



Accelerating IOT development

Leveraging VSS at the Edge

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About us



Aman Gupta

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DENSO CORPORATION

About our Company

DENSO CORPORATION Worldwide

1949
established



US \$47.9 billion
in annual sales



164,572
employees in 190 group
companies



2nd
highest sales among
automotive components
manufacturers worldwide



*From April 1, 2022 to March 31, 2023

Agenda

1. QUAD: What We have been doing
2. The Role of VSS Signals and Car simulator
3. DUO: The Digital Twin
4. QUAD-DASHBOARD: Remote Application Management
5. TERMINAL : Debugging containers remotely.
6. EXAMPLES : Real-world Applications
7. Future roadmap

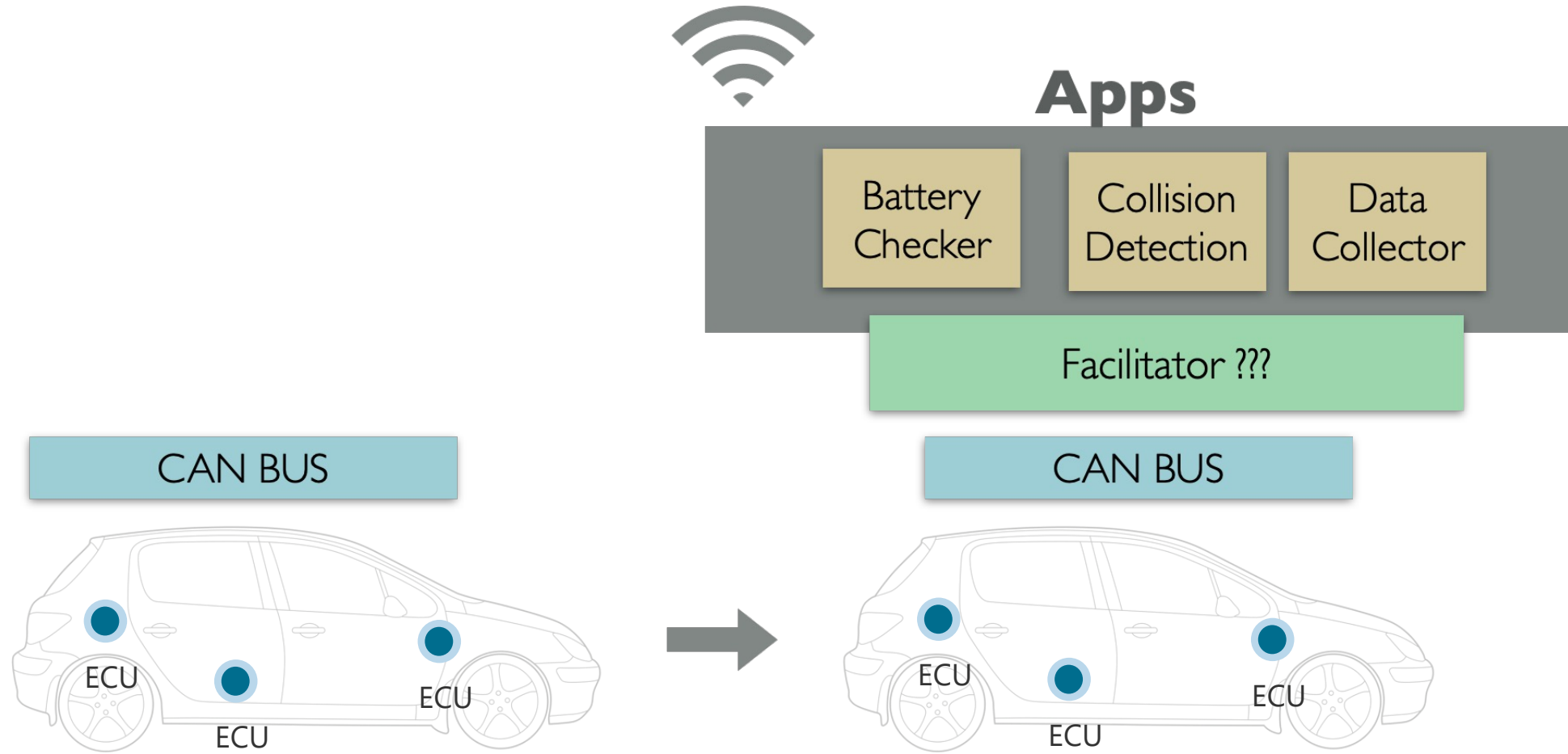
1

Introduction to QUAD

A complete vehicle IOT development platform

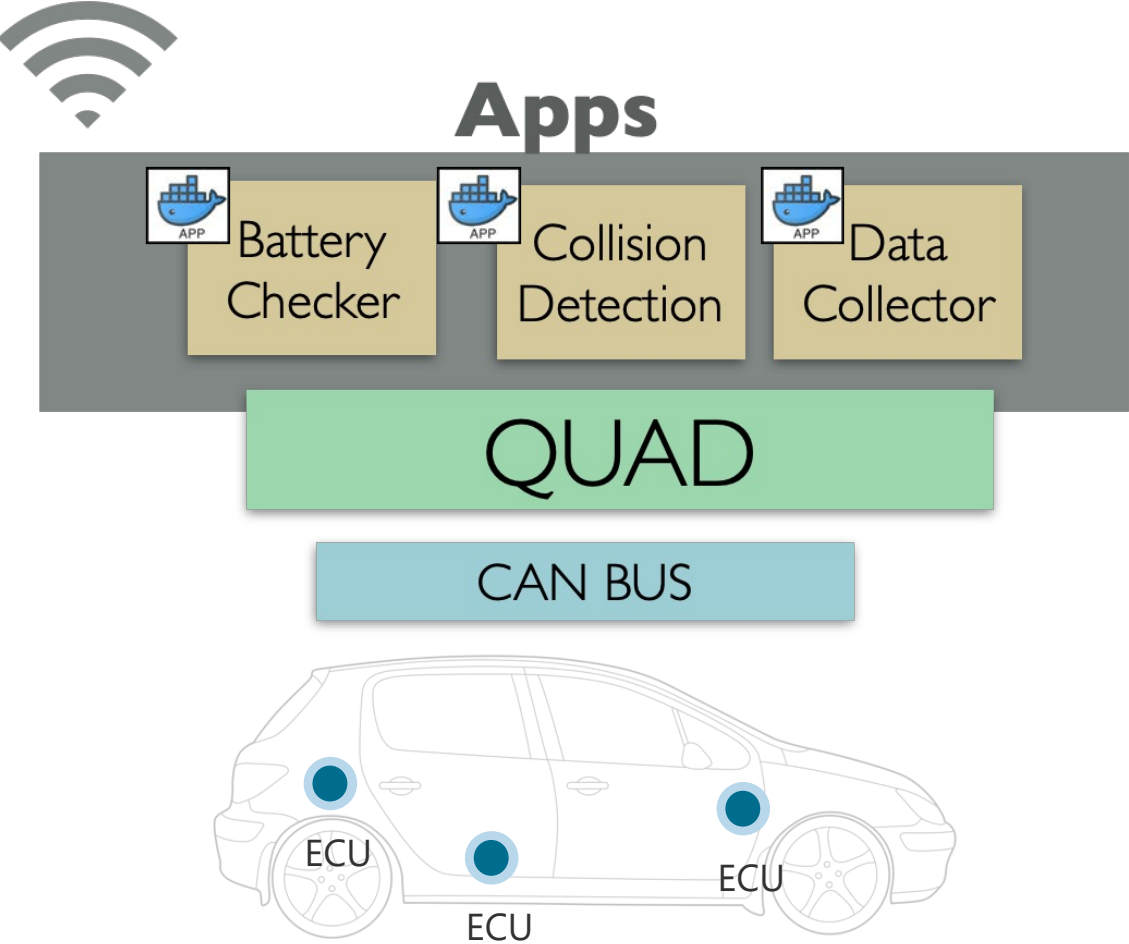
Need for QUAD?

