



Adaptive Data Services & Solutions for
Connected & Autonomous Vehicles

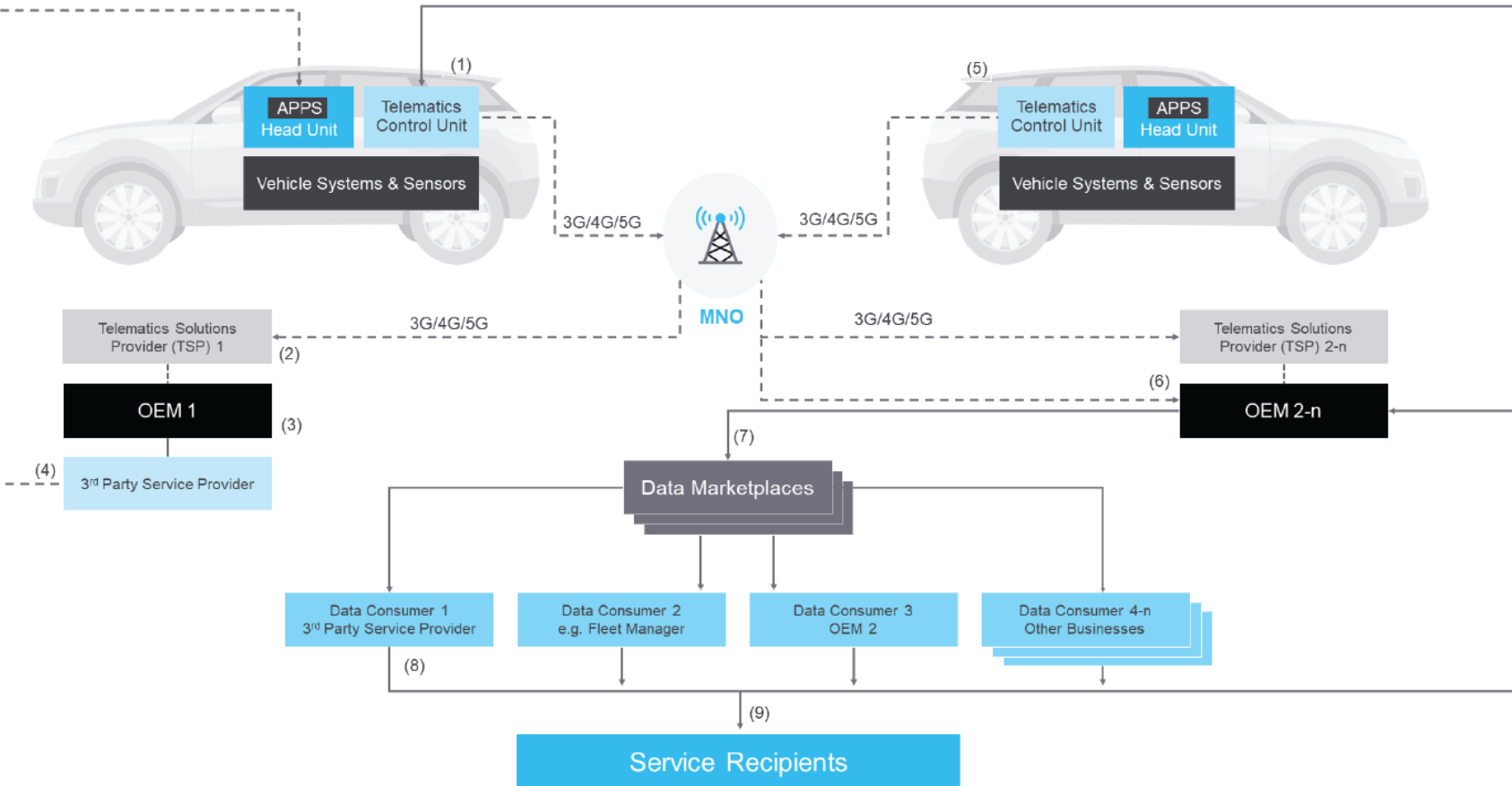
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Overview

