



HIVEMQ

MQTT Standards for Integrating **Edge** **AI** Systems

February 2024 Webinar

Speakers



Kudzai Manditereza

Developer Advocate - HiveMQ



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Marc Pous

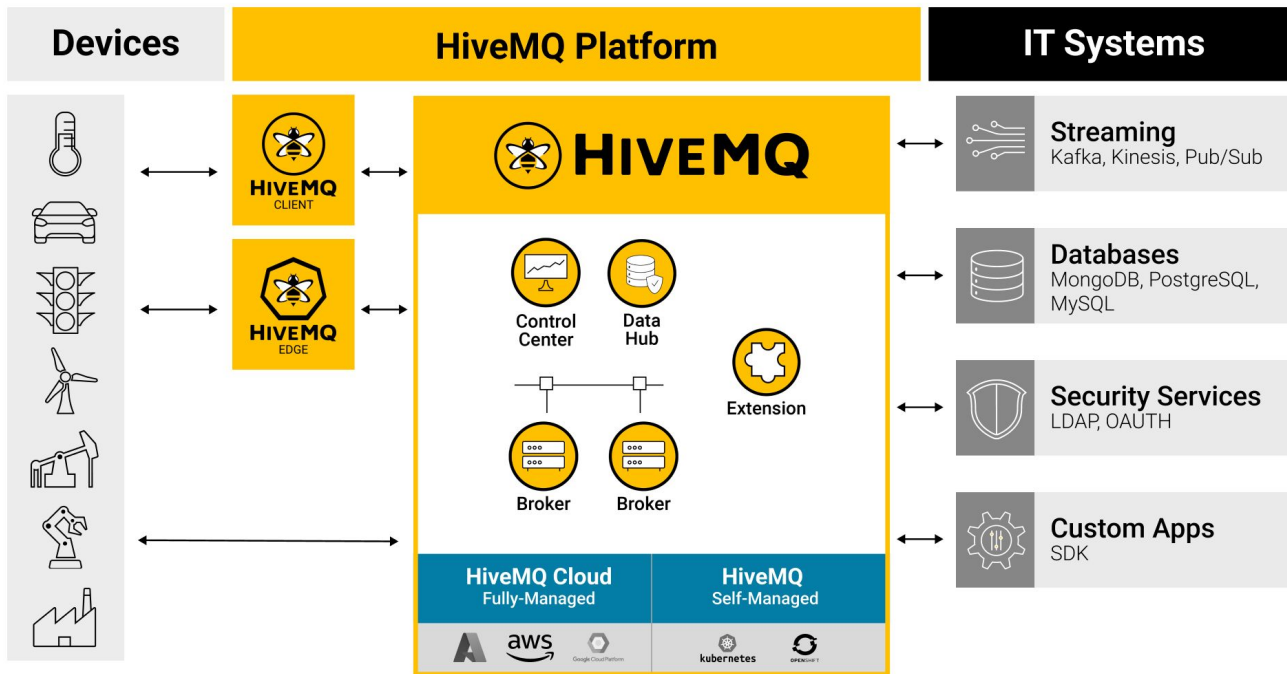
IoT Giant & Developer Advocate at balena.io



Agenda

- Introduction
- MQTT Standards for Integrating Edge AI Systems
- Demo 1 - Fully Integrated Pattern for Integrating Edge AI into MQTT
- Demo 2 - Unstructured Data Pattern for Integrating Edge AI into MQTT
- Q&A





Key Industries



Connected Car & Mobility



Manufacturing & Industrial Automation



Transportation & Logistics



Connected Assets & Products



Why Standards for **MQTT** in **Edge AI** are Critical?

**Interoperability and
Flexibility**

**Cost Savings and
Accelerated Deployment**

**Scalability and
Consistency**

**Innovation and
Community Engagement**



Contributors and Resources

The screenshot shows a GitHub repository page for 'modzy / edge-ai-standards-mqtt'. The browser address bar shows the URL: 'github.com/modzy/edge-ai-standards-mqtt/blob/main/Standards%20for%20Edge%20AI%20System%20Compatability%20with%20MQTT.md'. The repository name is 'modzy / edge-ai-standards-mqtt'. The navigation bar includes 'Code', 'Issues 7', 'Pull requests', 'Actions', 'Projects', 'Security', and 'Insights'. The left sidebar shows the file tree with folders 'diagrams', 'example-payloads', 'protos', and 'v2-planning', and files '.gitignore', 'README.md', and 'Standards for Edge AI System Co...'. The main content area shows the file 'Standards for Edge AI System Compatability with MQTT.md' by user 'bmunday3'. The file has 845 lines (646 loc) and is 39.4 KB. The file content is displayed in a preview mode, showing the title 'Edge AI System Compatability with MQTT' and sections for 'Design Standards' and 'Version History'. The 'Design Standards' section includes 'Version 1.0.0-alpha.1, 2023-12-08'. The 'Version History' section includes a table with columns 'Revision Number', 'Date', 'Author', and 'Description'. The table has one row: '1.0.0-alpha.1', 'TBD', 'Edge AI on MQTT Project Team', 'Alpha Release'. Below the table, it lists 'Edge AI on MQTT Project Team members:' followed by a bulleted list of names and organizations.

github.com/modzy/edge-ai-standards-mqtt/blob/main/Standards%20for%20Edge%20AI%20System%20Compatability%20with%20MQTT.md

modzy / edge-ai-standards-mqtt

<> Code Issues 7 Pull requests Actions Projects Security Insights

Files

main

Go to file

- diagrams
- example-payloads
- protos
- v2-planning
- .gitignore
- README.md
- Standards for Edge AI System Co...

edge-ai-standards-mqtt / Standards for Edge AI System Compatability with MQTT.md

bmunday3 Update Standards for Edge AI System Compatability with MQTT.md

Preview Code Blame 845 Lines (646 loc) · 39.4 KB

Edge AI System Compatability with MQTT

Design Standards

Version 1.0.0-alpha.1, 2023-12-08

Version History

Revision Number	Date	Author	Description
1.0.0-alpha.1	TBD	Edge AI on MQTT Project Team	Alpha Release

Edge AI on MQTT Project Team members:

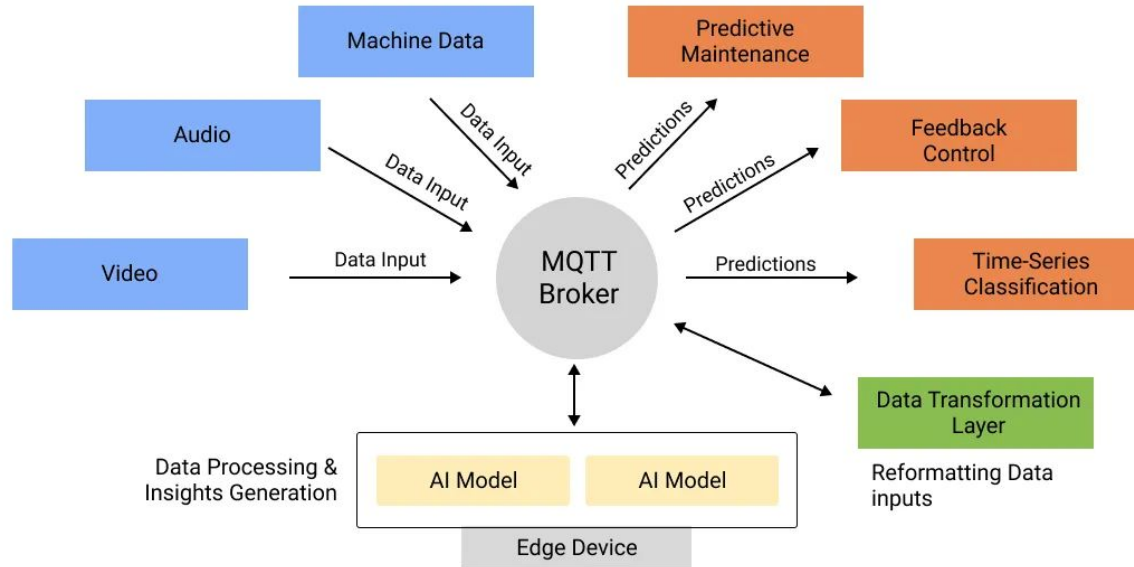
- Kudzai Manditereza, HiveMQ
- Seth Clark, Modzy
- Bradley Munday, Modzy
- Nathan Mellis, Modzy
- Joshua Coenen, Oshkosh Corporation
- Brent Wassell, Oshkosh Corporation