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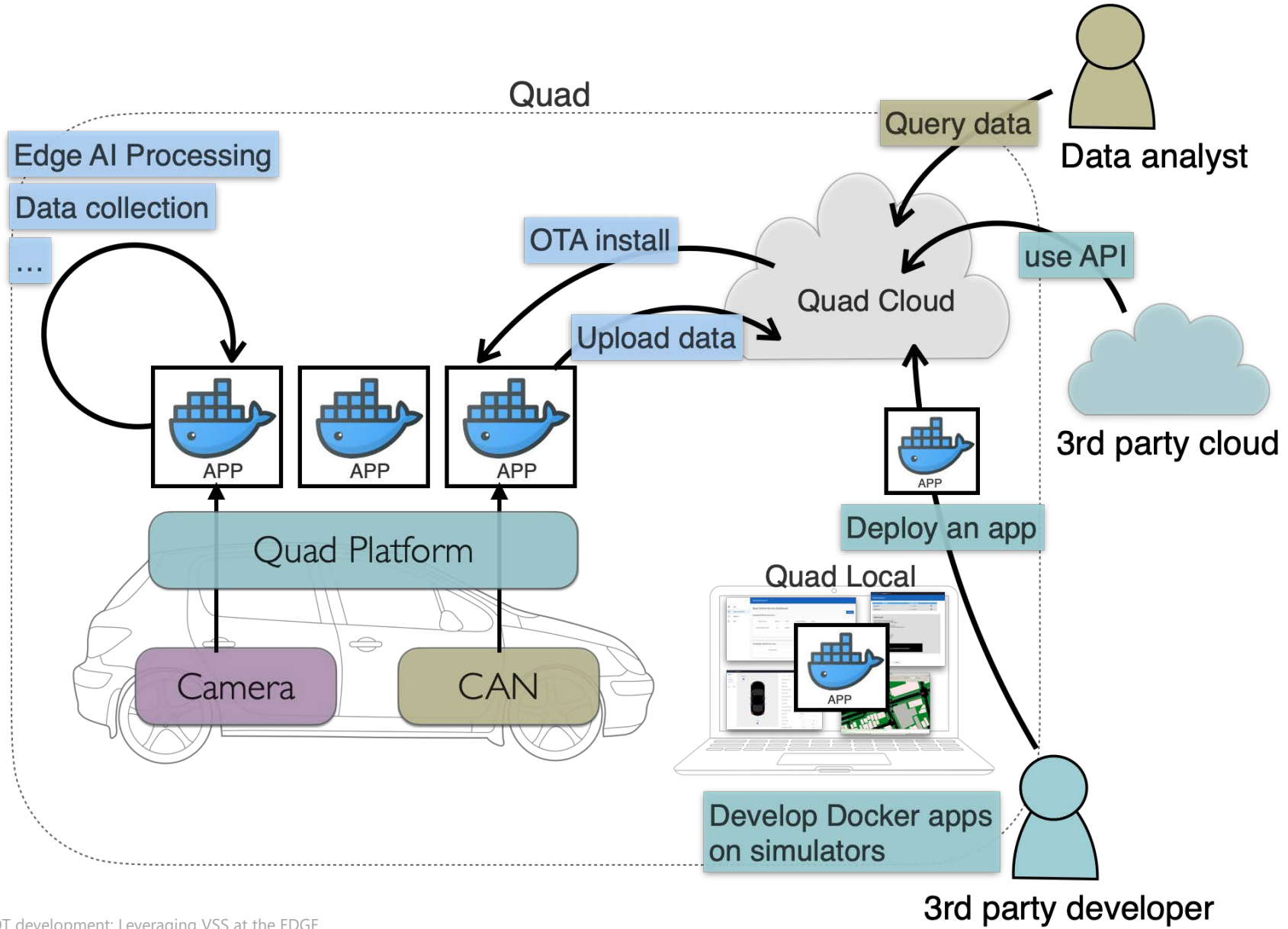
Quad