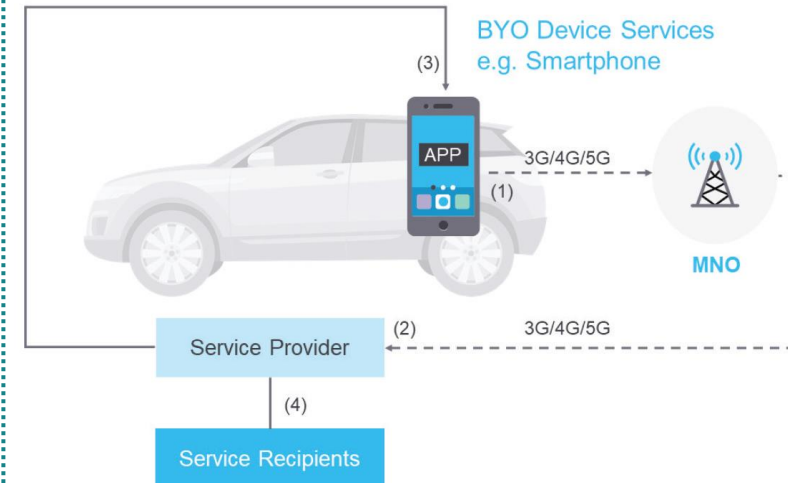


Connected Car Data Ecosystem

Neutral Server / Data Marketplace Model



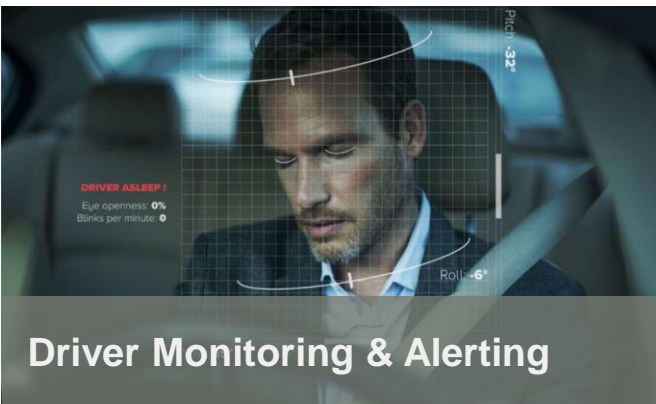
App Model



Industries



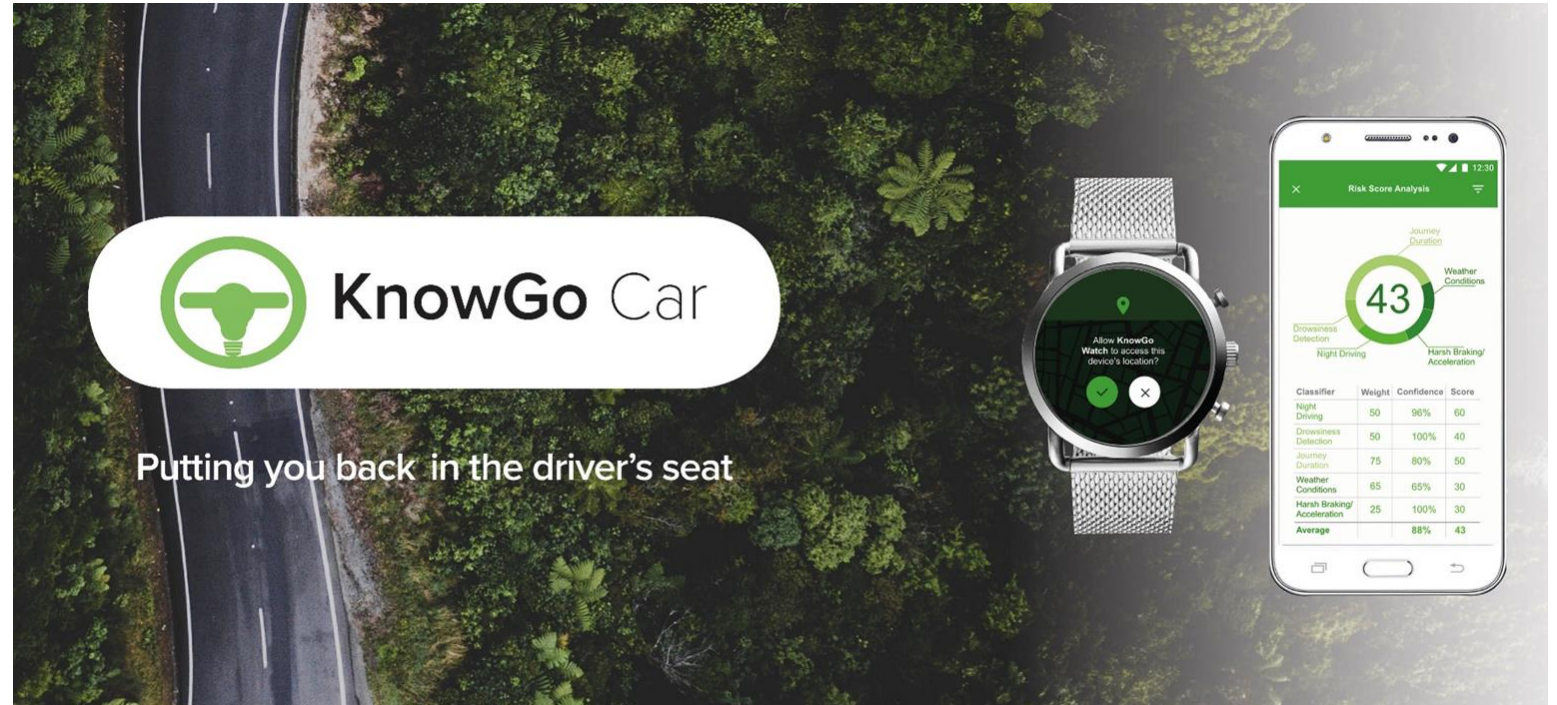
Intelligent Vehicle Services



Our Solution

KnowGo Car

A vehicle data management & services platform that allows end-users and service providers to **leverage both personally identifiable and other types of sensitive data** in a way that is secure, privacy-preserving, ethical, and **adaptable across country borders and industry sectors**.

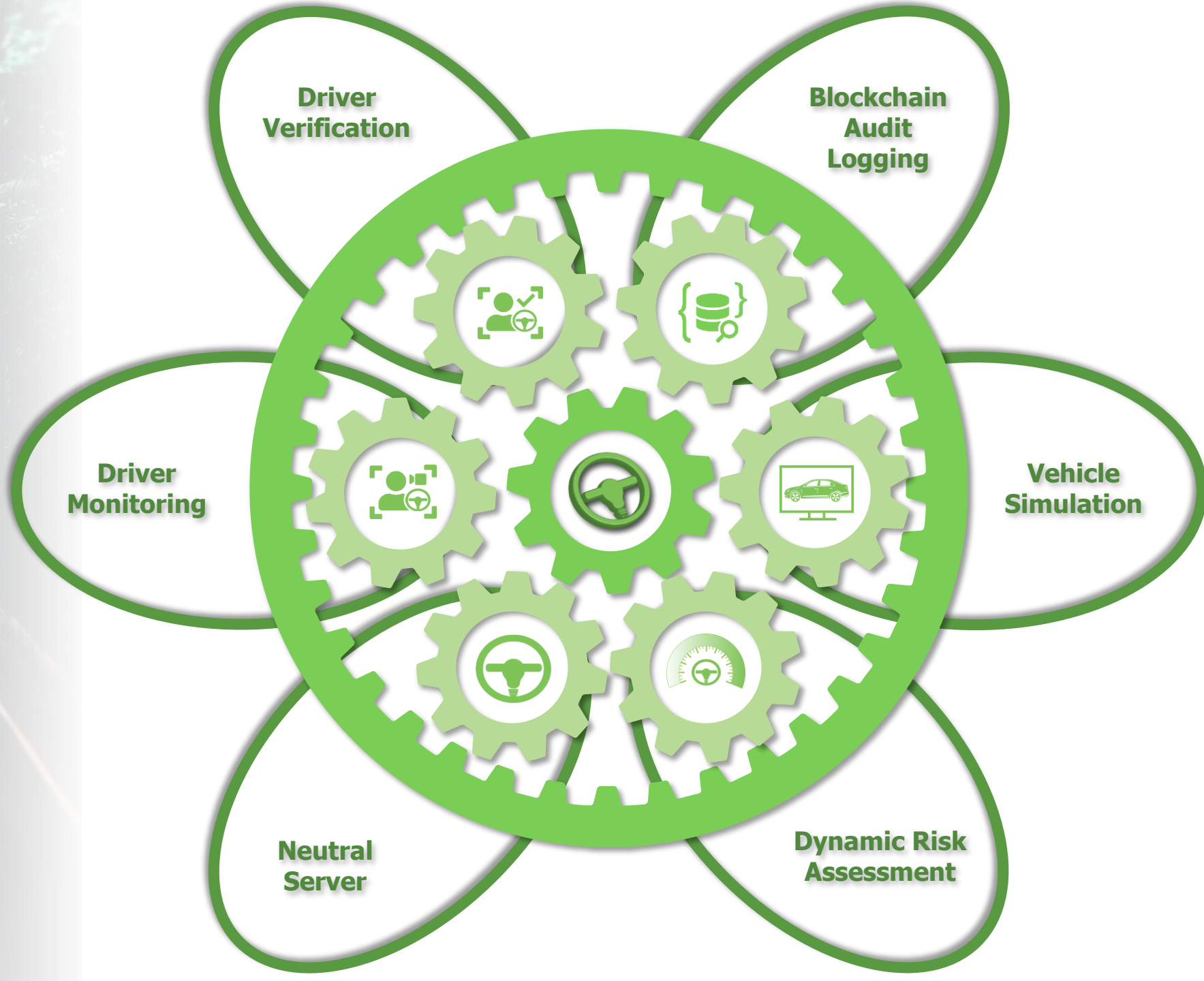


- ✓ Industry 1st GDPR-by-design vehicle data management platform, future-proof for future regulation and regulatory variance.
- ✓ Industry 1st platform that can deal with cross-border data service continuity, compliance, and auditing.
- ✓ Run in the cloud, in-vehicle, or on-device.
- ✓ Bring connected car services to existing non-connected vehicles.
- ✓ Integrate into head unit or project to in-vehicle display.