Common Patterns for Edge AI on MQTT

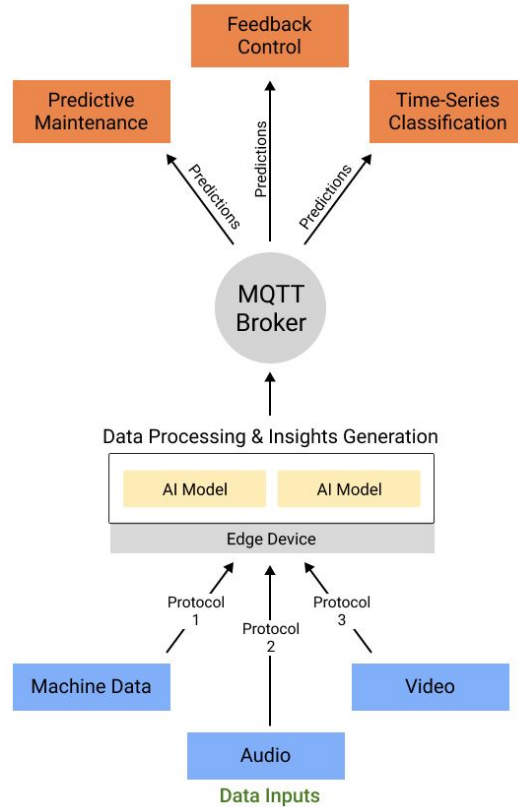
	MODEL INPUT: MQTT TOPIC(S) [SUBSCRIBE]	MODEL INPUT: OTHER PROTOCOLS, DIRECT SENSOR DATA, ETC.
Model Output: MQTT topic(s) [Publish]	The “Fully-integrated” pattern	The “Unstructured Data” pattern
Model Output: Other systems lacking MQTT support	The “Ambassador” pattern	Not covered by this standard



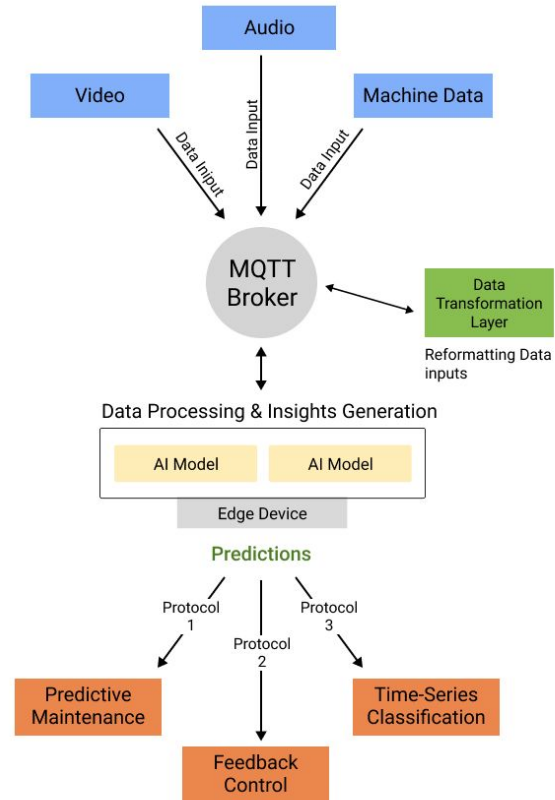
The Fully-Integrated Pattern



The Unstructured Data Pattern



The Ambassador Pattern



Guidelines for MQTT Topic Structure Design



Topic Namespaces for Edge AI

- **Raw Data Namespace** – hold raw sensor data as it is captured. AI model input in the ambassador and fully-connected patterns.
- **Inference Namespace** – hold metrics directly generated by a machine-learning model; do not necessarily provide business value on their own.
- **Insight Namespace** – metrics with innate business value that are composed, calculated, or otherwise built on top of individual inference metrics.



Raw Data namespace Example

```
site/area/line/cell/milling_machine/raw
```

Messages to this topic might include the following metrics:

- Air temperature (K)
- Process temperature (K)
- Rotational speed (rpm)
- Torque (Nm)
- Tool wear (min)



Inference Namespace Example

site/area/line/cell/milling_machine/Machine Failure Prediction/0.0.1/inference

Model name

Messages to this topic might include the following metrics:

- Failure Likelihood (with confidence score measured from 0 to 1)
- Non-Failure Likelihood (with confidence score measured from 0 to 1)

Model version

Insight Namespace Example

site/area/line/cell/milling_machine/Machine Failure Prediction/0.0.1/insight

Model name

Messages to this topic might include the following metric:

- Maintenance Required: Published anytime the inference/failure score is larger than the inference/no_failure score, indicating that the Machine Failure Prediction model has found the milling machine to be likely to fail sometime soon.

Model version

Flat MQTT Topic Structure

```
[Customized MQTT topic structure]/Edge_DeviceID + /model_name/model_version/inference
```

- **[Customized MQTT topic structure]** – Any existing top-level topic structure for a flat MQTT namespace
- **Edge_DeviceID** – A unique identifier of some kind pointing to the device's location upon which an AI/ML model is running.
- **model_name** – The name of a specific AI/ML model.
- **model_version** – Version of AI/ML model
- **inference** – The namespace element that will contain any messages generated by this version of this model.



MQTT Sparkplug Topic Structure

```
namespace/group_id/message_type/edge_node_id/[device_id]
```

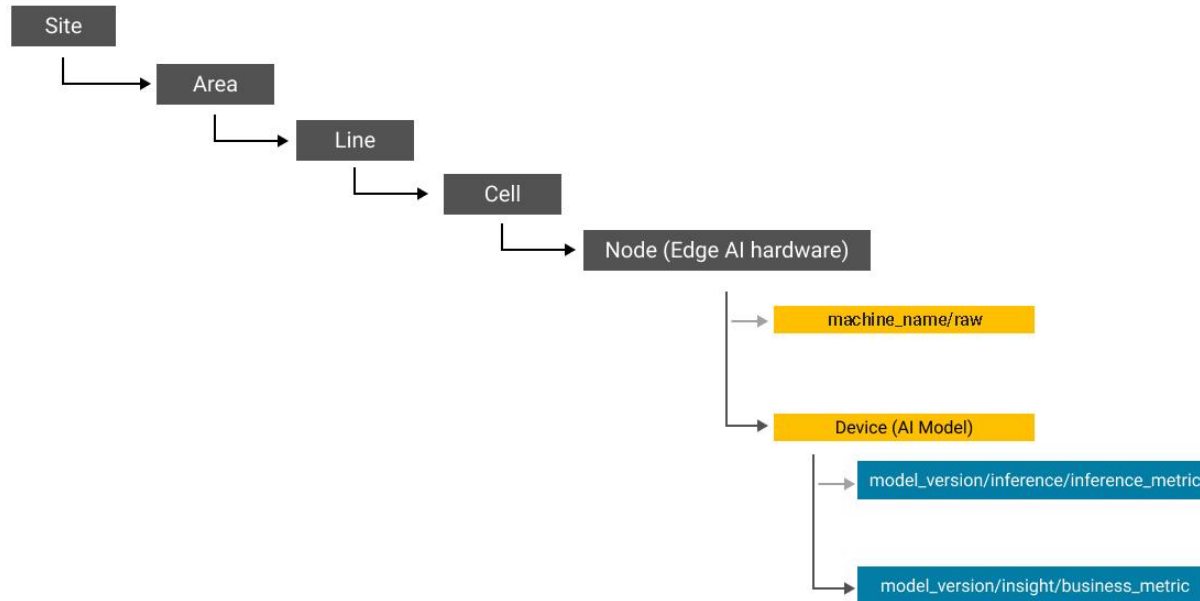
- **namespace** – Sparkplug B root namespace
- **group_id** – Recommends using a concatenation of the ISA-95 format of site:area:line:cell
- **message_type** – Edge AI apps will primarily publish results using the DDATA message type, but other message types supported.
- **edge_node_id** – Identity of the computing hardware that is running models or communicates to the MQTT broker.
- **device_id** – Identity of the AI/ML model that is generating inferences.

ip_camera_1,
edge_server_1,
machinery_1

Machine Failure Prediction



Unified namespace Snapshot



Guidelines for MQTT Payload Structure Design



Structured Payloads for **Edge AI Outputs**

- **Predictions** – regarding potential future events.
- **Structured insights** – (Classification or Detection) that are extracted from unstructured sources like audio and video.



