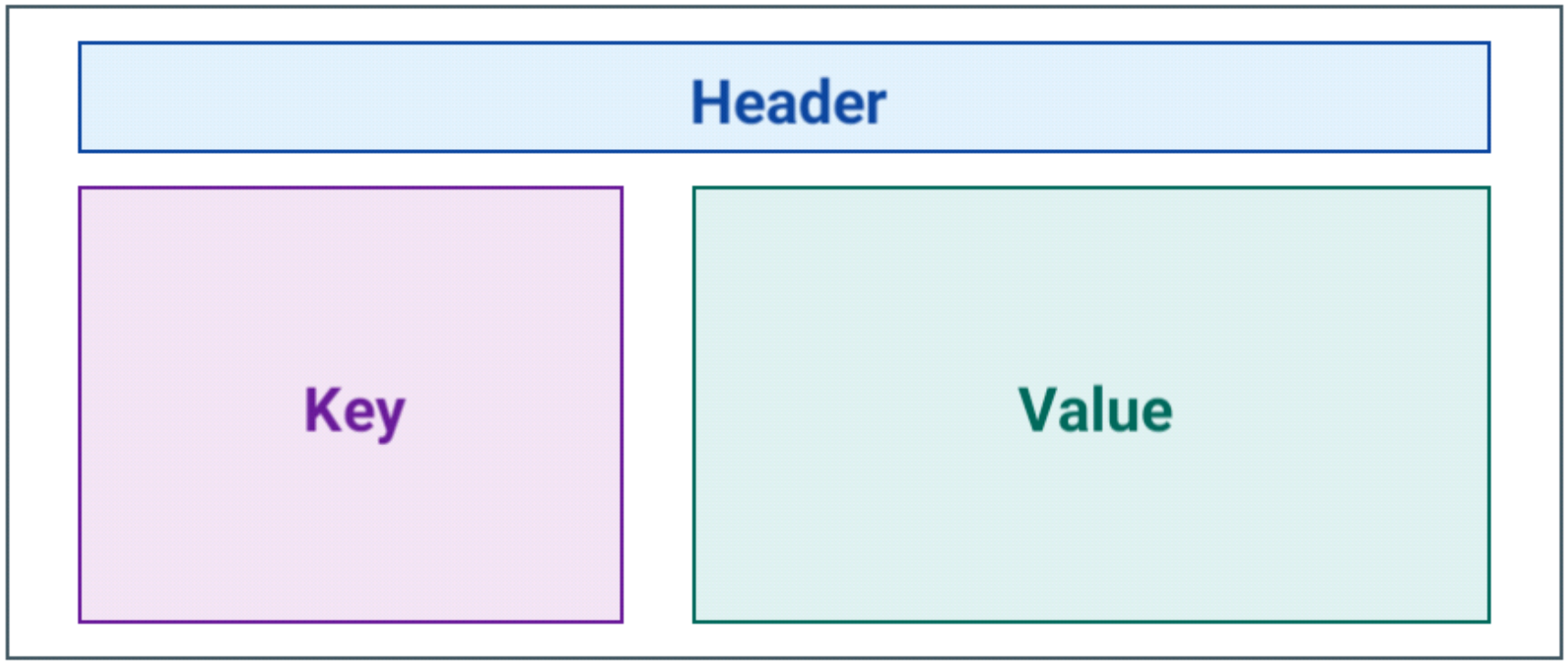
The messages the machines send between themselves

- Large string/binary data
- No rules
- (but I do have advice!)

Payload Design Tips

Apache Kafka Records

Use all the features of Apache Kafka's records



Header

- Metadata *about* the main payload
- Available without deserializing

```
source_type: sensor
trace_id: 1b15c98e-a52a-443d
```


Key

- Key usually sets the partition
- Can include multiple fields

```
{
  "type": "sensor_reading",
  "factory_id": 44891
}
```


Flat or Nested Structures?

- Always use a top level object structure (not an array)
- Group related fields together

```
{
  "stores_request_id": 10004352789,
  "parent_order": {
    "order_ref": 777289,
    "agent": "Mr Thing (1185)"
  },
  "bom": [
    {"part": "hinge_cup_sg7", "quantity": 18},
    {"part": "worktop_kit_sm", "quantity": 1},
    {"part": "softcls_norm2", "quantity": 9}
]}
```


More Data or Less Data?