Docker-based 3rd party development environment



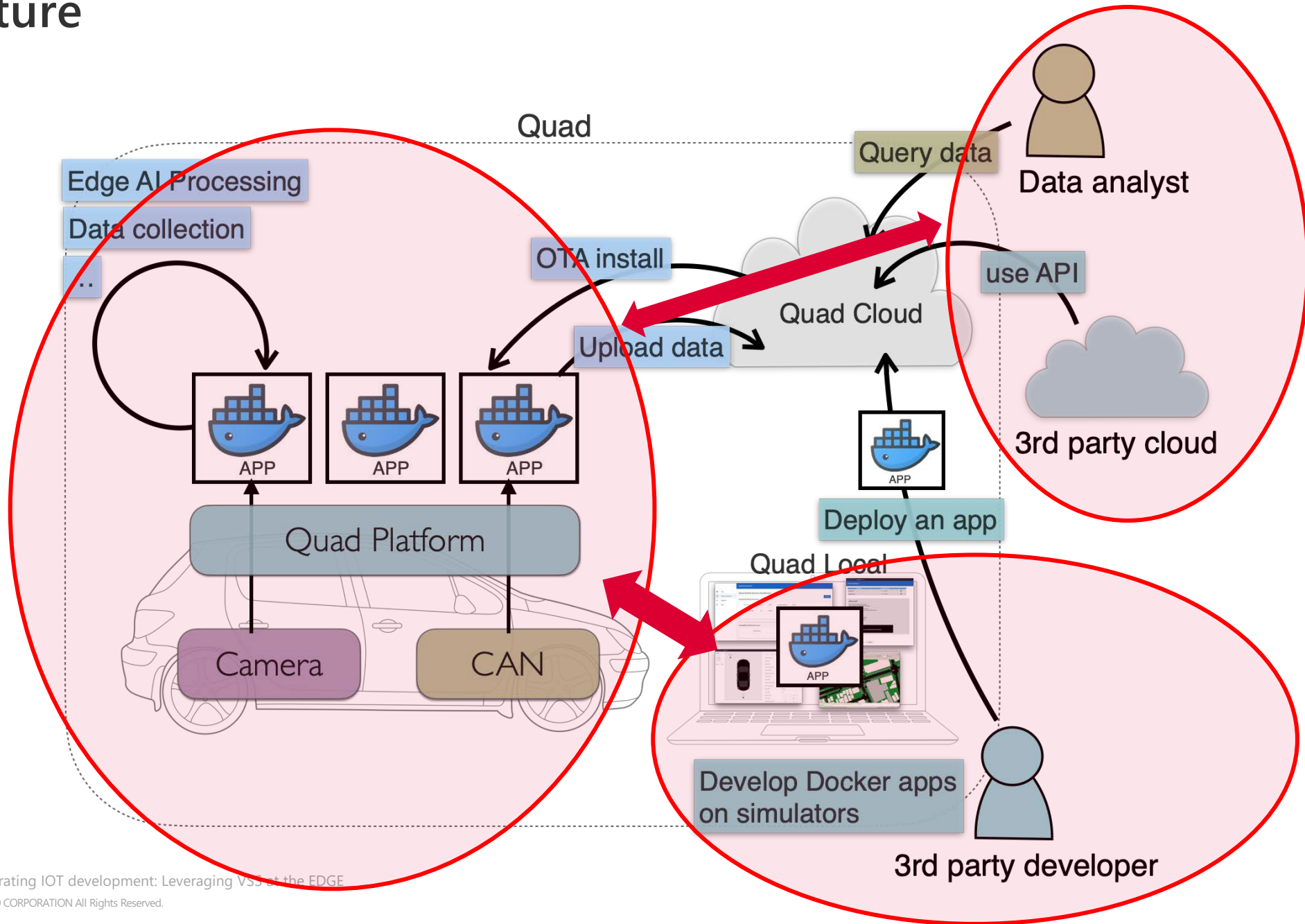
Architecture

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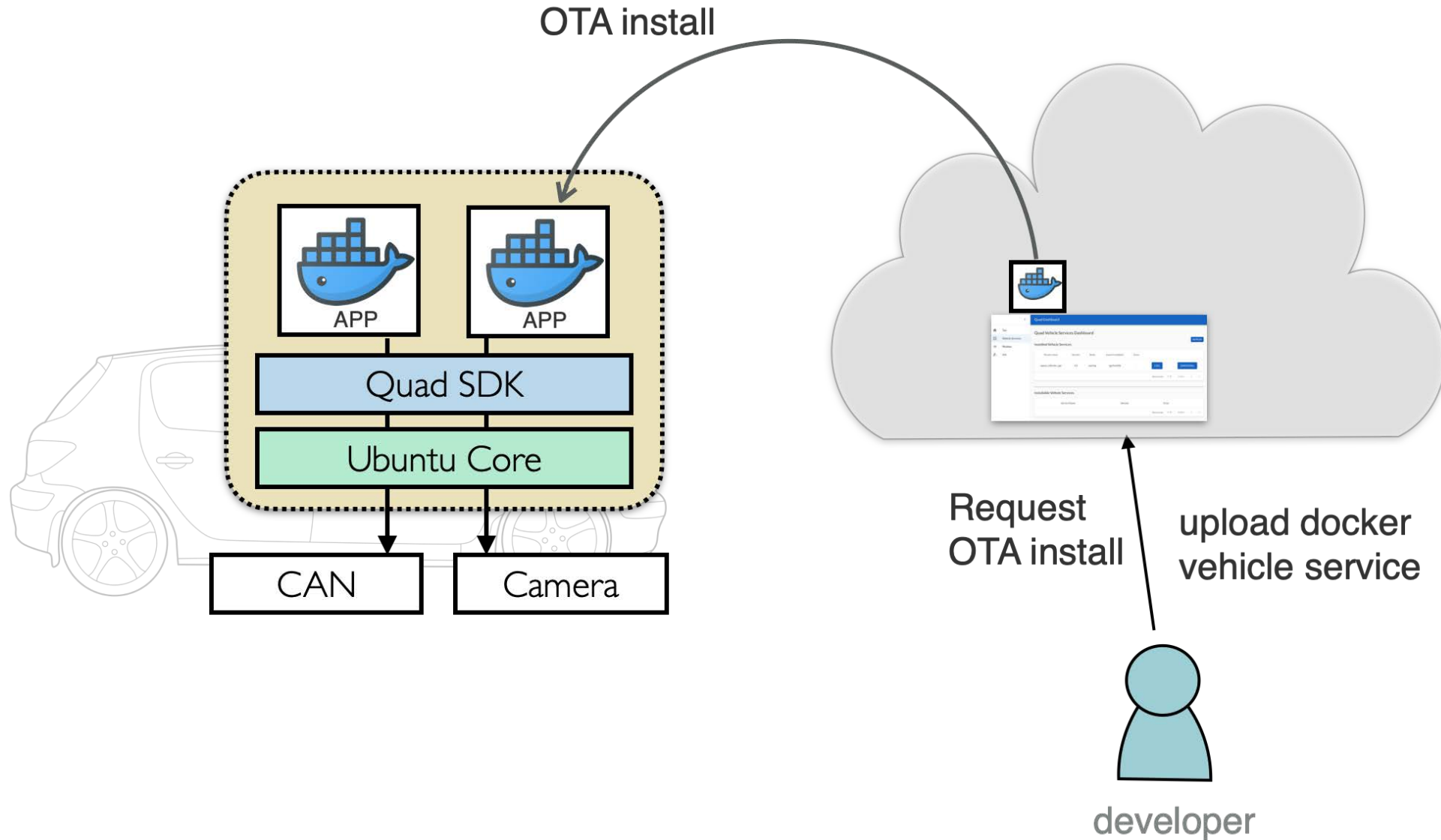
Architecture

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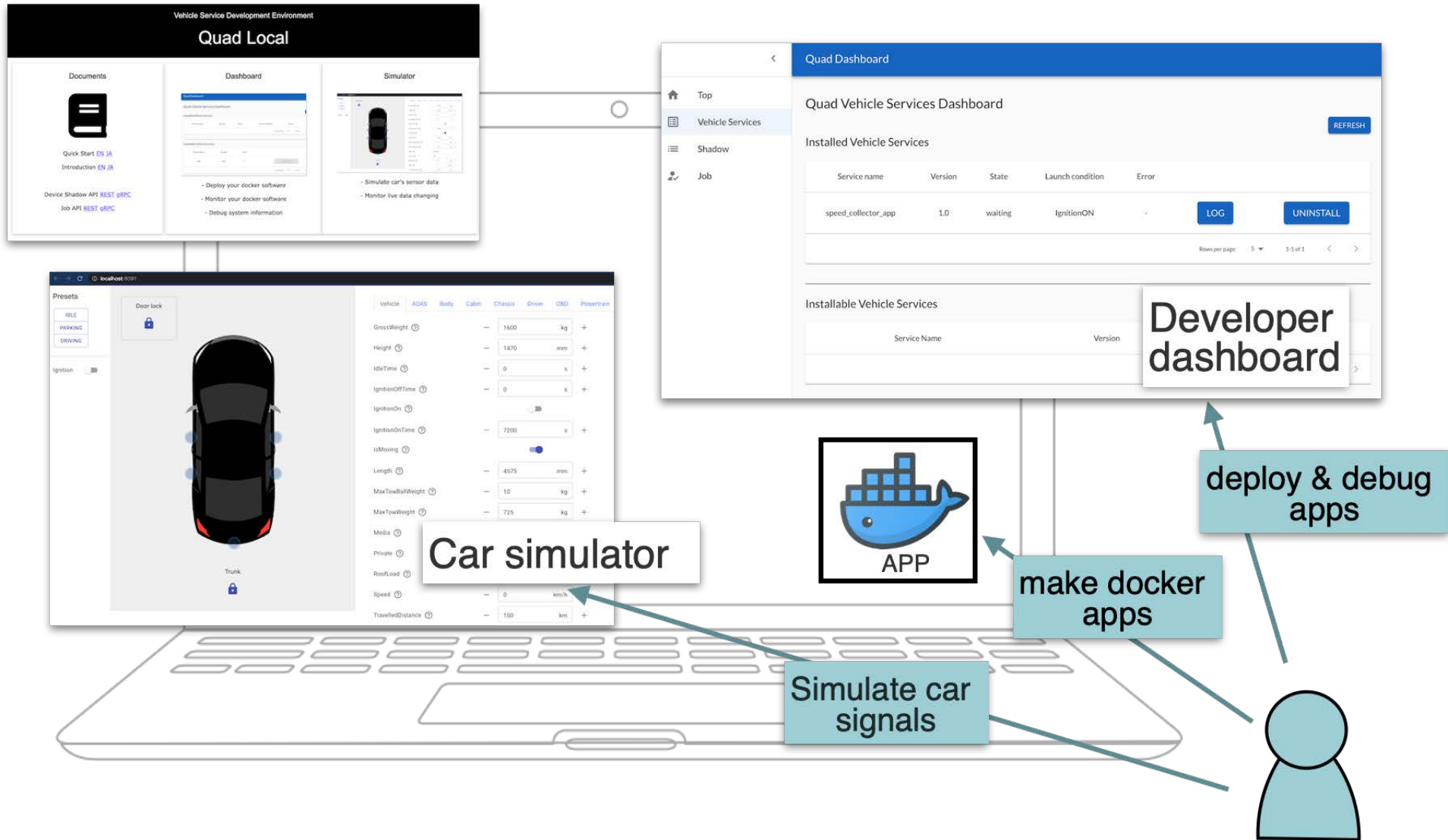
Car Developer's Journey