Recommended Formatting

- **Protobuf** – should be used whenever possible for its efficiency and future-proofing qualities
- **JSON** – Should be used for compatibility with non-protobuf capable systems.



Flat MQTT Payload Template

```
{
  "identifier": "inference-2HYZh8a4jtFi3xFc4e3TWRmclff",
  "model": {
    "identifier": "brzrip6cxk",
    "version": "0.0.1",
    "name": "Machine Failure Prediction"
  },
  "tags": {
    "sourceTopic": "site:area:line:cell/node/device/raw/sensor_name",
    "sourceMessageID": "abcd1234",
    "inputSizeInBytes": 32,
    "inputSha256Digest": "be01ef104fb88fd151132733e746fe29b997348bf34be875e25ba48c0d7436ca"
  },
  "resultType": "classPredictions",
  "result": {
    "classPredictions": [
      {
        "className": "no_failure",
        "score": 0.974
      },
      {
        "className": "failure",
        "score": 0.026
      }
    ]
  },
  "explanation": {
  }
}
```



MQTT Sparkplug DBIRTH Payload

```
{
  "timestamp":1486144502122,
  "metrics":[
    {
      "name":"0.0.1/inference/identifier",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"inference-2HYZh8a4jtFi3xFc4e3TWRmclff"
    },
    {
      "name":"0.0.1/inference/model/identifier",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"brzrip6cxk"
    },
    {
      "name":"0.0.1/inference/model/version",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"0.0.1"
    },
    {
      "name":"0.0.1/inference/model/name",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"Machine Failure Prediction"
    },
    {
      "name":"0.0.1/inference/tags/sourceTopic",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"site:area:line:cell/node/device/raw/sensor_name"
    }
  ]
}
```



MQTT Sparkplug Host Application

Metric		Value	Data Type
Site:Area:Line:Cell	/group_id		
↳Edge Node ID	/edge_node_id		
↳Edge Node Device ID	/device_id		
↳Inference			
↳identifier		inference-2HYZh8a4jtFi3xFc4e3TWRmclff	String
↳model			
↳identifier		brzrip6cxk	String
↳version		0.0.1	String
↳name		Machine Failure Prediction	String
↳tags			
↳sourceTopic		site:area:line:cell/node/device/raw/sensor_name	String
↳dataType		abcd1234	String
↳inputSizeInBytes		32	Integer
↳inputSha256Digest		be01ef104fb88fd1...	String
↳resultType		classPredictions	String
↳result		{ "classPredictions": [{"className": "no_ failure", "score":0.974}, {"className": "failure", "score":0.026}] }	String

MQTT Sparkplug DDATA Payload

```
{
  "timestamp":1486144502122,
  "metrics":[
    {
      "name":"0.0.1/inference/identifier",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"inference-2HYZh8a4jtFi3xFc4e3TWRmclff"
    },
    {
      "name":"0.0.1/inference/tags/sourceTopic",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"site:area:line:cell/node/device/raw/sensor_name"
    },
    {
      "name":"0.0.1/inference/tags/sourceMessageID",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"abcd1234"
    },
    {
      "name":"0.0.1/inference/tags/inputSizeInBytes",
      "timestamp":1486144502122,
      "dataType":"integer",
      "value":32
    },
    {
      "name":"0.0.1/inference/tags/inputSha256Digest",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"2o3nvi30fh4fb88fd120932733e746fe29b99732ifhi34be875e25ba48c0d7436ca"
    },
    {
      "name":"0.0.1/inference/result",
      "timestamp":1486144502122,
      "dataType":"string",
      "value":"{"classPredictions":[{"className":"no_failure","score":0.087},{"className":"failure","score":0.913}]}
    }
  ],
  "seq":1
}
```

Edge AI/ML Model Result Formats



Classification

Classification assigns a class to an individual piece of data. This might be useful for classifying an individual image, audio snippet, video frame, or a piece of machine data.

```
{  
  "classPredictions": [  
    {  
      "class": "className",  
      "score": 1.0  
    }  
  ]  
}
```

Multi-Classification

Similar to classification models, but used when model outputs are grouped into more than two distinct classes.

```
{
  "classifications": [
    {
      "classPredictions": [
        {
          "class": "className",
          "score": 1.0
        }
      ]
    }
  ]
}
```

Object Detection

Object detection is used to identify regions of interest within an image or video that are defined by a bounding box. Bounding boxes can have one or more classifications, and images can have one or more bounding boxes.

```
{
  "detections": [
    {
      "class": "className",
      "score": 1.0,
      "boundingBox": {
        "x": 100,
        "y": 200,
        "width": 300,
        "height": 400
      }
    }
  ]
}
```

Named Entity Recognition

Named entity recognition is used to identify unique entities, such as names, organizations, and locations, within a larger corpus of text.

```
{
  "entities": [
    {
      "entityGroup": "B-LOC",
      "score": 1.0,
      "textSpan": {
        "start": 0,
        "end": 5,
        "text": "Paris is a city."
      }
    }
  ]
}
```

Demos

Fully Integrated Pattern - Marc Pous, balena.io

Unstructured Data Pattern - Magnus McCune, [HiveMQ](https://hiveMQ.com)