- For small payloads, add the context fields
- Use lightweight representation rather than the full object
- Be careful of triggering many extra lookups
- Hypermedia can help

Example: GitHub Webhooks

(snippet from the push webhook)

```
"user": {
    "login": "Codertocat",
    "id": 21031067,
    "avatar_url": "https://avatars1.githubusercontent.com/u/21031067?v=4",
    "url": "https://api.github.com/users/Codertocat",
    "html_url": "https://github.com/Codertocat",
    "followers_url": "https://api.github.com/users/Codertocat/followers",
    "following_url": "https://api.github.com/users/Codertocat/following{/other_us
    "gists_url": "https://api.github.com/users/Codertocat/gists{/gist_id}",
    "starred_url": "https://api.github.com/users/Codertocat/starred{/owner}{/repo
    "organizations_url": "https://api.github.com/users/Codertocat/orgs",
    "repos_url": "https://api.github.com/users/Codertocat/repos",
    "type": "User",
  },
```


A Note on Timestamps

- Apache Kafka includes publish time in the header.
- Consider adding payload-level timestamps.
- Timestamps only as accurate as your clock!

Pick a standard, any standard!

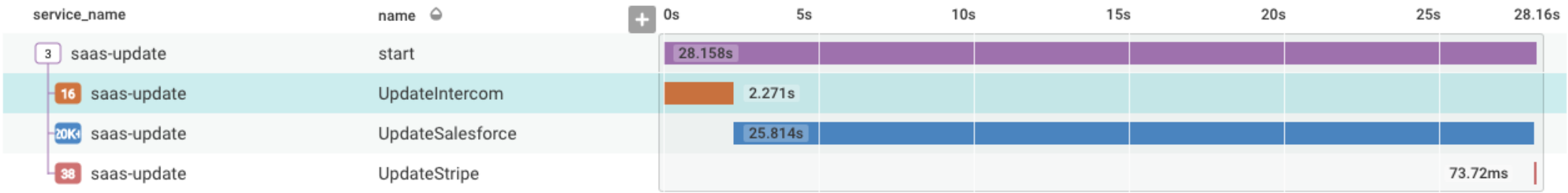
`1615910306` or `2021-05-11T10:58:26Z`

Event Tracing

Standards are great! https://opentelemetry.io

- Trace ID used by every event in the story
- Span ID in event, becomes Parent Span ID for child

(beautiful graph from honeycomb.io)



Using and Evolving Schemas

Data Formats

Some formats require schemas.

- **JSON**: text-based, few data types, schema optional
- **XML**: text-based, stronger typing, schema optional
- **Language-Specific Serialization**: (it depends!)
- **Protobuf**: binary format, handled by generated code
- **Avro**: binary format, schema required

Schemas

Schemas enforce payload structure

- Avro format requires a schema
  - message has schema version information
  - used to look up fieldnames and reconstruct paylod
- Schema Registry holds the schema versions for each topic

Evolving Schemas

- Aim for backwards-compatible changes
    - to rename: add the new field, keep the old one
    - safe to add optional fields
- Each change is a new version
- Avro supports aliases and default values

Example: Avro Schema

Avro schema example for sensor data

```
{
  "namespace": "io.aiven.example",
  "type": "record",
  "name": "MachineSensor",
  "fields": [
    {"name": "machine", "type": "string",
      "doc": "The machine whose sensor this is"},
    {"name": "sensor", "type": "string", "doc": "Which sensor was read"},
    {"name": "value", "type": "float", "doc": "Sensor reading"},
    {"name": "units", "type": "string", "doc": "Measurement units"}
  ]
}
```

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Describing Payloads

AsyncAPI for Apache Kafka

AsyncAPI describes event-driven architectures
https://www.asyncapi.com

We can describe the:

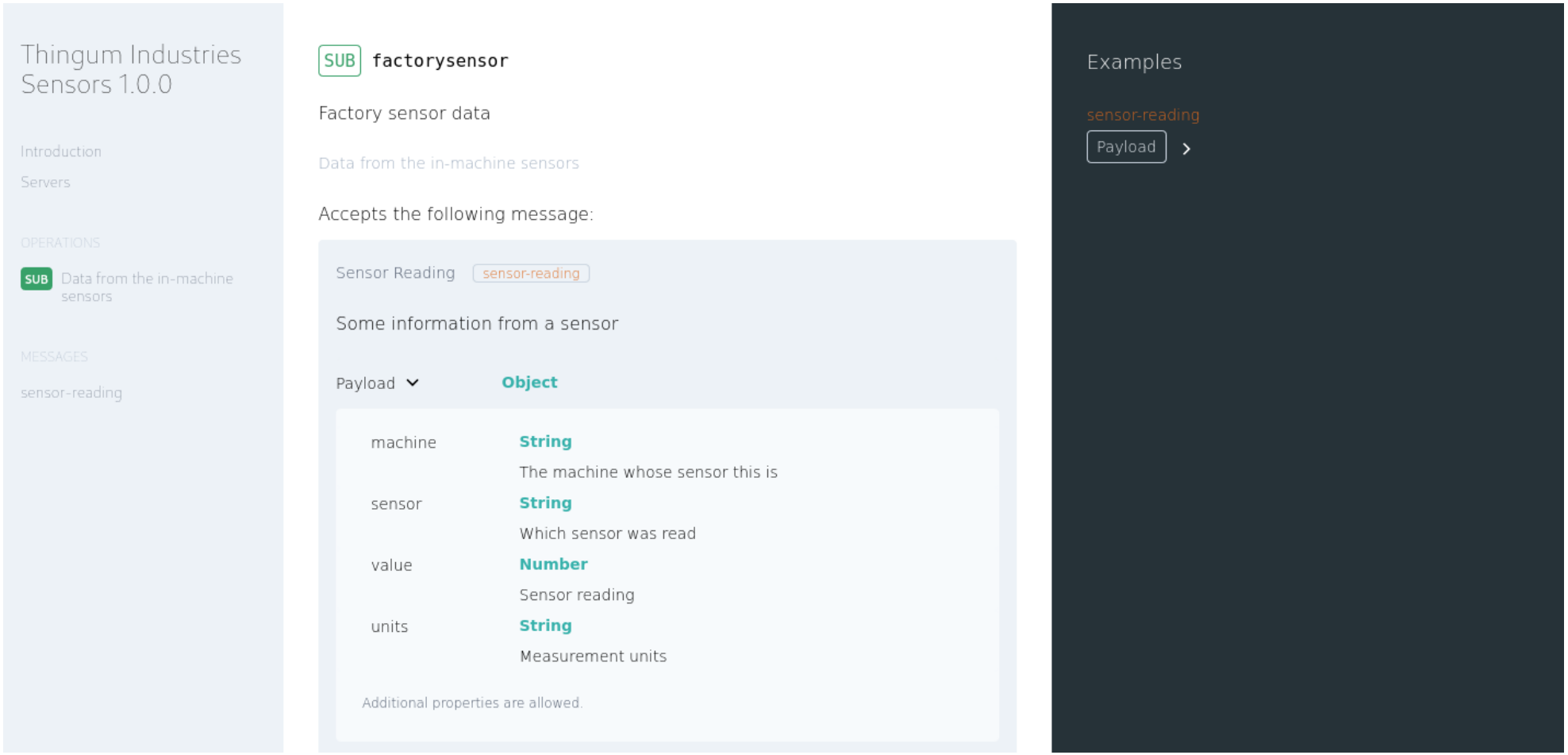
- brokers and auth
- topics
- payloads

Describing Payloads

The `channels` section of the AsyncAPI document

```yaml
factorysensor:
  subscribe:
    operationId: MachineSensor
    summary: Data from the in-machine sensors
    bindings:
      kafka:
        clientId:
          type: string
    message:
      name: sensor-reading
      title: Sensor Reading
      schemaFormat: "application/vnd.apache.avro;version=1.9.0"
      payload:
        $ref: machine_sensor.avsc
```


Documenting Payloads



Payloads and Event-Driven Systems

Design with intention, embrace standards

Resources

- Examples: https://github.com/aiven/thingum-industries
- Blog post: https://aiven.io/blog/tips-for-designing-payloads
- Aiven: https://aiven.io
- Karapace: https://karapace.io
- AsyncAPI: https://asyncapi.com