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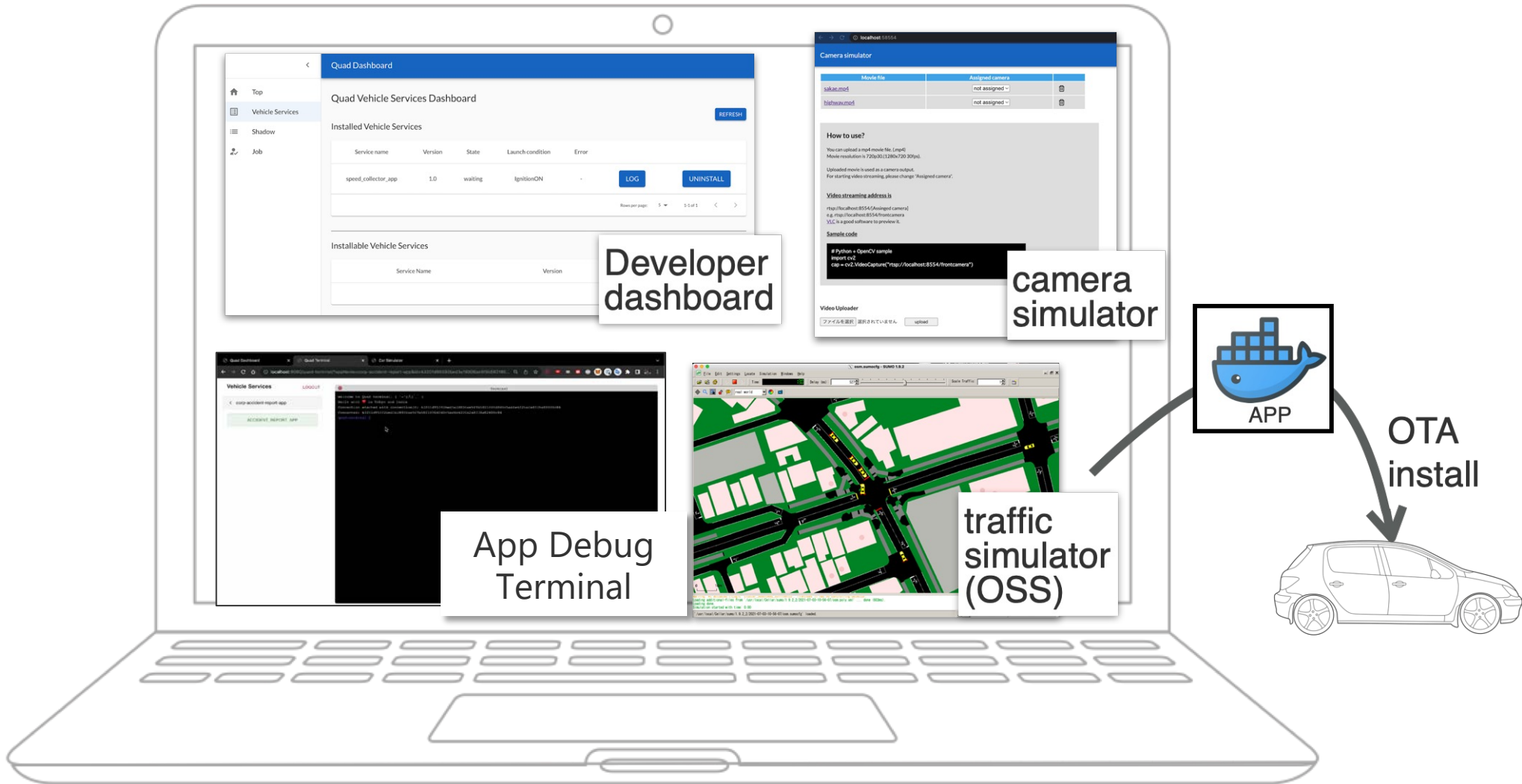
QUAD's Development tools

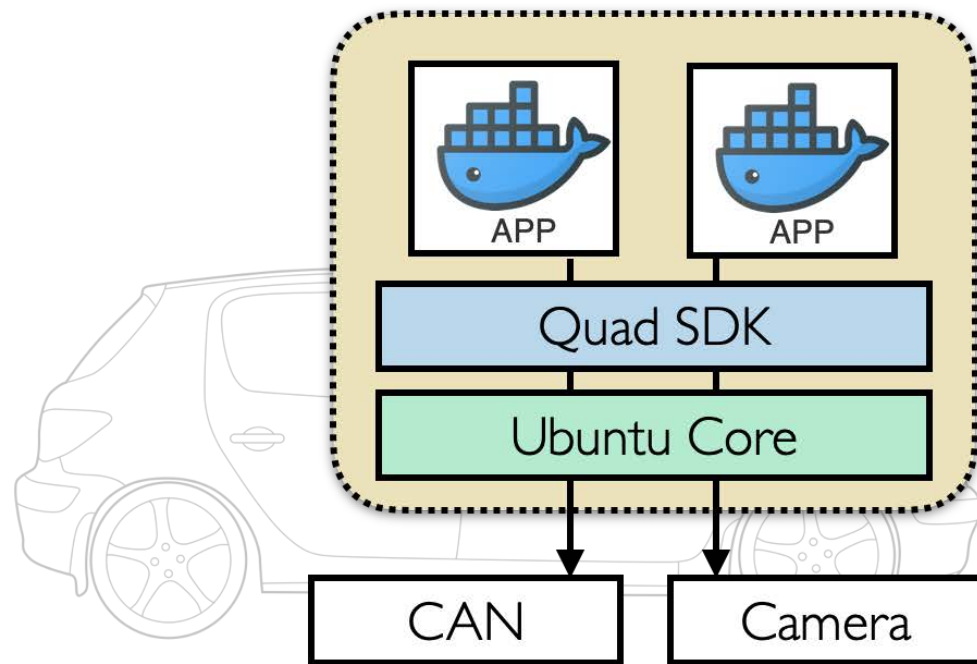
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QUAD's Development tools

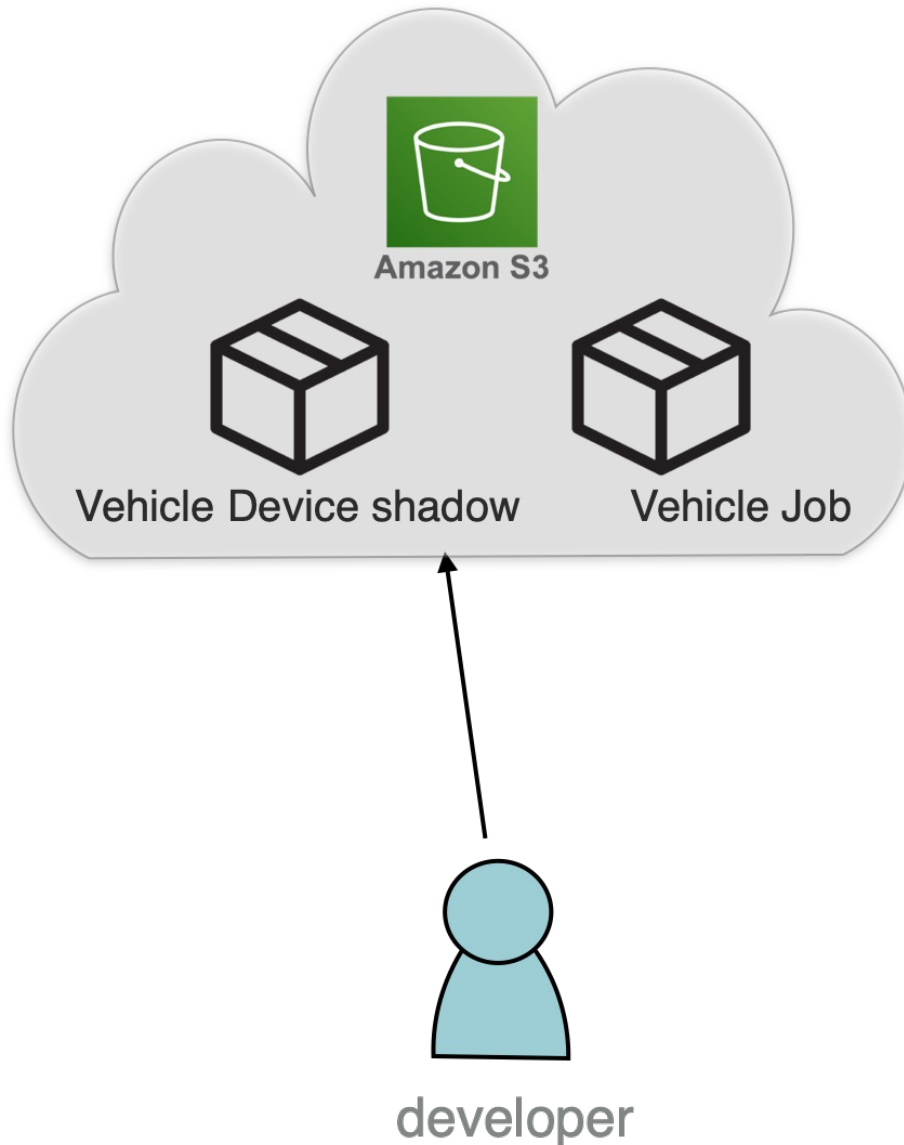
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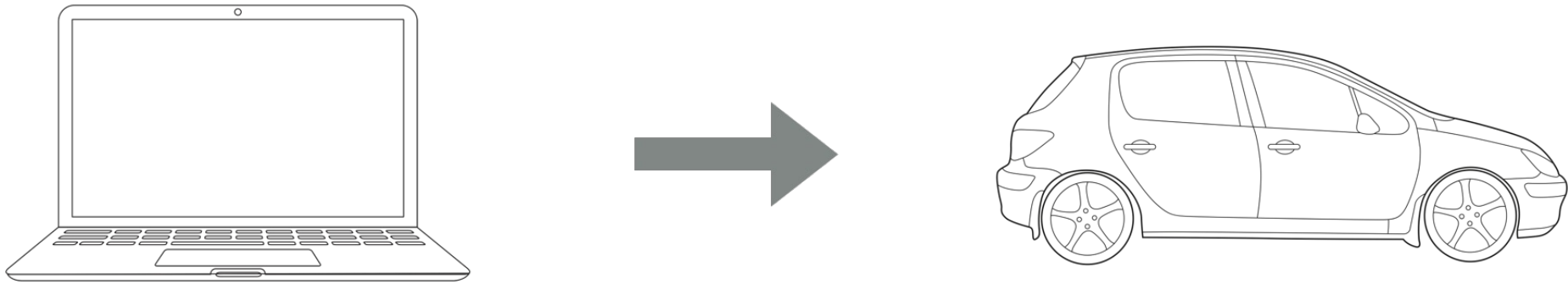
In-vehicle APIs