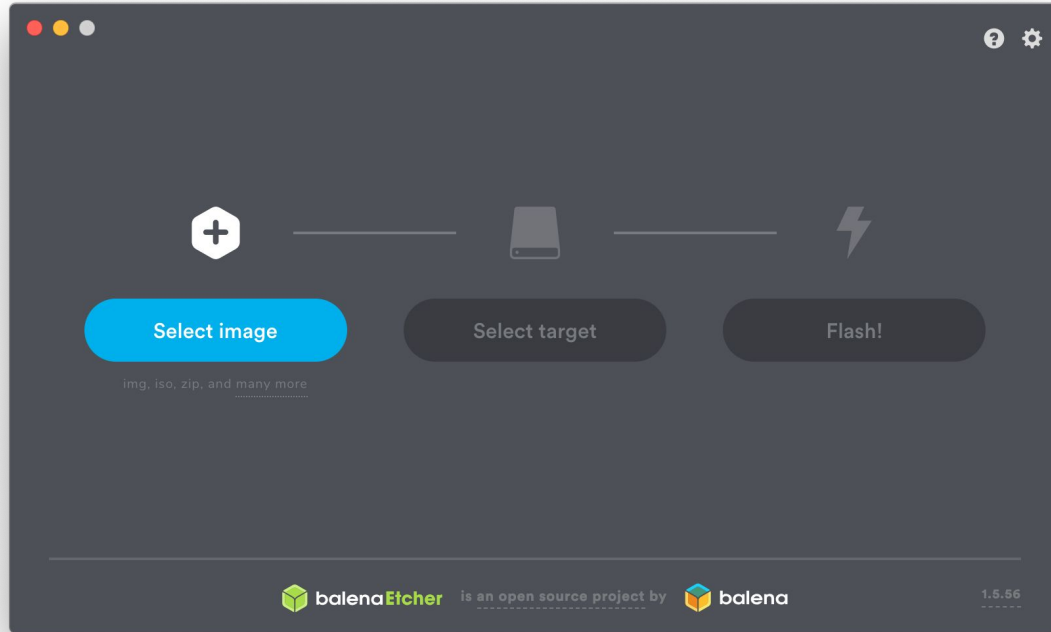


Demo 1: The Fully-Integrated Pattern with **HiveMQ** **Edge AI balena**

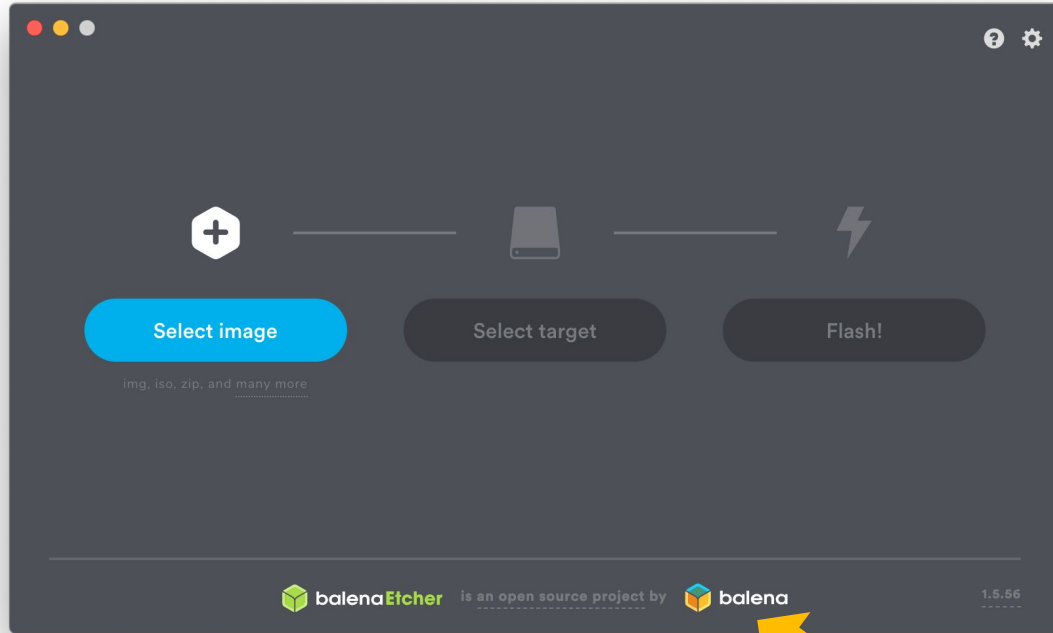
Marc Pous
IoT Giant & Developer Advocate



Anyone?



Anyone?



What is balena?



A secure container-based technology stack that enables you to **develop**, **deploy**, **manage** and **scale** large fleets of IoT Linux devices at any stage.

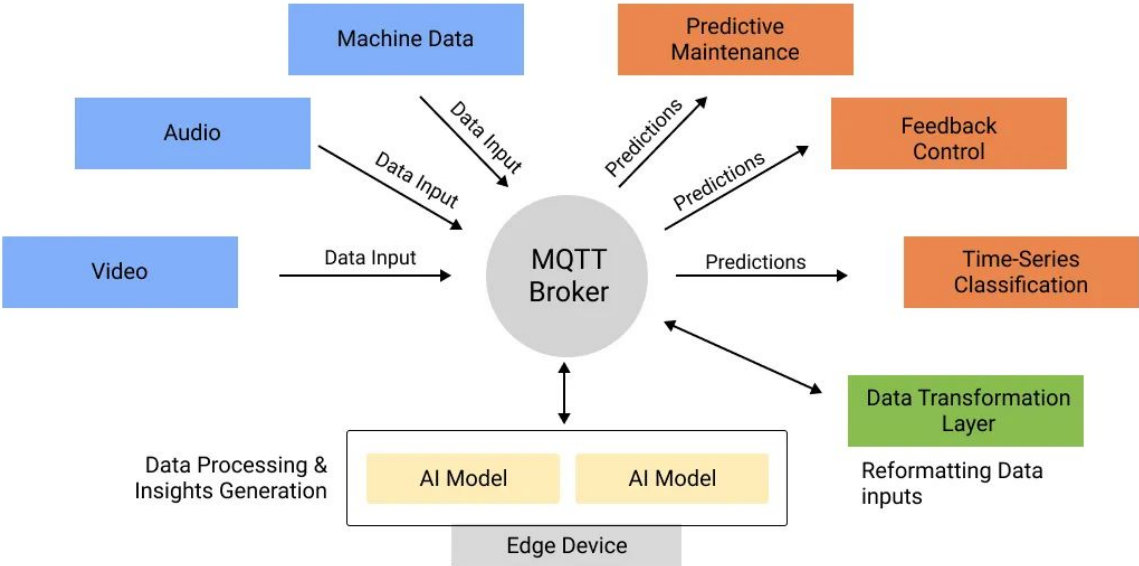
What is balena?

The screenshot shows the BalenaCloud dashboard for a device named "mean-rainfall". The interface is divided into several sections:

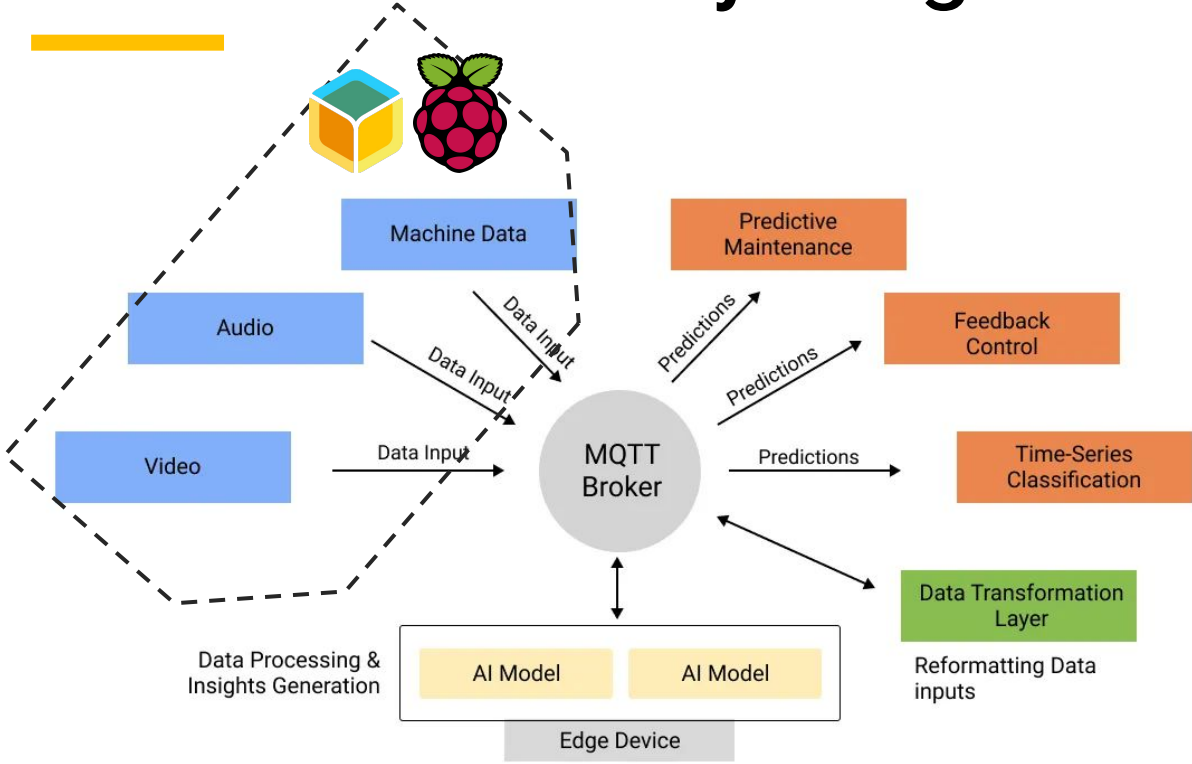
- Header:** "balena dashboard | mean-rainfall" and the URL "https://dashboard.balena-cloud.com/devices/79274f1c47d09ad5888d3d092a01e049".
- Left Sidebar:** Navigation menu with "balenaCloud" logo, "Organizations", "Marc Pous", "Fleets", "ming-noderedCon22", "Devices", "mean-rainfall", "Summary", "Device Variables", "Device Configuration", "Actions", "Settings", "Diagnostics", and "Location".
- Device Overview:** "mean-rainfall" (Actions dropdown).
 - STATUS: Online
 - UID: 79274f1
 - TYPE: Balena Fin (CM3)
 - ONLINE FOR: 5 days
 - HOST OS VERSION: balenaOS 2.83.21+rev1
 - SUPERVISOR VERSION: 12.10.3
 - CURRENT RELEASE: 4e72605
 - TARGET RELEASE: 4e72605
 - LOCAL IP ADDRESS: 10.136.218.127, 192.168.1.34
 - PUBLIC IP ADDRESS: 79.153.223.19
 - MAC ADDRESS: B8:27:EB:F8:4F:09, AC:3F:A4:EB:21:EC, AC:3F:A4:EB:20:EC
 - TAGS: No tags configured yet
 - PUBLIC DEVICE URL: [Link]
- System Metrics:** CPU (~42%), Temperature (-50C), Memory (350 MB/970 MB), Storage (1.0 GB/6.4 GB).
- Logs:** Searchable log entries for influxdb and grafana. Example entries: "influxdb [httpd] 172.18.0.2 - - [07/Oct/2022:02:35:02 +0000] \"GET /query?db=balena&show=field+keys HTTP/1.1\" 200 70 \"-\" \"Python-urllib/3.7\" a549f3ed-45e8-11ed-8075-0242ac120003 1 159".
- SERVICES:** Table of running services.