KnowGo Car



**Driver
Verification**

**Blockchain
Audit
Logging**

**Vehicle
Simulation**

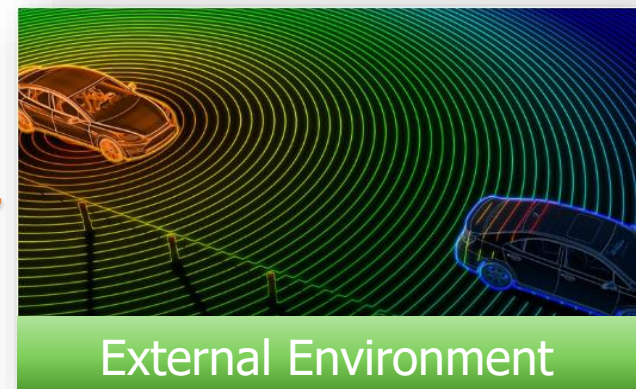
**Dynamic Risk
Assessment**

**Neutral
Server**

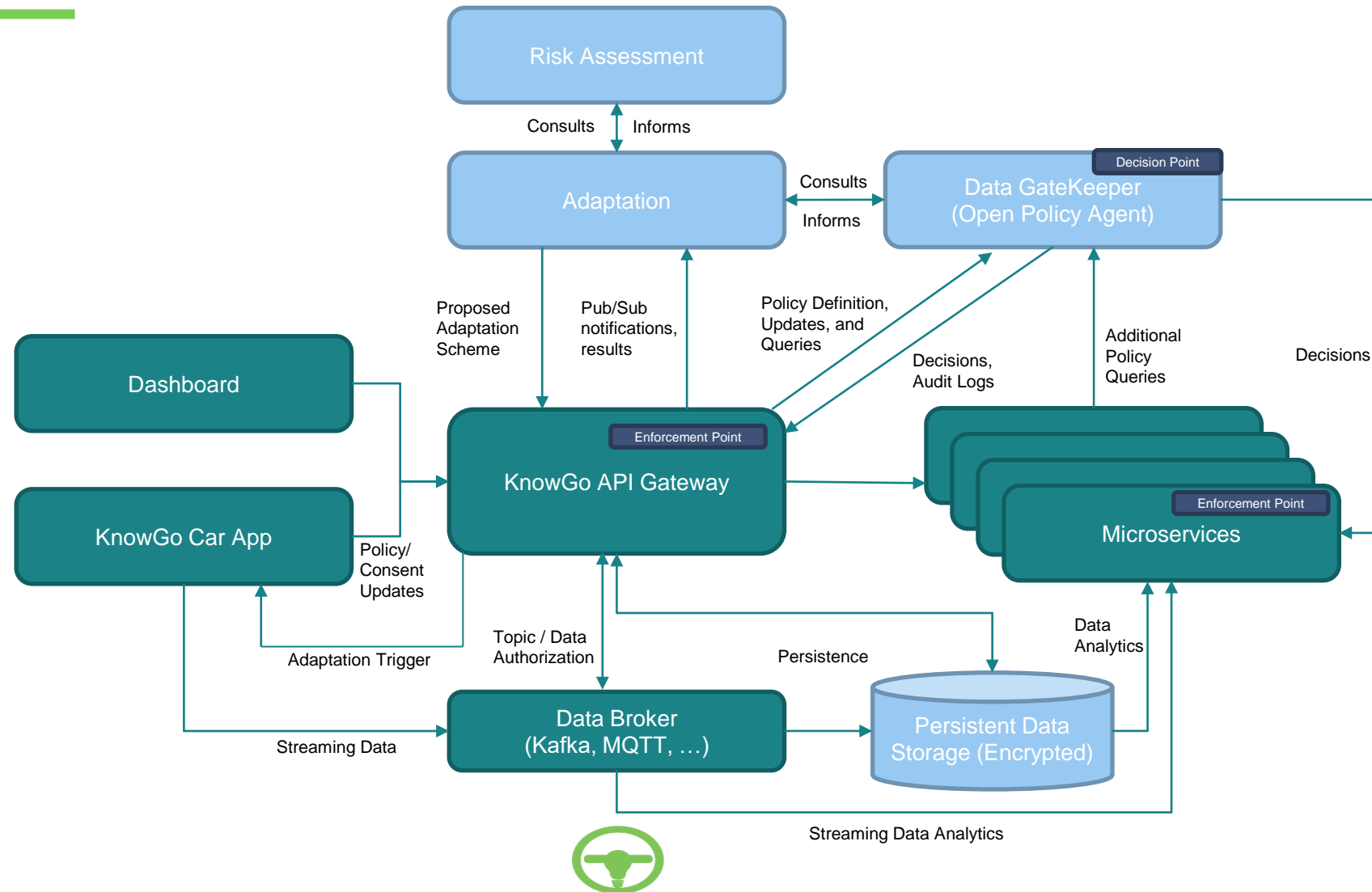
**Driver
Monitoring**

Real-Time Dynamic Adaptation

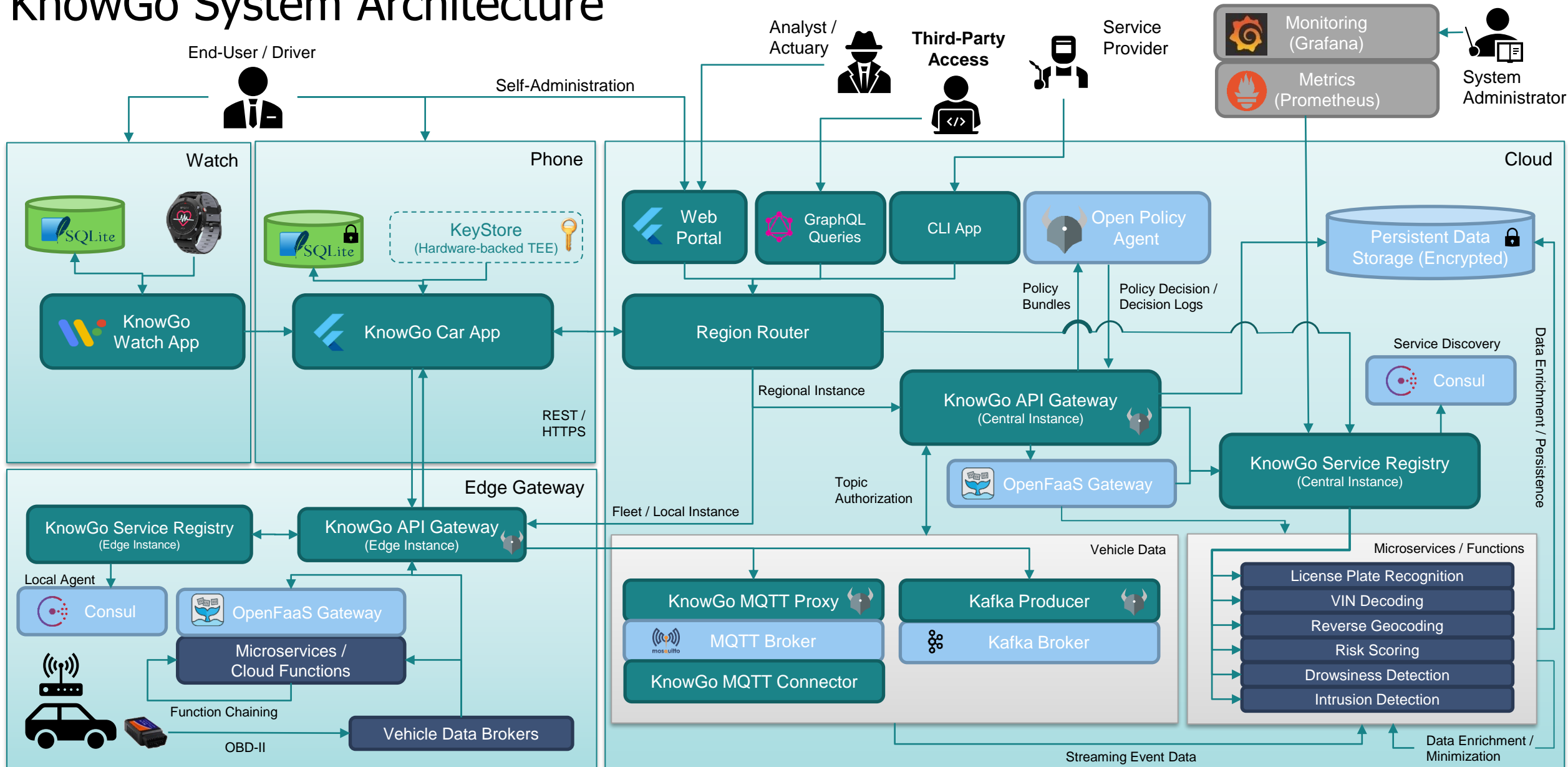
All Platform Components and Applications provide run-time adaptation capabilities, allowing **applications to be refactored and reconfigured in real-time** in response to changes in:



KnowGo High-Level System Architecture

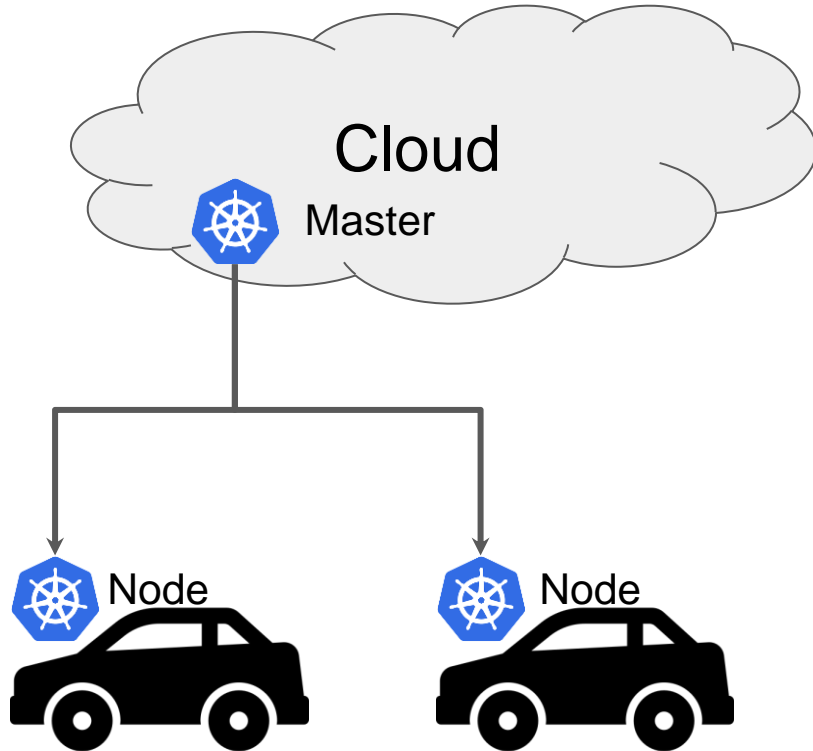


KnowGo System Architecture

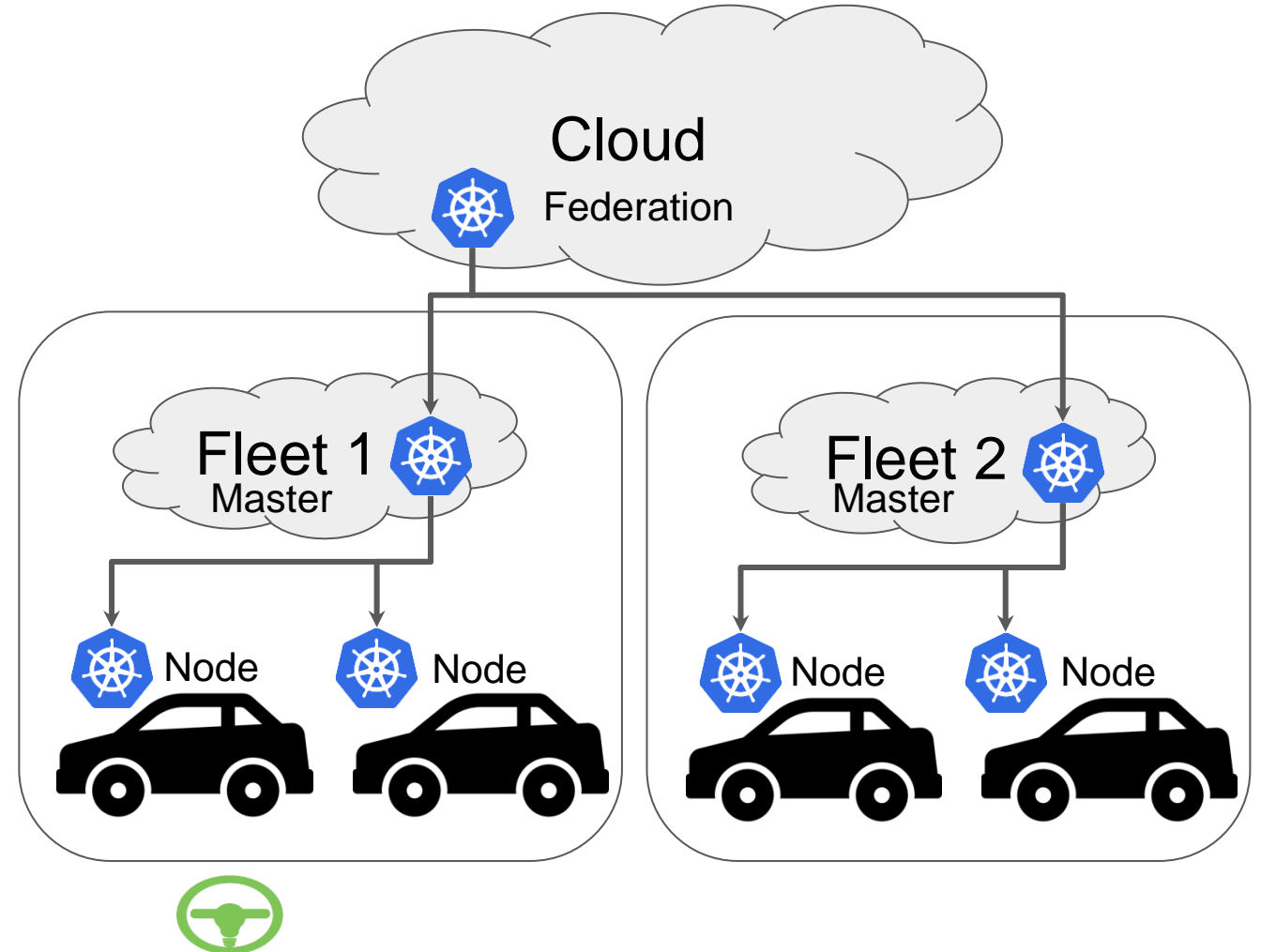


Kubernetes Deployment Scenarios

Deployment Scenario #1: Cloud -> Vehicle



Deployment Scenario #2: Cloud -> Fleet -> Vehicle



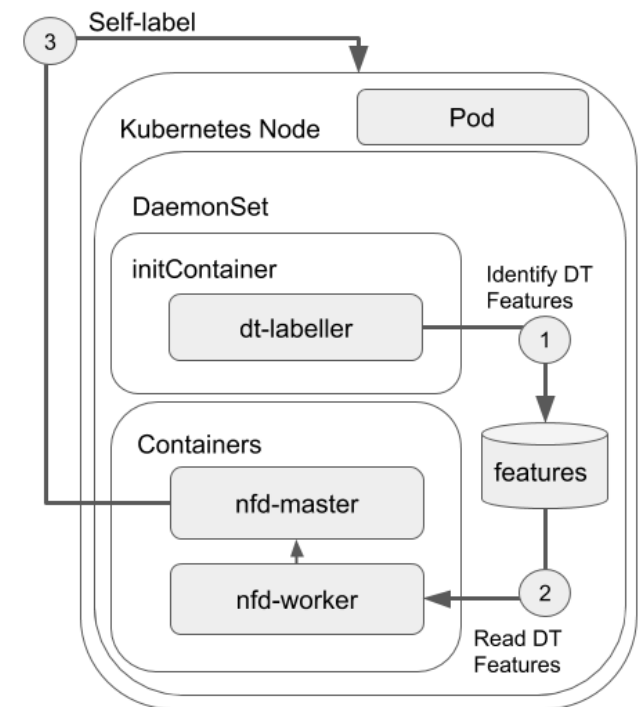
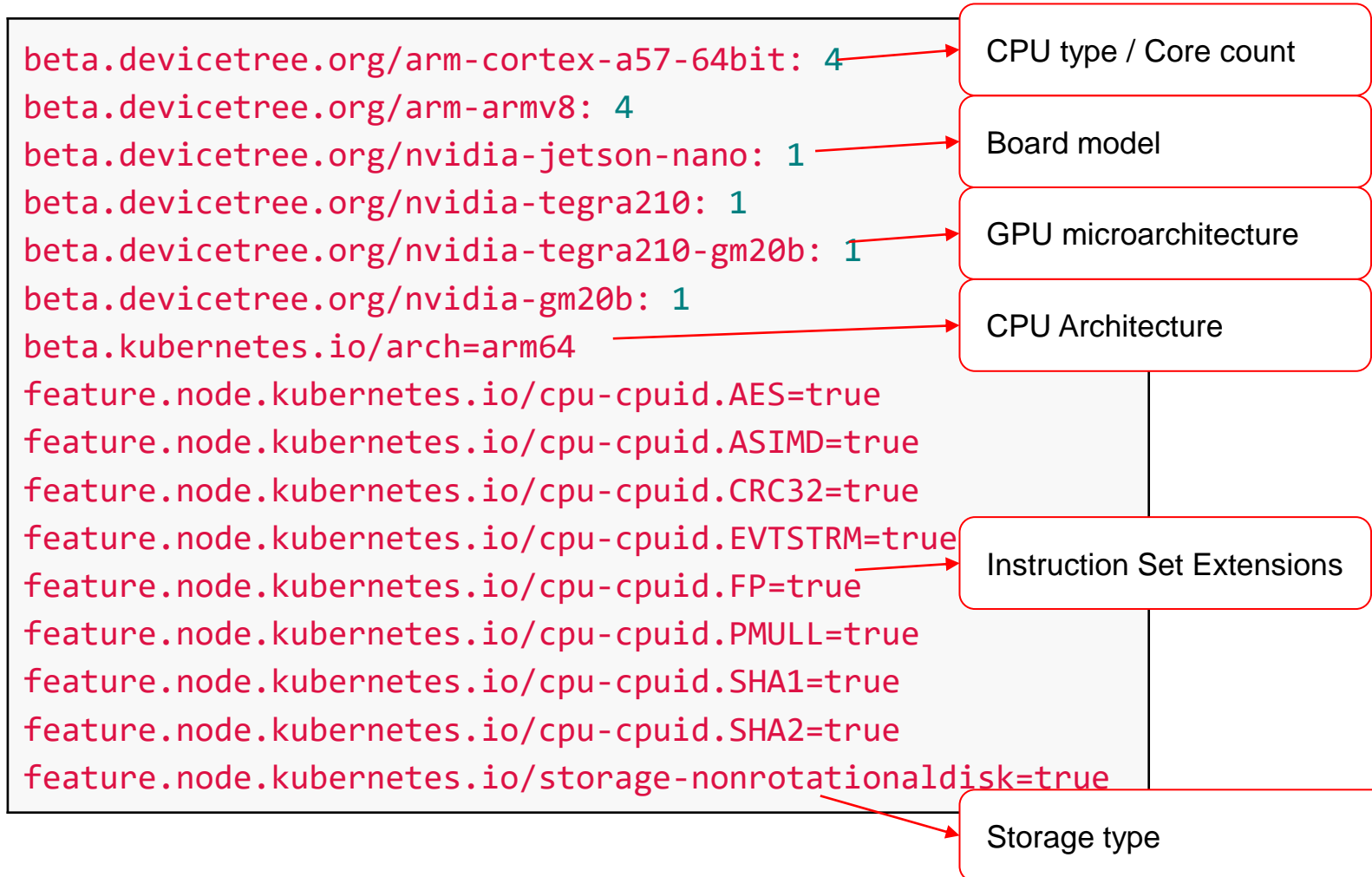
Edge Gateway Heterogeneity Challenges

- Edge Gateways (and by extension, ECUs and head units) are becoming increasingly powerful due to the continual addition of new types of accelerators. However:
 - Each requires its own unique container runtime.
 - In the case of Tensorflow, each requires adaptation/conversion from base Tensorflow model (TFLite, TensorRT), with accelerator-specific requirements (e.g. quantization-aware training/post-training quantization).