- **Device shadow API**
 - Read CAN data
 - Get desire data from the cloud
 - Report data to the cloud
- **Job API**
 - Get job request from the cloud
 - Send job status and response to the cloud
- **File upload API**
 - Upload a file to the cloud
- **Camera API**
 - Use multiple cameras
- **Sound API**
 - Play sound on the speaker



Cloud APIs

- **Device shadow API**
 - Get vehicle's report data
 - Send desire data to the vehicle
- **Job API**
 - Send job request to the vehicle
 - Check job result
- **AWS S3**
 - Get uploaded data
 - Get Event via S3 Event API



Shortening the time between development to the road
< 1 day

2

The Role of VSS Signals

Leveraging VSS in QUAD

Car Simulator

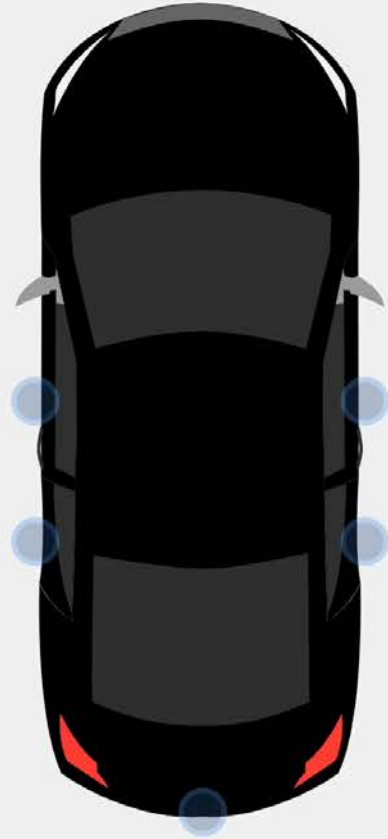
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Presets

- IDLE
- PARKING
- DRIVING

Ignition

Door lock

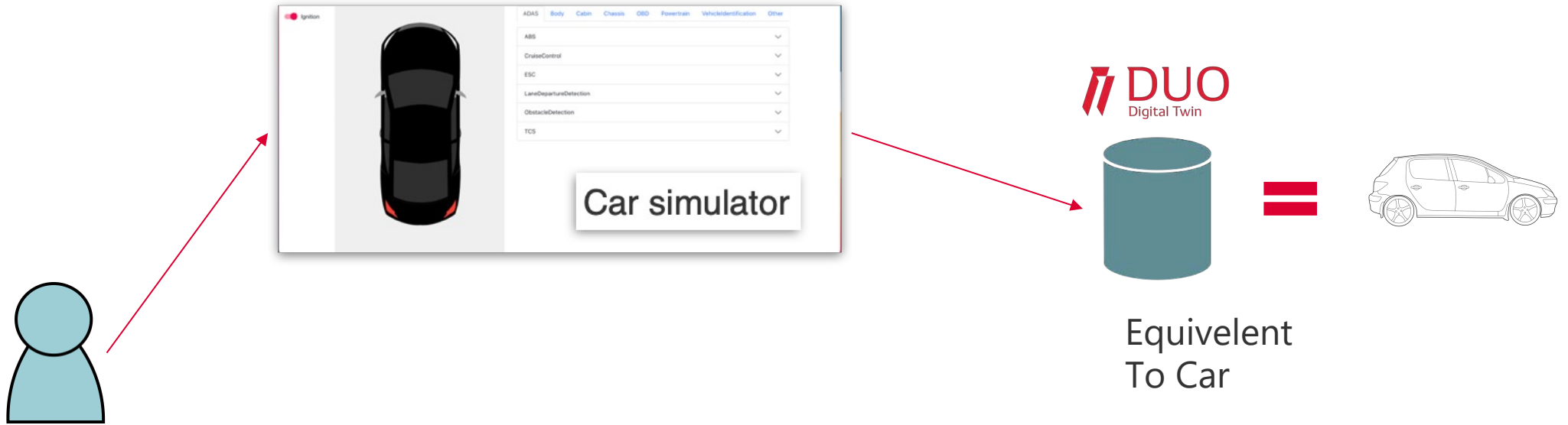


Vehicle ADAS Body Cabin Chassis Driver OBD Powertrain

CargoVolume ?	-	0	l	+
CurbWeight ?	-	1400	kg	+
CurrentOverallWeight ?	-	0	kg	+
EmissionsCO2 ?	-	0	g/km	+
GrossWeight ?	-	1600	kg	+
Height ?	-	1470	mm	+
IgnitionOn ?				<input type="checkbox"/>
IsMoving ?				<input type="checkbox"/>
Length ?	-	4575	mm	+
LowVoltageSystemState ?				<input type="text"/>