Service	Status	Release
grafana	Running	4e72605
influxdb	Running	4e72605
mqtt	Running	4e72605
node-red	Running	4e72605
wifi-connect	Running	4e72605
- Terminal:** "Select a target" dropdown and "Start terminal session" button.

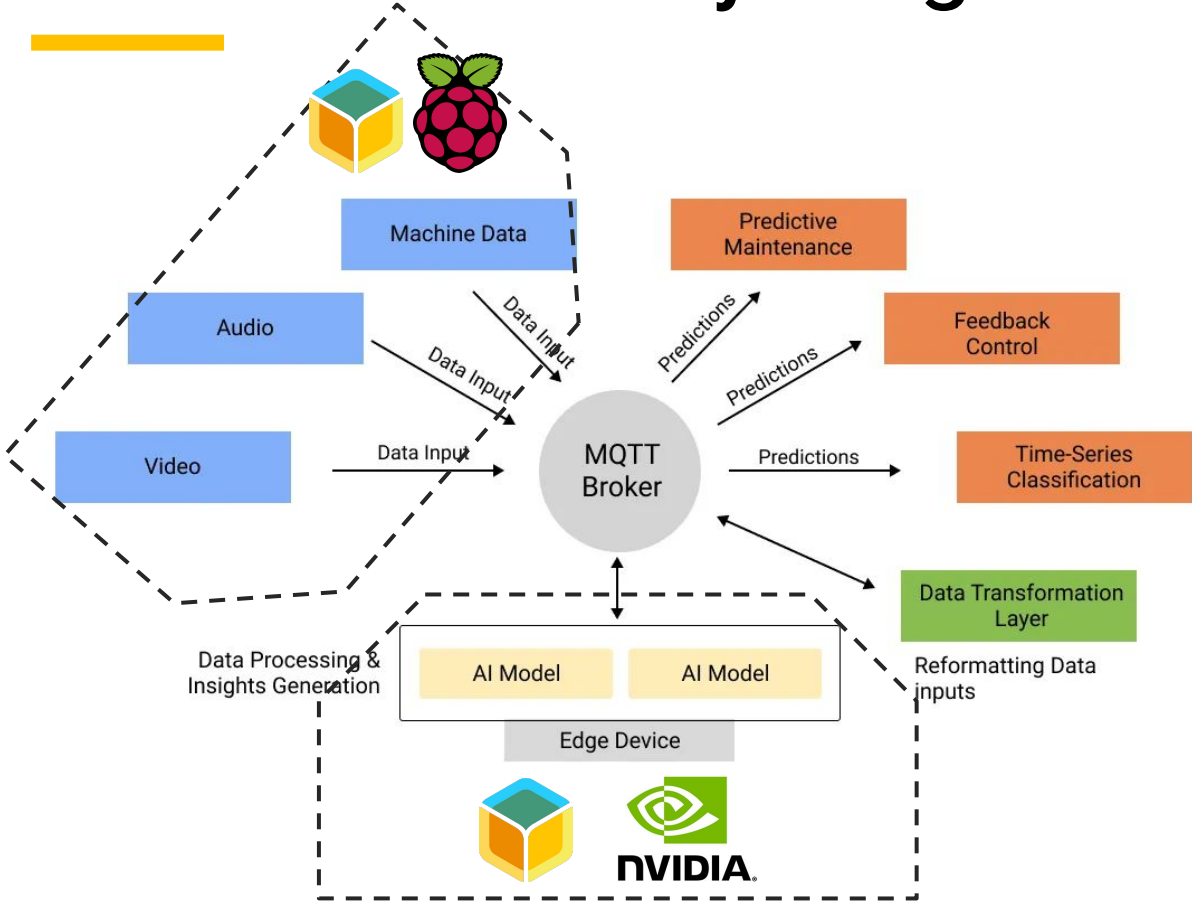
balena Demo - Fully-Integrated Pattern



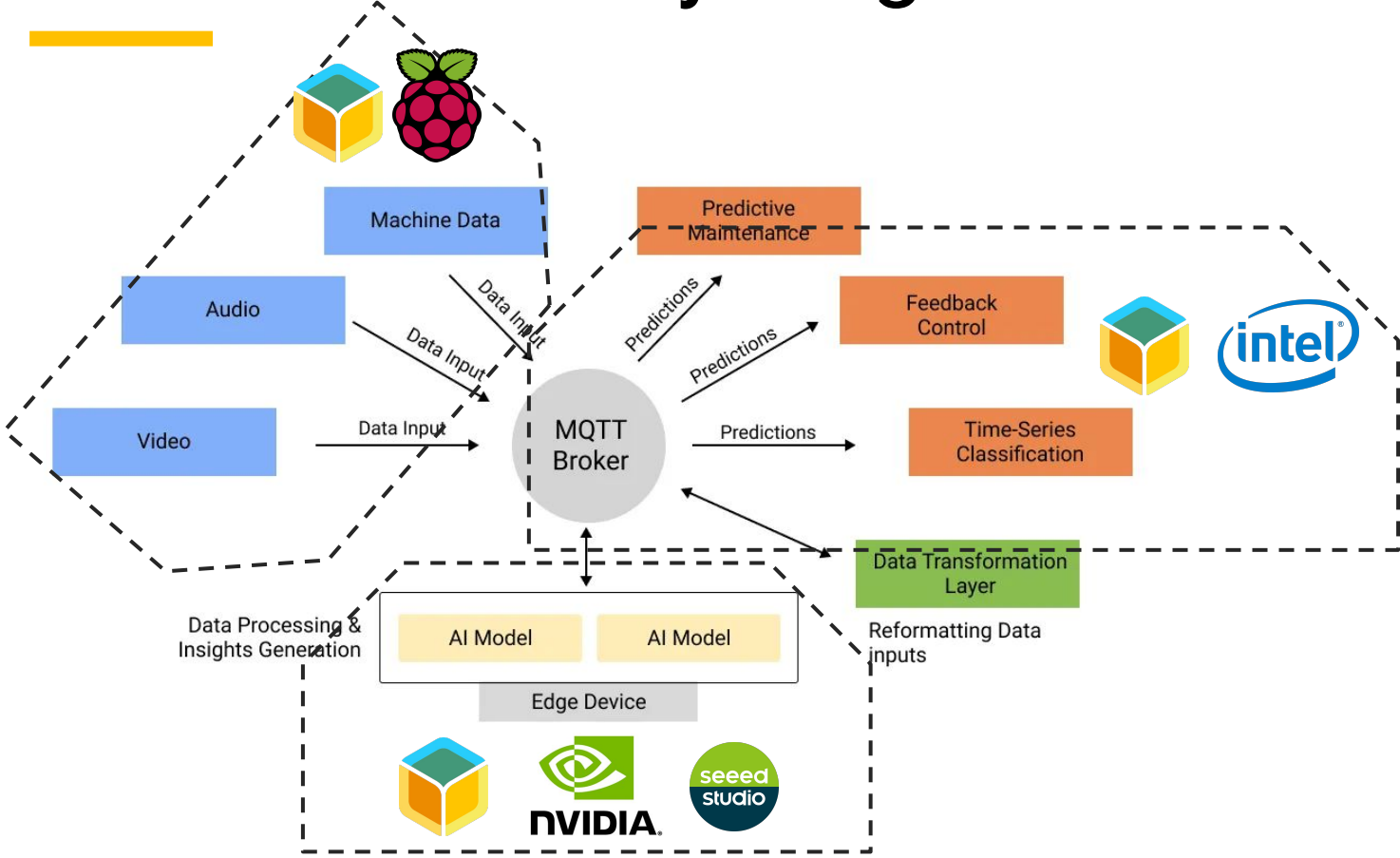
balena Demo - Fully-Integrated Pattern



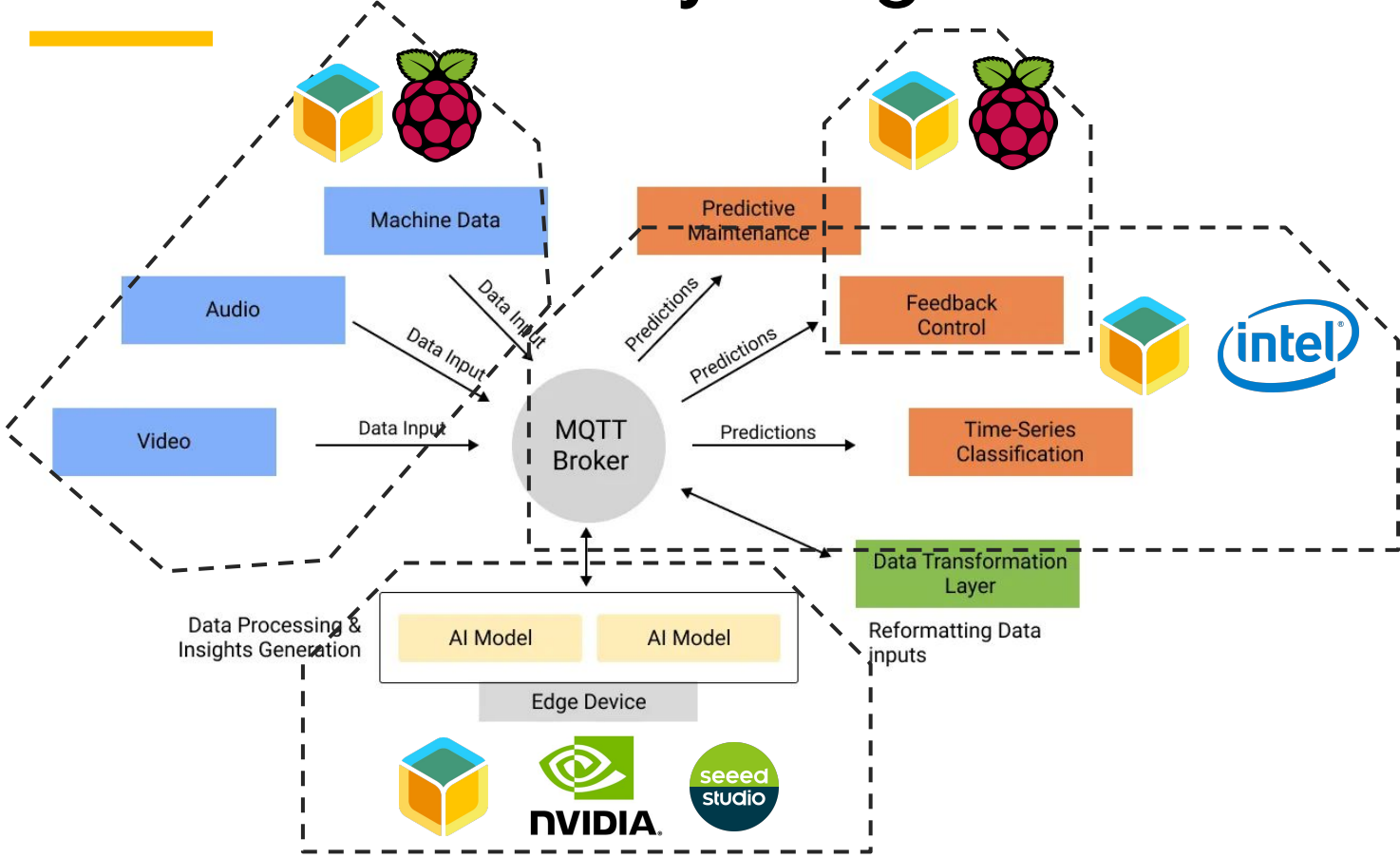
balena Demo - Fully-Integrated Pattern



balena Demo - Fully-Integrated Pattern



balena Demo - Fully-Integrated Pattern



balena Demo

- **balenaCam MQTT** – Raspberry Pi Camera publishing over MQTT.
<https://github.com/mpous/balena-cam-mqtt>
- **MING broker** – Intel NUC with the MING stack.
<https://github.com/mpous/ming>
- **Seed Studio ReComputer J4012 / NVIDIA Jetson Orin 16GB** – Edge AI device with TensorRT AI model to recognize real-time images.
<https://github.com/mpous/J4012-pytorch-mqtt>

Let me show you more ...

dashboard.balena-cloud.com/devices/f2b4b46175e94bad080dd16af02e89ab

Getting Started Docs Roadmap Forums Status balenaHub Marc Pous

Pi 4 Barcelona

Actions

FLEET
marc6/balena-can-mqtt

STATUS
Online

UUID
F2b4b46

TYPE
Raspberry Pi 4 (using 64bit OS)

ONLINE FOR
41 minutes

HOST OS VERSION
balenaOS 4.0.26+rev1

OS VARIANT
development

SUPERVISOR VERSION
14.13.4

CURRENT RELEASE
0.2.10+rev7