 - Available memory limits these primarily to inference-only workloads, with training pushed back to Cloud or HPC resources on the backend.
- Possible to leverage different accelerators at different stages of the image processing pipeline within the same application:
 - FPGA/Vision Processor for preparing images for inference
 - GPU/NVDLA/NCS2/Tensor units for carrying out inference
- Possible to use different accelerators for supplying same model:
 - Both in terms of Edge-focused model zoo, and at run-time via ONNX

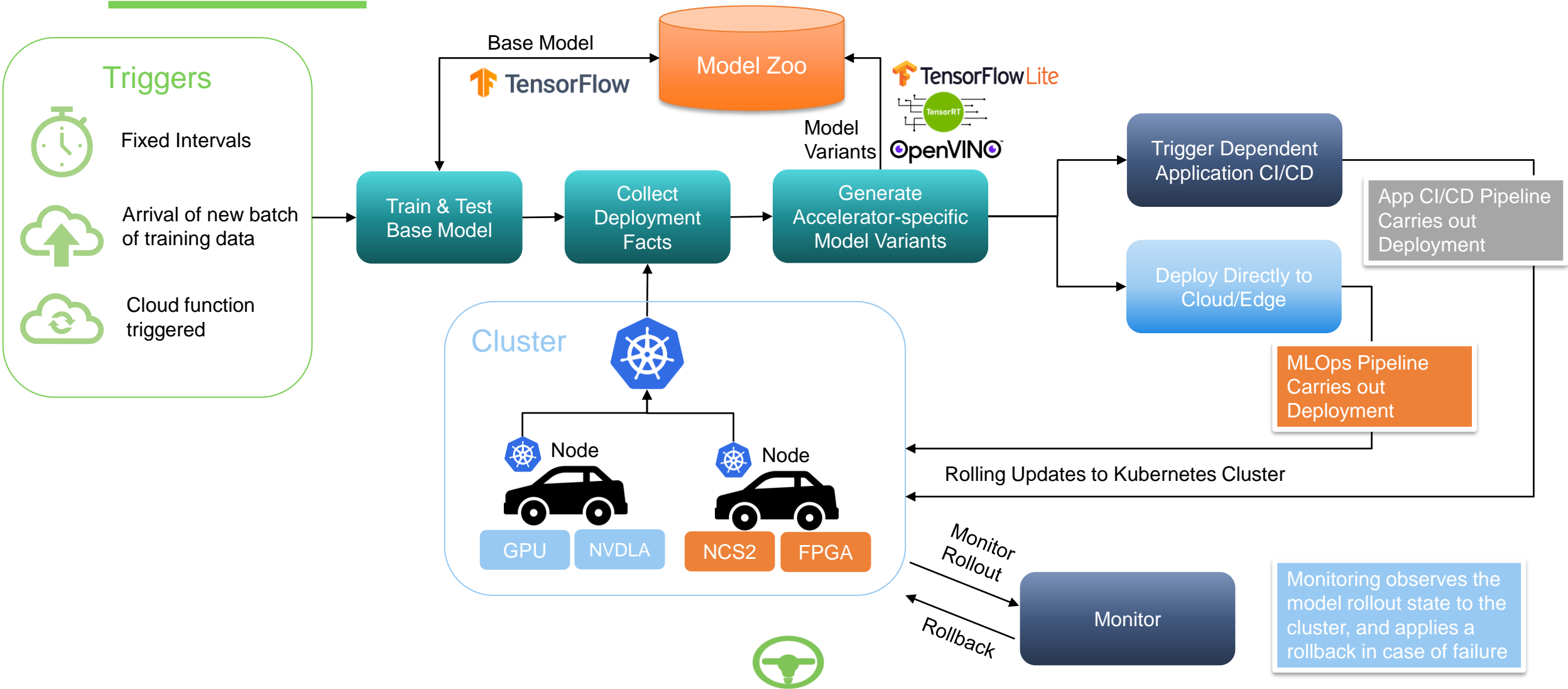


Edge Gateway Feature Detection

Node feature discovery and self-labelling provides an overview of available accelerators and hardware characteristics:



MLOps Pipeline



Cloud vs. Edge Containers in CI/CD Pipeline

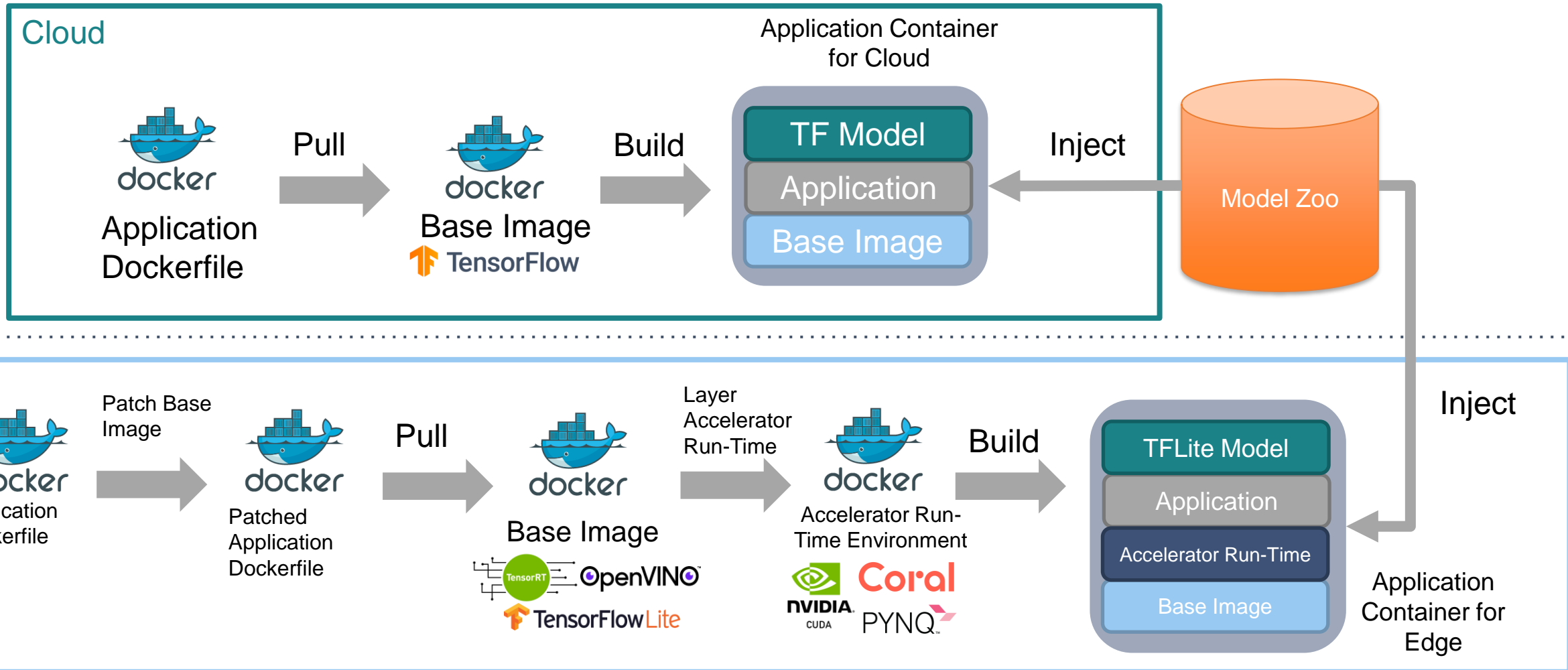
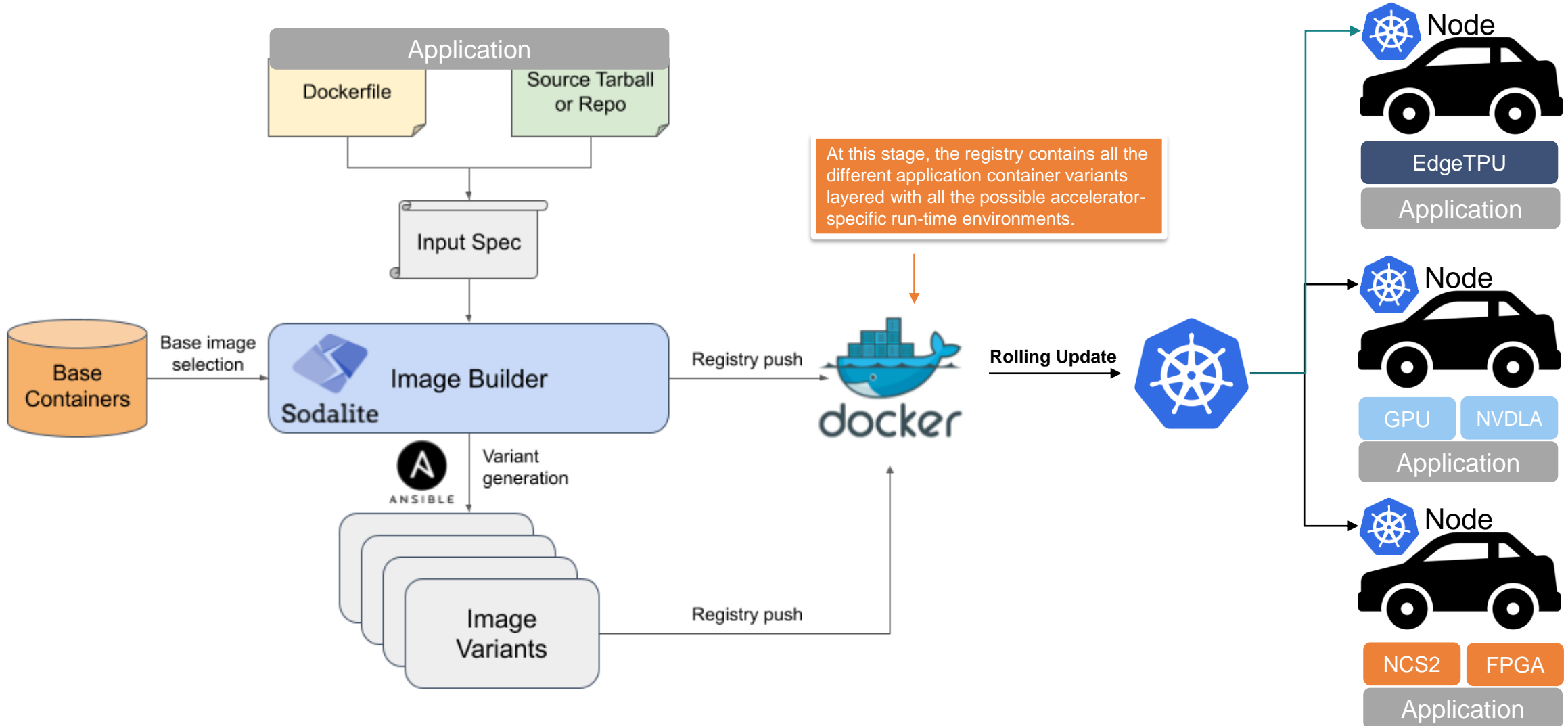