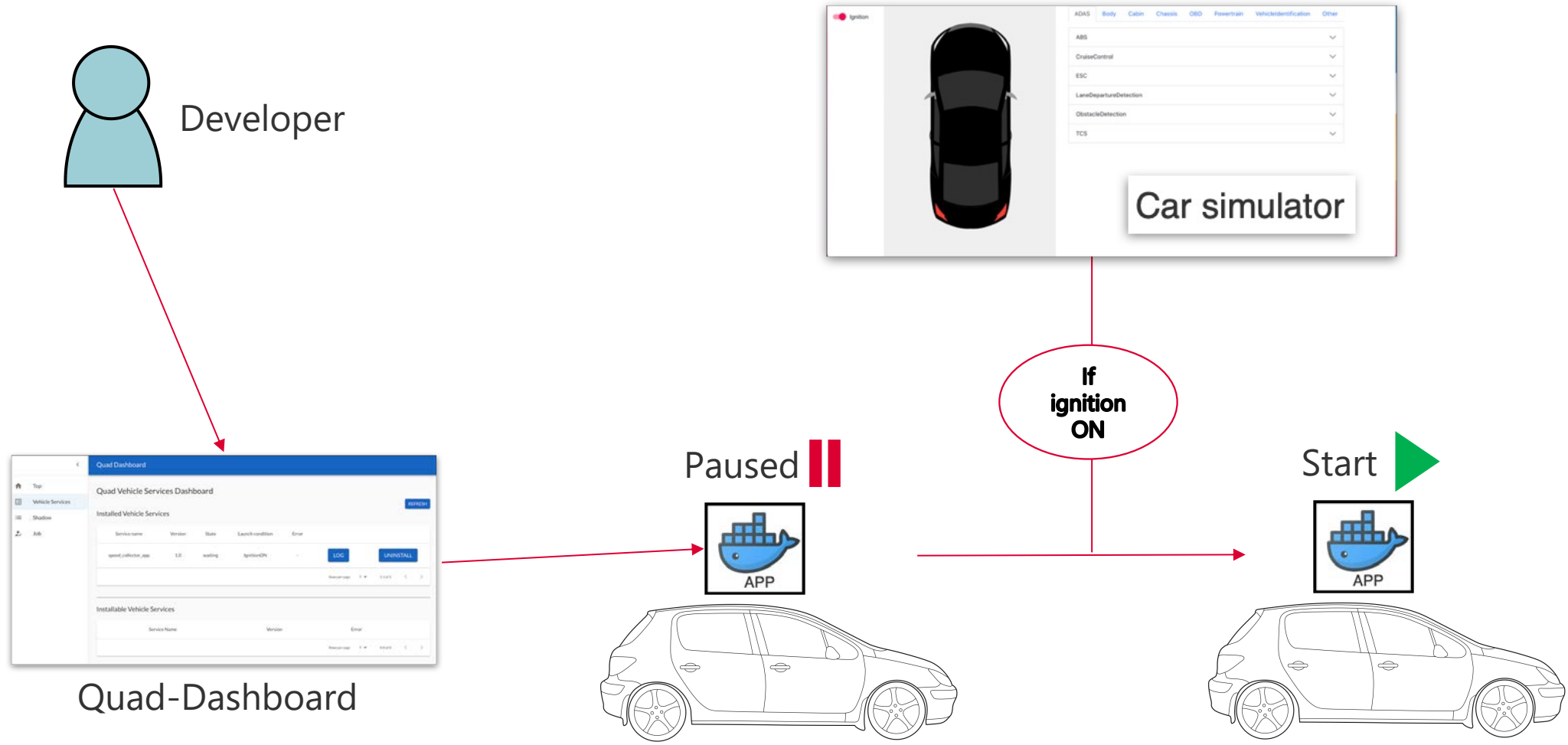
Car simulator

We used vss signals generated using vss-tools scripts and made a data structure used in our simulator.



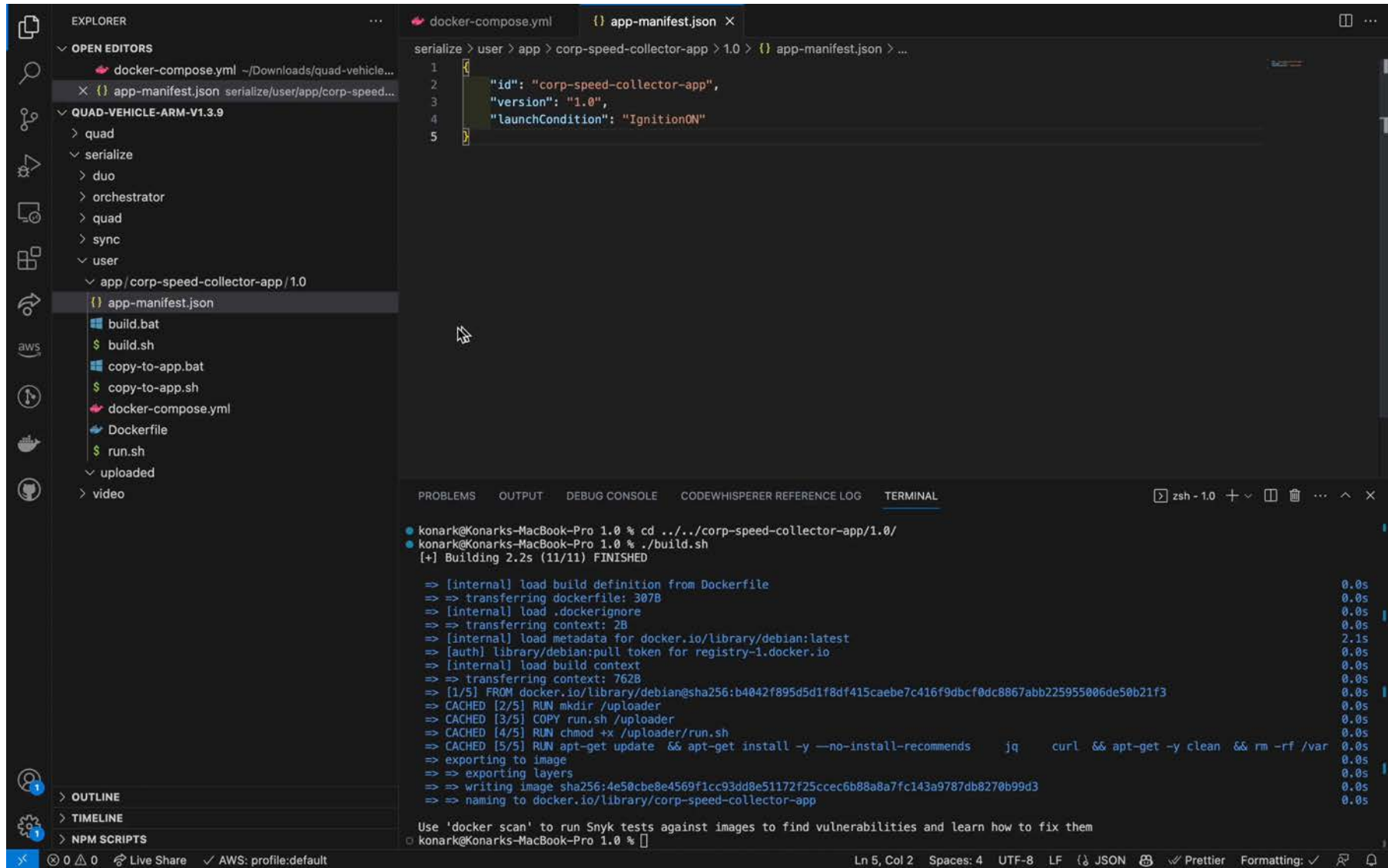
Car simulator with QUAD

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Car simulator with QUAD

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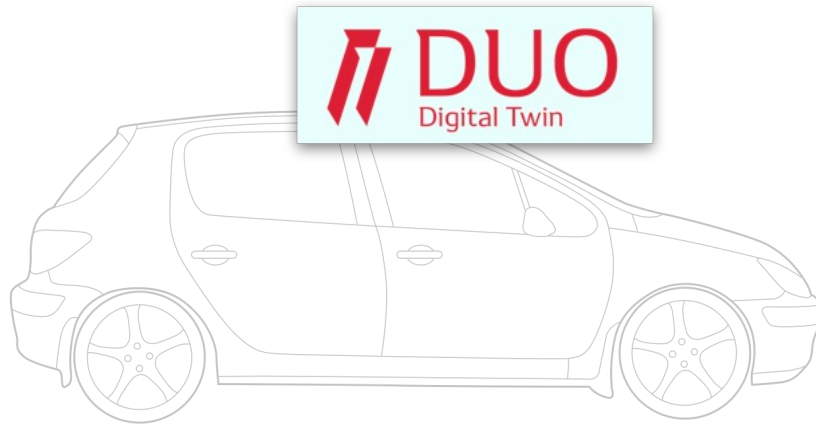