TARGET RELEASE
0.2.10+rev7

SUPPORT ACCESS
Off

IS ACTIVE
On

PUBLIC DEVICE URL
Off On

LOCAL IP ADDRESS
192.168.1.163

PUBLIC IP ADDRESS
181.41.128.238

MAC ADDRESS
D8:3A:DD:2A:08:B6 D8:3A:DD:2A:08:B7

LOCAL IP ADDRESS
192.168.1.163

PUBLIC IP ADDRESS
181.41.128.238

MAC ADDRESS
D8:3A:DD:2A:08:B6 D8:3A:DD:2A:08:B7

TAGS (0)
No tags configured yet

NOTES
Add device notes

CPU -3% **Temperature** -40C

Memory 290 MB/7.6 GB **Storage** 1.3 GB/28.3 GB

Logs UTC Timestamps

```

2024-02-27T16:45:45+01:00 balena-can-mqtt Convert the image to JPEG format
2024-02-27T16:45:45+01:00 balena-can-mqtt Return the image as a bytes object
2024-02-27T16:45:45+01:00 balena-can-mqtt Send MQTT Image...
2024-02-27T16:45:45+01:00 balena-can-mqtt 192.168.1.156
2024-02-27T16:45:45+01:00 balena-can-mqtt 1883
2024-02-27T16:45:45+01:00 balena-can-mqtt balena/site/area/line/cell/camera/raw
2024-02-27T16:45:45+01:00 balena-can-mqtt python-mqtt-1709048745
2024-02-27T16:45:45+01:00 balena-can-mqtt 192.168.1.156
2024-02-27T16:45:46+01:00 balena-can-mqtt Trying to Capture the image...
2024-02-27T16:45:46+01:00 balena-can-mqtt Start the webcam capture...
2024-02-27T16:45:47+01:00 balena-can-mqtt Convert the image to JPEG format
2024-02-27T16:45:47+01:00 balena-can-mqtt Return the image as a bytes object
2024-02-27T16:45:47+01:00 balena-can-mqtt Send MQTT Image...