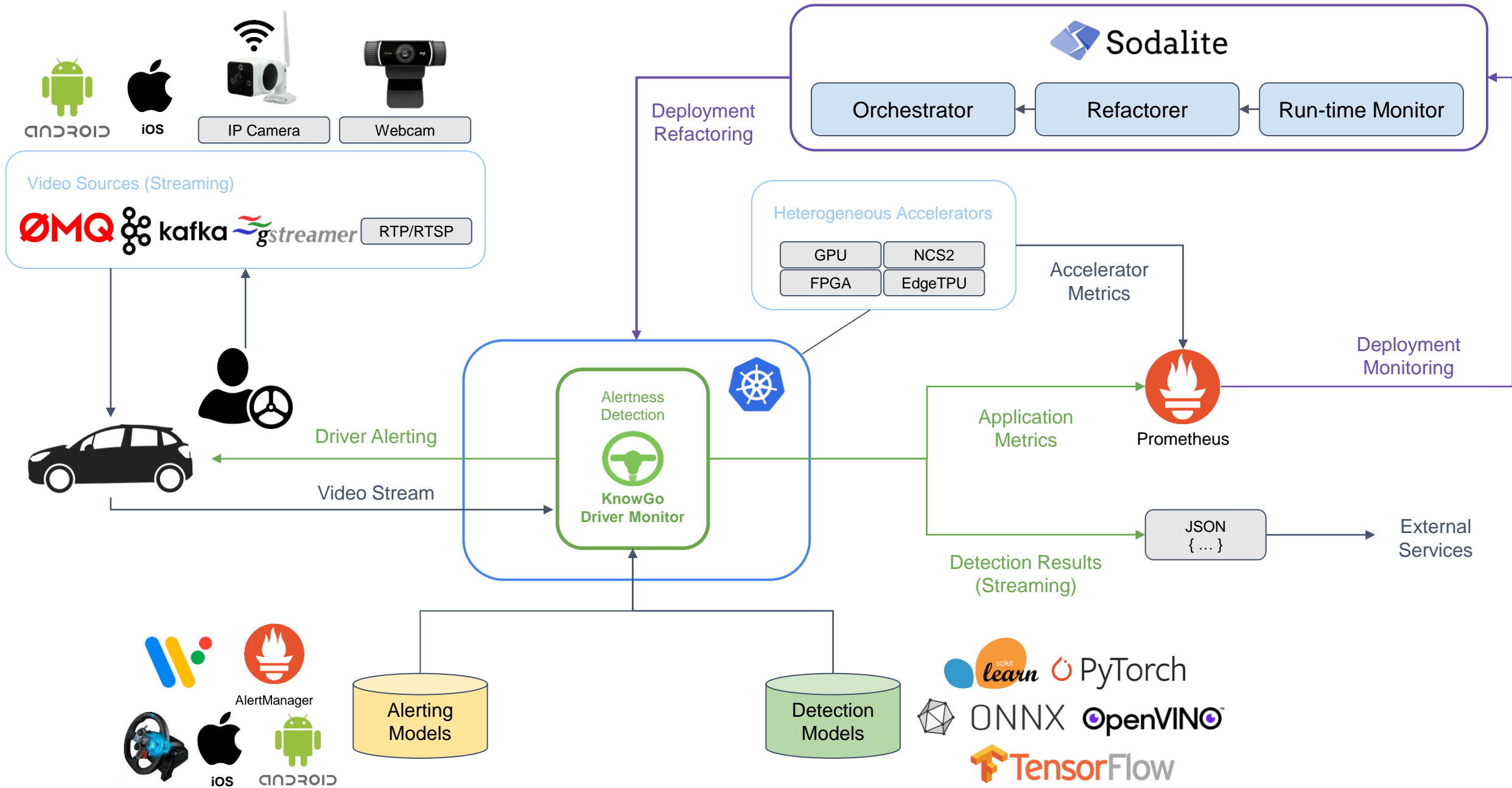
Image Variants: One Application, Multiple Execution Possibilities



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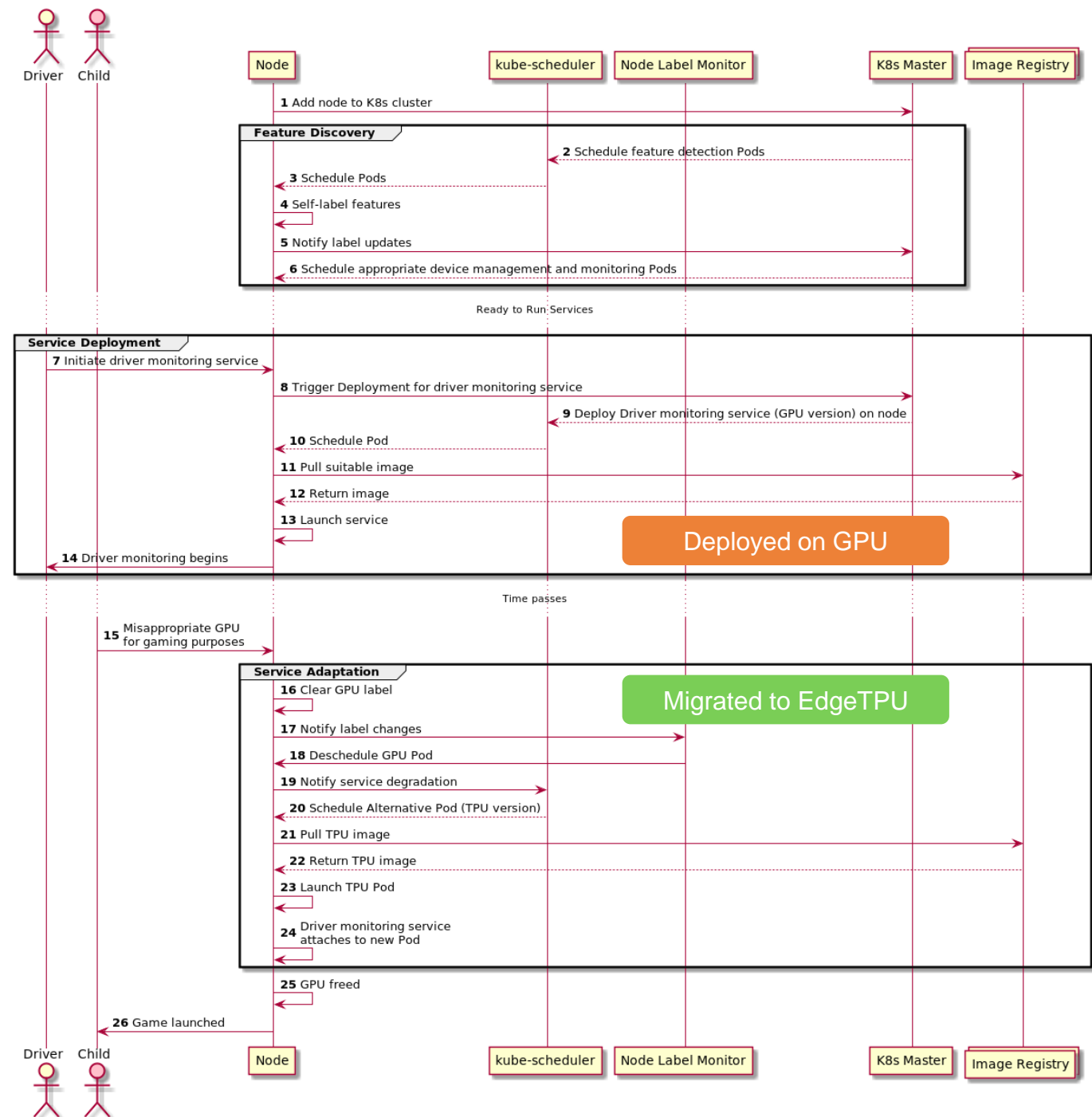
Case Study #1: KnowGo Driver Monitor





Dynamic Resource Adaptation

- Different accelerators may be under contention at different times, requiring deployed applications to adapt:
 - GPU preferred for driver monitoring, but may become unavailable when a child in the back takes it over to play a game
 - Driver monitoring can be handled by multiple accelerators
 - Gaming can only be handled by the GPU
 - Edge-based GPUs can not presently be partitioned or sliced (no GPU virtualization / NVIDIA GRID)
- Must hand the application off to another resource while minimizing service disruption.



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Case Study #2: KnowGo Score



SAE J3016™ LEVELS OF DRIVING AUTOMATION



What does the human in the driver's seat have to do?

SAE LEVEL 0
SAE LEVEL 1
SAE LEVEL 2

You are driving whenever these driver support features are engaged - even if your feet are off the pedals and you are not steering

You must constantly supervise these support features: you must steer, brake or accelerate as needed to maintain safety

SAE LEVEL 3
SAE LEVEL 4
SAE LEVEL 5

You are not driving these automated driving features are engaged - even if you are seated in "the driver's seat"

When the feature requests, you must drive

These automated driving features will not require you to take over driving

These are driver support features

These are automated driving features

What do these features do?