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DUO

The Digital Twin

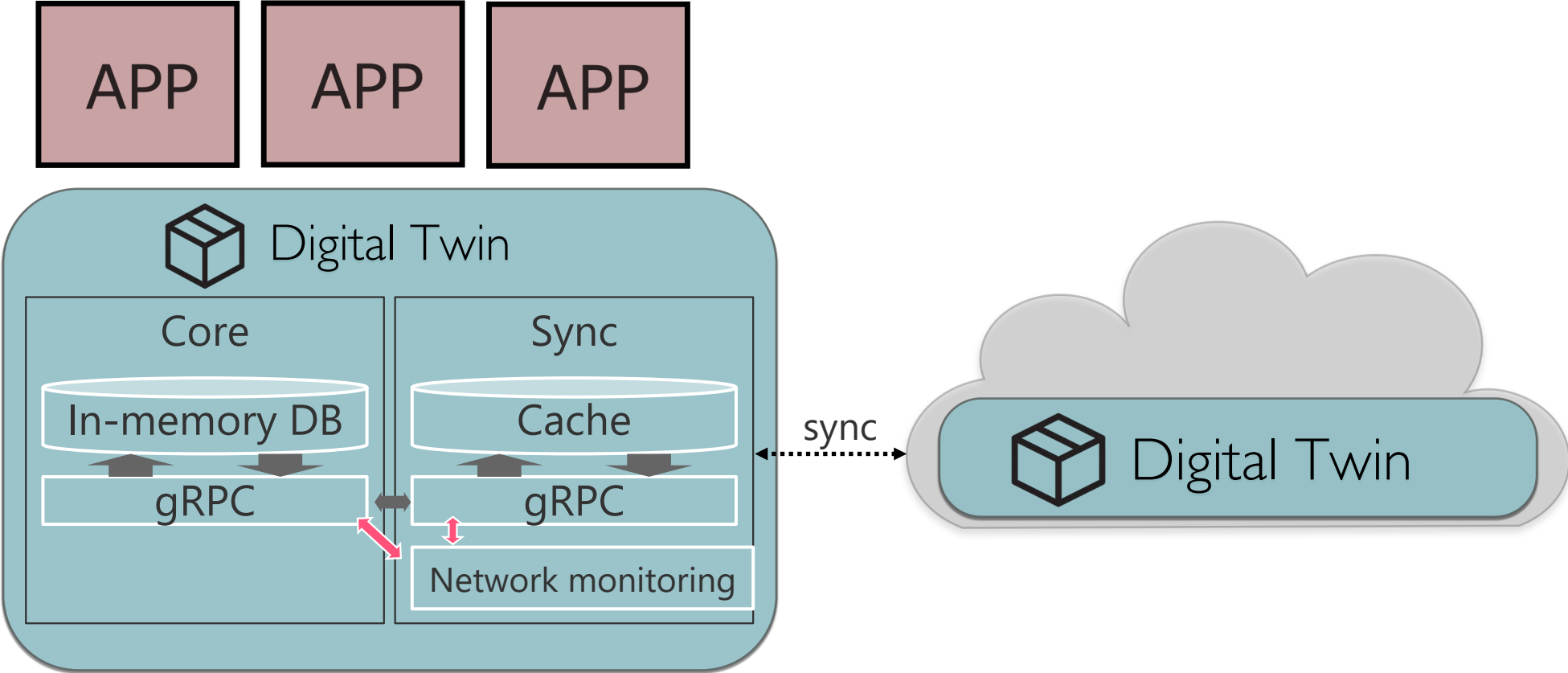
DUO Edge



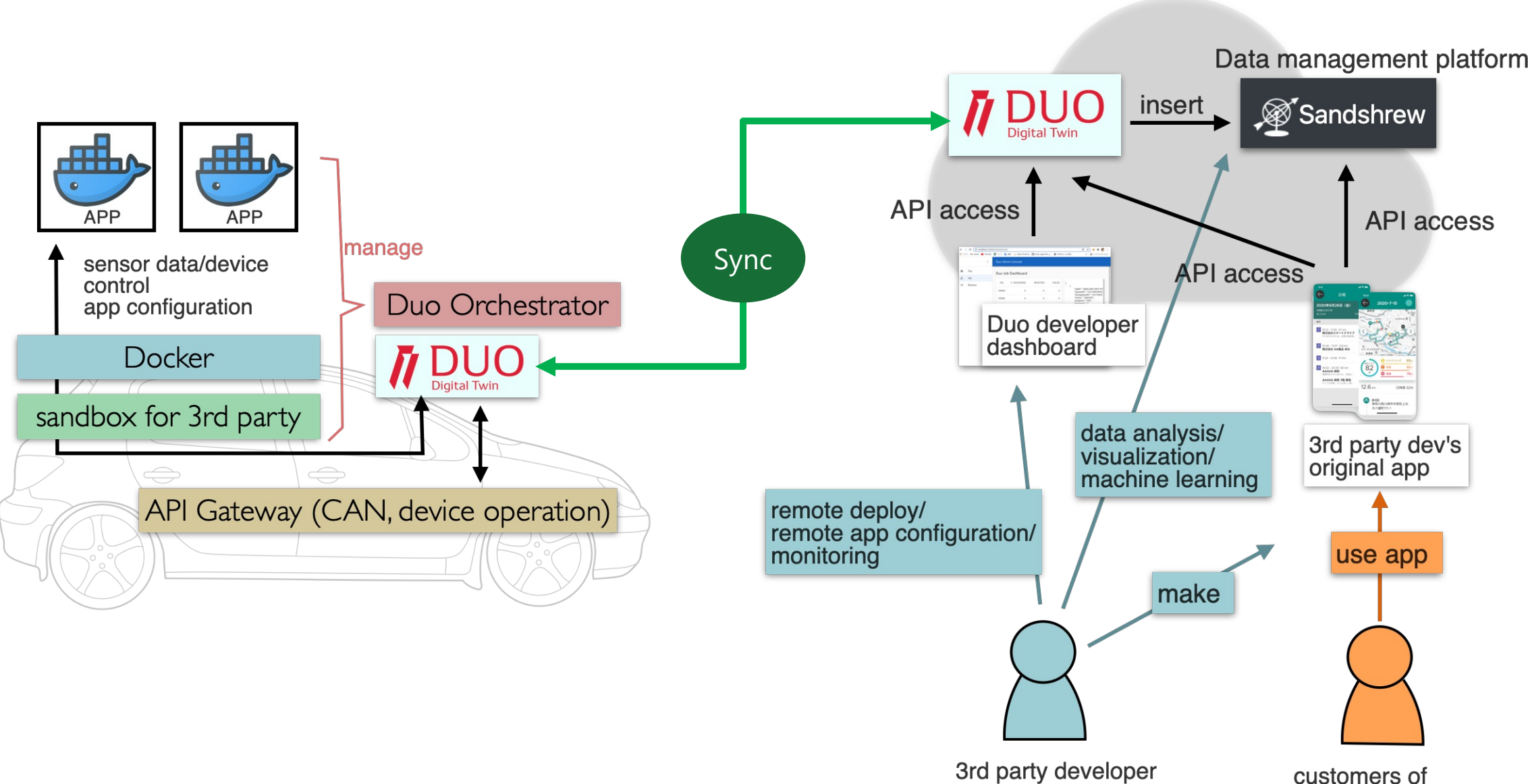
Sync

DUO Cloud





DUO Architecture



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QUAD DASHBOARD

Remote Application Management

Quad-dashboard

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The 'Quad Vehicle Services Dashboard' for DeviceID: device123. It features a sidebar with navigation options: Top, Vehicle Services, Shadow, Job, and Service Repository. The main content area is titled 'Quad Vehicle Services Dashboard' and includes a 'REFRESH' button. It displays two tables:

- Installed Vehicle Services:** A table with columns for Service name, Version, State, Launch Conditions, and Error. It contains one entry: 'corp-accident-report-app' (Version 1.0, State waiting, Launch Conditions IgnitionON, Error -). Action buttons 'LOG' and 'UNINSTALL' are present for this entry.
- Installable Vehicle Services:** A table with columns for Service Name, Version, and Error. It is currently empty.

The 'Service Repository' dashboard for DeviceID: device123. It features a sidebar with navigation options: Top, Vehicle Services, Shadow, Job, and Service Repository. The main content area is titled 'Service Repository' and includes 'REGISTER SERVICE' and 'REFRESH' buttons. It displays a table with columns for Service Name, Version, and Status. It contains one entry: 'corp-accident-report-app' (Version 1.0, Status ready). Action buttons 'FILES' and 'DELETE' are present for this entry.

- All the services ready for installation and which are already installed are listed here.

- Can be used to directly install an available service.

Quad Cloud Dashboard

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Quad-dashboard

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Job Dashboard

Shadow Dashboard

Thing	SUCCEEDED	REJECTED	FAILED	IN_PROGRESS
corp-accident-report-app	0	0	0	0
corp-speed-collector-app	0	0	0	0
uploader	0	0	0	0
orchestrator	0	0	0	0
vss	0	0	0	0

```
{  "report": {    "services": {      "corp-accident-report-app": {        "error": "",        "launchConditions": [          "IgnitionON"        ],        "running": "waiting",        "serviceName": "corp-accident-report-app",        "version": "1.0"      }    }  },  "desire": {}}
```

- Job: Think of it as a "set" of instructions to a service.
- Shows the status of a job.