```

Terminal

Select a target

Start terminal session

Service	Status	Release
balena-can-mqtt	Running	0.2.10+rev7

Changelog v23.3.20

dashboard.balena-cloud.com/devices/97f248abce6b966a84d81ffb68ceb16f

Getting Started Docs Roadmap Forums Status balenaHub Marc Pous

x86 i5 Barcelona

Actions

FLEET
marc6/hivemq4-ming

STATUS
Online

UUID
97f248a

TYPE
Generic x86_64 (GPT)

ONLINE FOR
2 days

HOST OS VERSION
balenaOS 2.115.1+rev1

OS VARIANT
development

SUPERVISOR VERSION
14.11.1

CURRENT RELEASE
0.0.0+rev1

TARGET RELEASE
0.0.0+rev1

SUPPORT ACCESS
Off

IS ACTIVE
On

PUBLIC DEVICE URL
Off On

LOCAL IP ADDRESS
192.168.1.156

PUBLIC IP ADDRESS
181.41.128.238

MAC ADDRESS
1C:69:7A:0F:02:02 4C:1D:96:60:08:00

TAGS (0)
No tags configured yet

NOTES
Add device notes

CPU -3% **Temperature** -39C

Memory 2.7 GB/15.5 GB **Storage** 4.6 GB/225.4 GB

Logs UTC Timestamps

```

2024-02-27T16:40:12+01:00 grafana INFO [02-27[15:40:12] Update check succeeded logger=grafana.upta
te_checker duration=91.965218ms
2024-02-27T16:40:12+01:00 grafana INFO [02-27[15:40:12] Update check succeeded logger=plugins.upta
te_checker duration=107.178051ms
2024-02-27T16:40:17+01:00 Influxdb 2024-02-27T15:40:17.290264Z info Retention policy deletion check (start
) {"log_id": "0nSDM_gw000", "service": "retention", "trace_id": "0nboQ12W000", "op_name": "retention_delete_che
ck", "op_event": "start"}
2024-02-27T16:40:17+01:00 Influxdb 2024-02-27T15:40:17.290393Z info Retention policy deletion check (end) {
"log_id": "0nSDM_gw000", "service": "retention", "trace_id": "0nboQ12W000", "op_name": "retention_delete_check", "op_e
vent": "end", "op_elapsed": "0.148ms"}
2024-02-27T16:41:46+01:00 grafana INFO [02-27[15:41:46] Usage stats are ready to report logger=infra.usages
tats
  
```

Terminal

Select a target

Start terminal session

Service	Status	Release
grafana	Running	0.0.0+rev1
hivemq4	Running	0.0.0+rev1
influxdb	Running	0.0.0+rev1
node-red	Running	0.0.0+rev1

Changelog v23.3.20

brave-sound | balena dashboard x +

dashboard.balena-cloud.com/devices/daa8cbd5b253ec8b65209d1743a8eba6

Getting Started Docs Roadmap Forums Status balenaHub Marc Pous

Organizations Marc Pous Fleets jstson-containers Devices brave-sound

Summary

- Device Variables
- Device Configuration
- Actions
- Settings
- Diagnostics
- Location

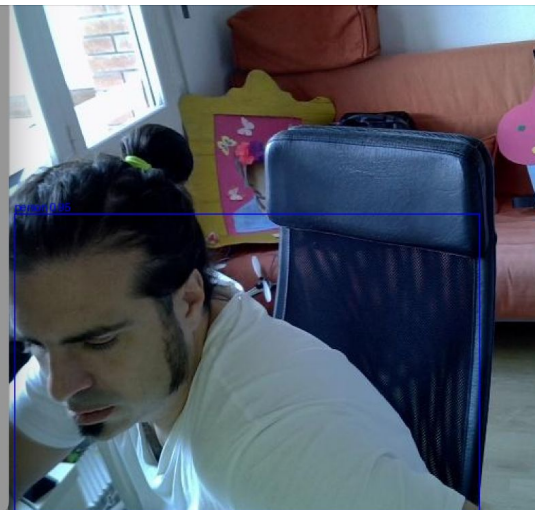
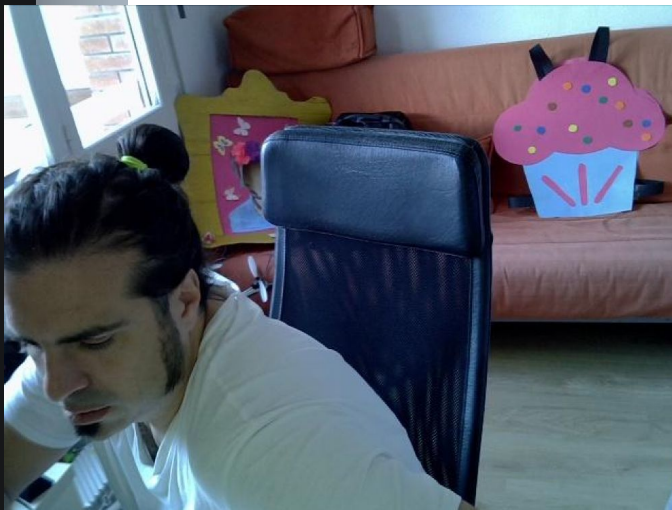
Terminal

```
pytorch +
"y_min": 222.33391117976126,
"x_max": 69.08445126181599,
"y_max": 58.88376232854893
}
}
}
}
}
Received message from topic: balena/site/area/line/cell/camera/raw
Reading engine from file yolov3.trt
[02/27/2024-15:44:13] [TRT] [W] The getMaxBatchSize() function should not be used with an engine built from a network created with NetworkDefinitionCreationFlag::KEXPLICIT_BATCH flag. This function will always return 1.
[02/27/2024-15:44:13] [TRT] [W] The getMaxBatchSize() function should not be used with an engine built from a network created with NetworkDefinitionCreationFlag::KEXPLICIT_BATCH flag. This function will always return 1.
[02/27/2024-15:44:13] [TRT] [W] The getMaxBatchSize() function should not be used with an engine built from a network created with NetworkDefinitionCreationFlag::KEXPLICIT_BATCH flag. This function will always return 1.
[02/27/2024-15:44:13] [TRT] [W] The getMaxBatchSize() function should not be used with an engine built from a network created with NetworkDefinitionCreationFlag::KEXPLICIT_BATCH flag. This function will always return 1.
Running inference on image /usr/src/tensorrt/samples/python/yolov3_onnx/mqtt-image.jpg...
[[ 12.66301574 111.78762575 431.82563615 356.97973131]
 [535.74149613 221.85315436 69.63452878 59.69856189]] [0.98583513 0.98866131] [ 0 32]
Saved image with bounding boxes of detected objects to mqtt_bboxes.png.
Publishing MQTT messages after inferences...
{
  "detections": [
    {
      "class": "person",
      "score": 0.9858351285852168,
      "boundingBox": {
        "x_min": 12.663015741061585,
        "y_min": 111.78762575237364,
        "x_max": 431.8256361488377,
        "y_max": 356.9797313857942
      }
    },
    {
      "class": "sports ball",
      "score": 0.9886613080758055,
      "boundingBox": {
        "x_min": 535.7414961116686,
        "y_min": 221.85315436343663,
        "x_max": 69.63452877746144,
        "y_max": 59.69856189484561
      }
    }
  ]
}
```

Changelog v23.3.20

Need help?

```
{
  "detections": [
    {
      "class": "person",
      "score": 0.9657025785242721,
      "boundingBox": {
        "x_min": 3.7658301071171607,
        "y_min": 150.20850711183255,
        "x_max": 447.67390142228925,
        "y_max": 313.51492320512546
      }
    },
    {
      "class": "sports ball",
      "score": 0.9867270698056363,
      "boundingBox": {
        "x_min": 536.148606279469,
        "y_min": 222.20140379521948,
        "x_max": 68.18516925408174,
        "y_max": 59.01444510192577
      }
    }
  ]
}
```