These features are limited to providing warnings and momentary assistance

These features provide steering OR brake/acceleration support to the driver

These features provide steering AND brake/acceleration support to the driver

These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met

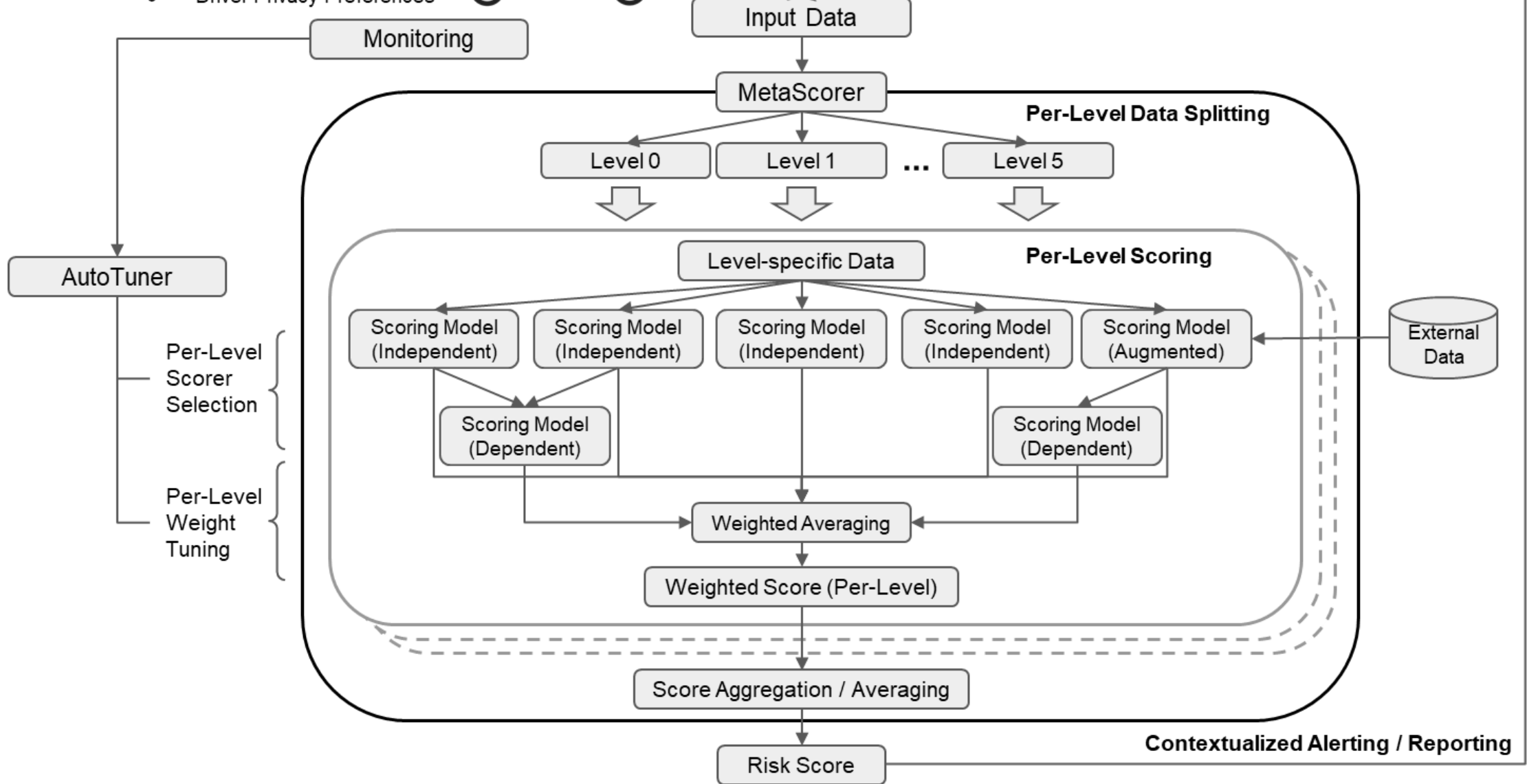
This feature can drive the vehicle under all conditions

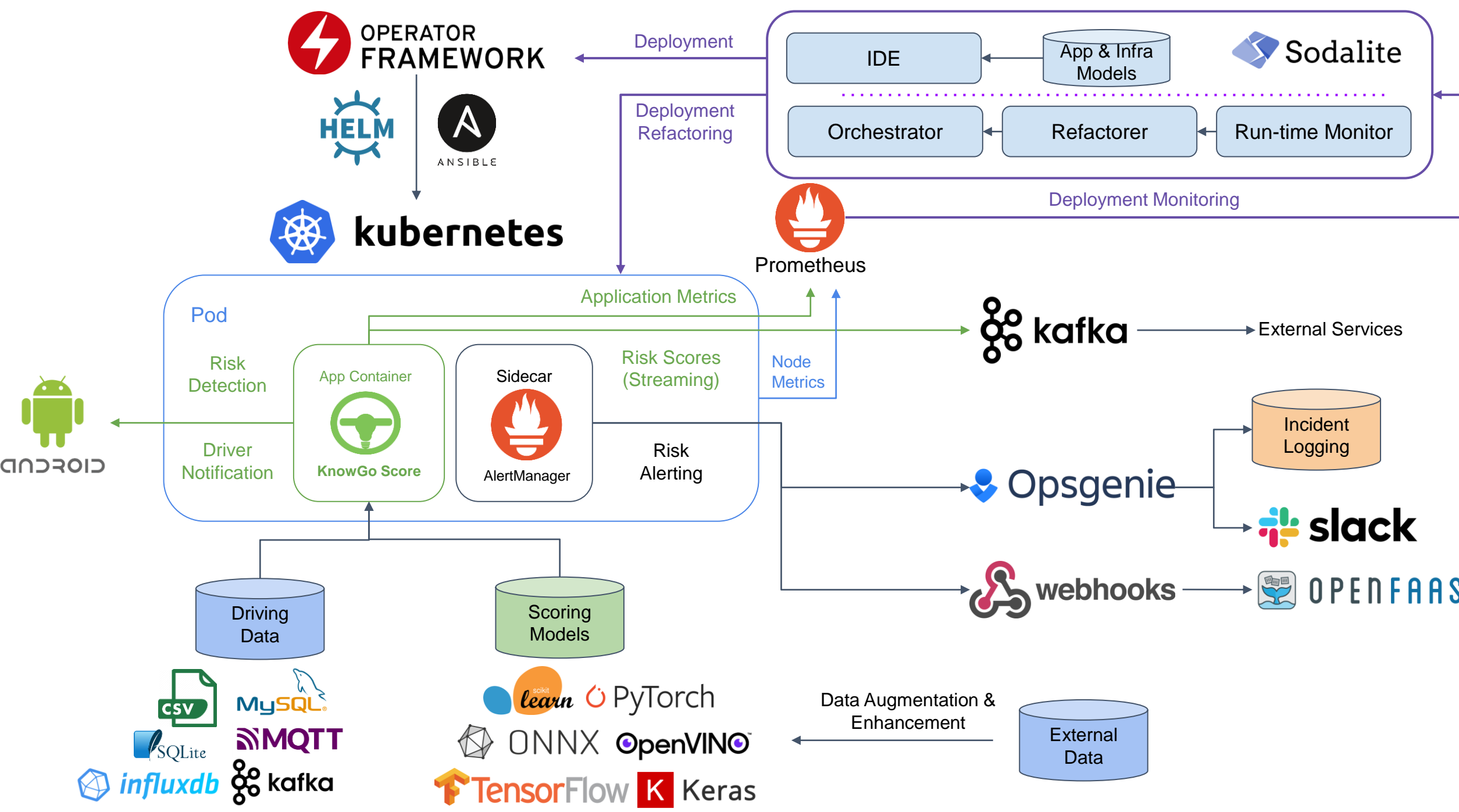
Example Features

- automatic emergency braking
- blind spot warning
- lane departure warning
- Land centering OR Adaptive cruise control
- Land centering AND Adaptive cruise control at the same time

- traffic jam chauffeur
- local driverless taxi
- pedals/steering wheel may or may not be installed
- same as level 4, but feature can drive everywhere in all condition

- Monitoring Changes in:
- Automation Level
 - Legal Jurisdiction
 - Driver Privacy Preferences







Thank You!