- Can be used to check the reported and desired shadow data.

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TERMINAL

Debugging containers remotely

Quad Dashboard DeviceID: device123

Top
Vehicle Services
Shadow
Job
Service Repository

Quad Vehicle Services Dashboard

[REFRESH](#)

Installed Vehicle Services

Service name	Version	State	Launch Conditions	Error
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Rows per page: 5 0-0 of 0

Installable Vehicle Services

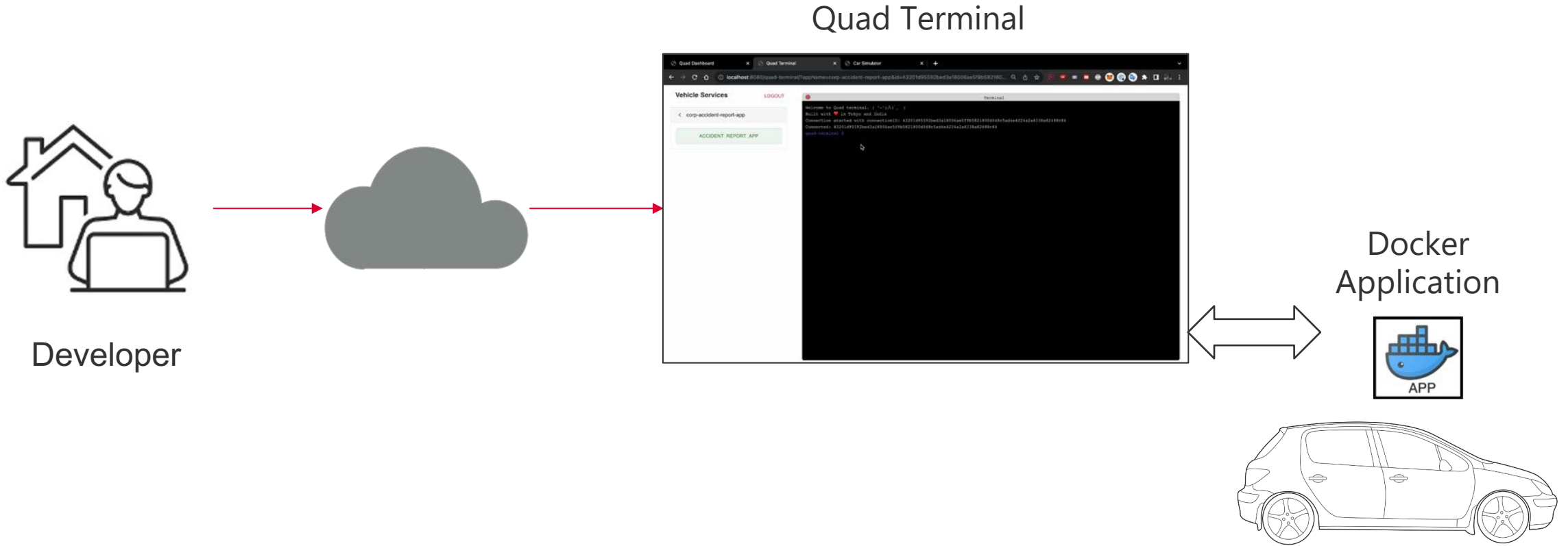
Service Name	Version	Error
corp-accident-report-app	1.0	-

[INSTALL](#)

Rows per page: 5 1-1 of 1

Accessing QUAD Terminal Remotely

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REAL WORLD APPLICATIONS

QUAD USE CASES

Food delivery company

How developing an app on QUAD can help food delivery companies?



Using the CAN signals that they will have access to from QUAD, it would be easy for them to:

- Develop & Deploy application
- Debug a vehicle remotely
- Everything in one place

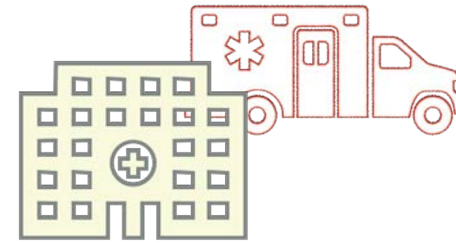


Government owned vehicles

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Some state-controlled departments:

- Police: Cop vehicles
- Hospitals: Ambulances
- Fire department: Fire brigades



Using our platform QUAD, developers can build applications which can help in:



- Keeping track of all state-owned vehicles
- Maintenance: Which vehicle needs service, are not working, ...
- Availability: Which car is nearest to the needed area zone.
- Exchanging and recording data, actual scene footage

The same concept can be extended to:

- Cab companies
- Oil and gas companies
- Security company
- Tourism company
- Public transport buses
- Logistics company
- and so on ...



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Future roadmap

Future roadmap

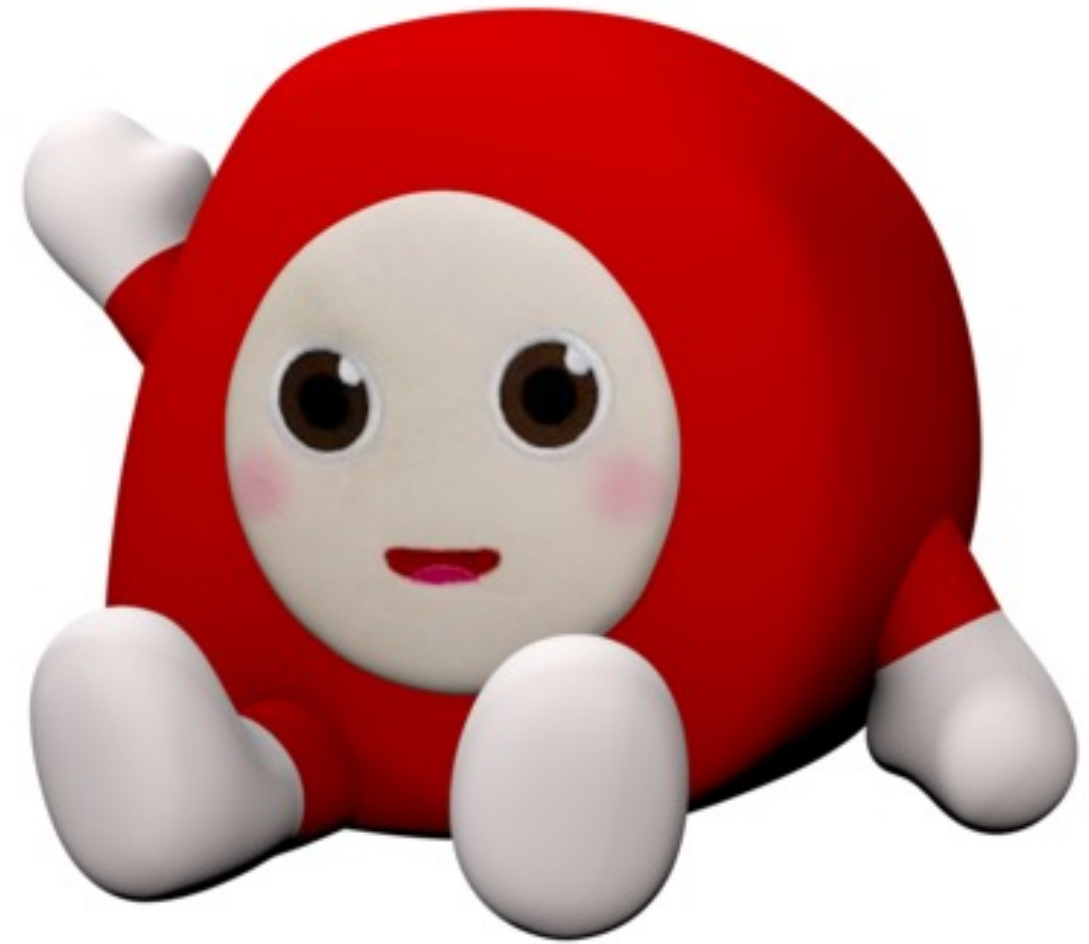
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- Continue to operate with market services and gather customer needs.
- Support WebAssembly apps as well, which will enable them to run-on low-cost hardware.



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Thank you



DENSO

Crafting the Core

8

Extras (Data Management in QUAD)

Data management

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