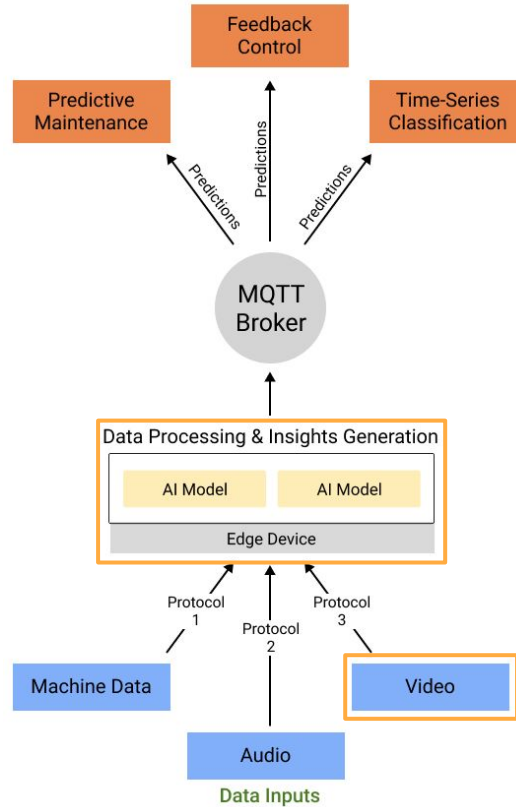


Demo 2: The Unstructured Data Pattern with **HiveMQ**

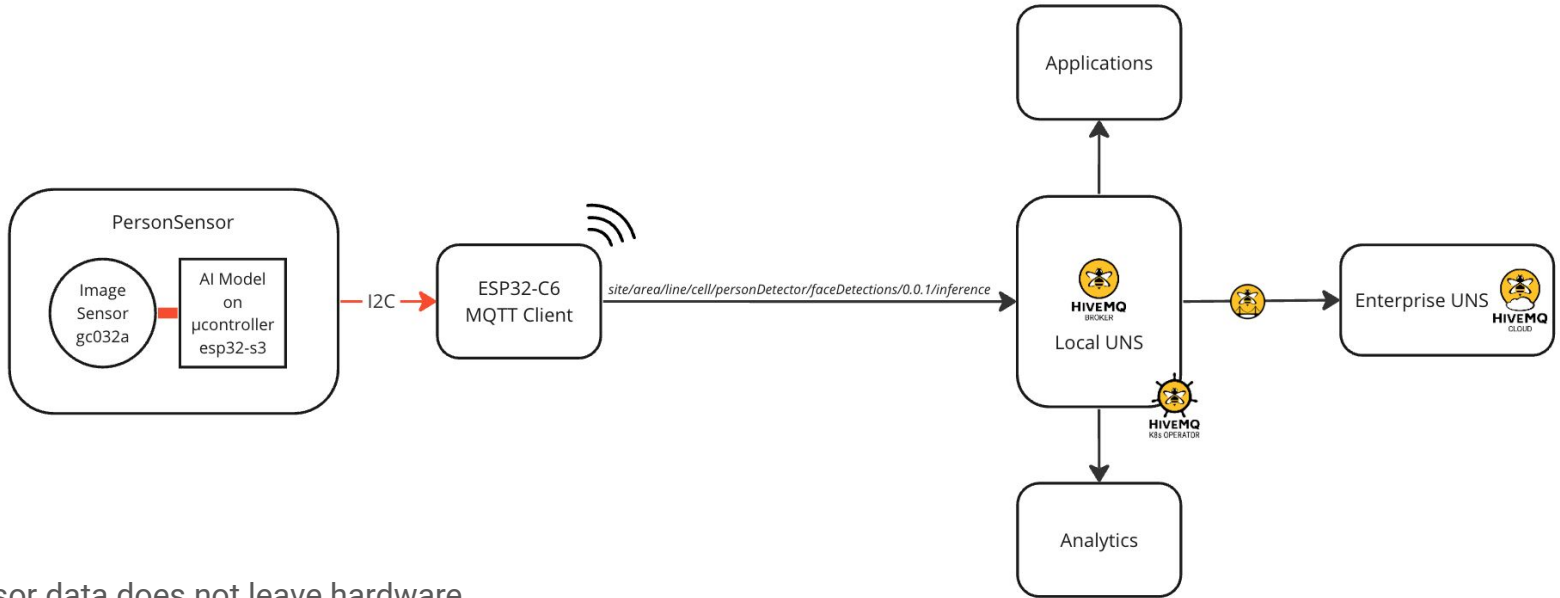
Magnus McCune
Senior IoT Solutions Architect



The Unstructured Data Pattern



Demo - Unstructured Data Pattern



*Image sensor data does not leave hardware

	ESP32-S3	ESP32-C6
Processor	Tensilica Xtensa 32 bit 240MHz dual-core	RISC V 32 bit 160MHz
SRAM	520KB	512KB
ROM	384KB	320KB
WiFi	WiFi4 - Absent	WiFi6

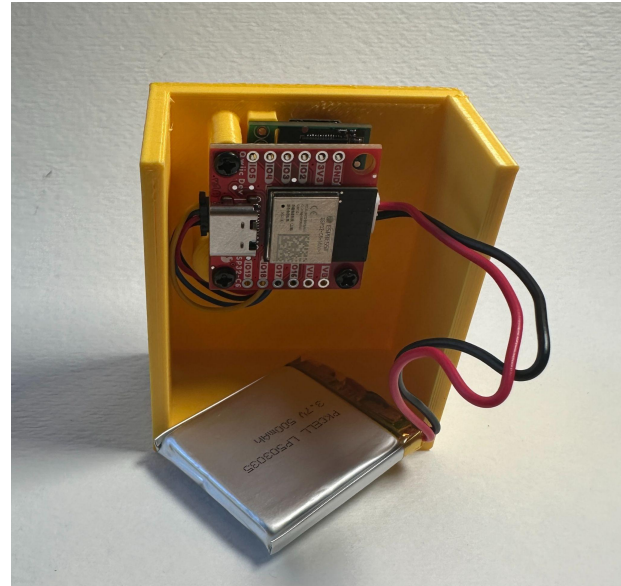
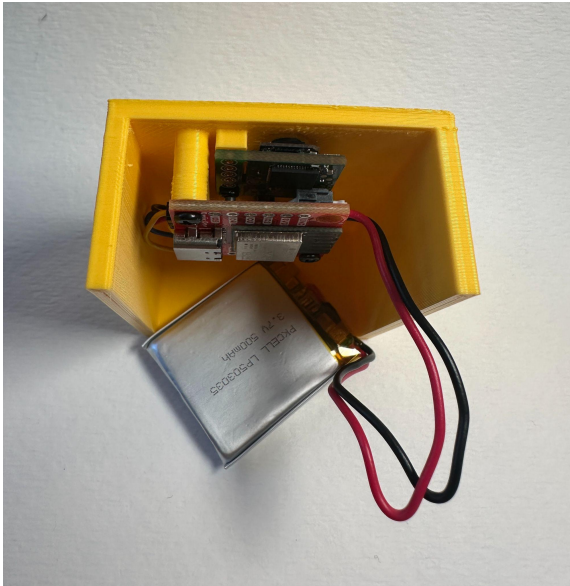
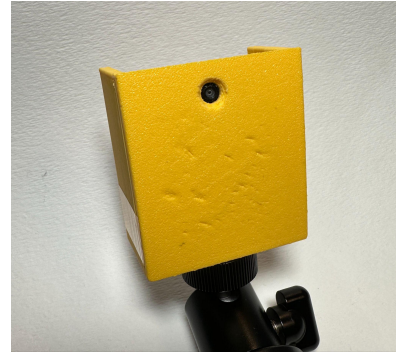
Output from Useful Sensor PersonSensor

```
{
  "facesDetected": 2,
  "detections": [
    {
      "class": "face0",
      "score": 99,
      "facing": false,
      "boundingBox": {
        "x": 92,
        "y": 59,
        "width": 43,
        "height": 62
      }
    },
    {
      "class": "face1",
      "score": 96,
      "facing": true,
      "boundingBox": {
        "x": 148,
        "y": 74,
        "width": 34,
        "height": 57
      }
    }
  ]
}
```

Inference - JSON payload following the format defined in spec with the full output from the AI Model

Insight - An example insight using this data might involve simple business logic calculation that compares the number of faces currently present to an expected number of faces.

Demo



Demo

demo/halifax/area/line/cell/personDetector/state

offline

1364

QoS 0

26-02-2024 16:33:27.59607111

demo/halifax/area/line/cell/personDetector/state

online

1365

QoS 0

26-02-2024 16:34:28.59668664

Not part of the EdgeAI spec, but it is always a good practice to include device state in our namespace.

Demo

```
demo/halifax/area/line/cell/personDetector/faceDetections/0.0.1/inference
```

```
{  
  "detections": [],  
  "facesDetected": 0  
}
```

When no one is in frame, the `detections` array is empty and the `facesDetected` metric reads 0

Report By Exception written into the logic ensures that no repeat messages are published if the payloads would otherwise be identical



Demo

demo/halifax/area/line/cell/personDetector/faceDetections/0.0.1/inference

```
{
  "detections": [
    {
      "class": "face0",
      "score": 65,
      "facing": false,
      "boundingBox": {
        "x": 112,
        "y": 91,
        "width": 36,
        "height": 62
      }
    }
  ],
  "facesDetected": 1
}
```

When a person is within frame the *facesDetected* metric indicates the number of identified faces and the *detections* array contains an object for each detected face.

The face0 object contains a confidence score, the *facing* bool and a nested object describing the bounding box.

Thank You!

Q&A

