

Accelerating IOT development

Leveraging VSS at the Edge

10/10/2023

Aman Gupta Konark Verma

DENSO CORPORATION





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About us



Aman Gupta Software Engineer DENSO CORPORATION



Konark Verma

Software Engineer DENSO CORPORATION





About our Company

DENSO CORPORATION Worldwide



*From April 1, 2022 to March 31, 2023

DENSO Crafting the Core

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





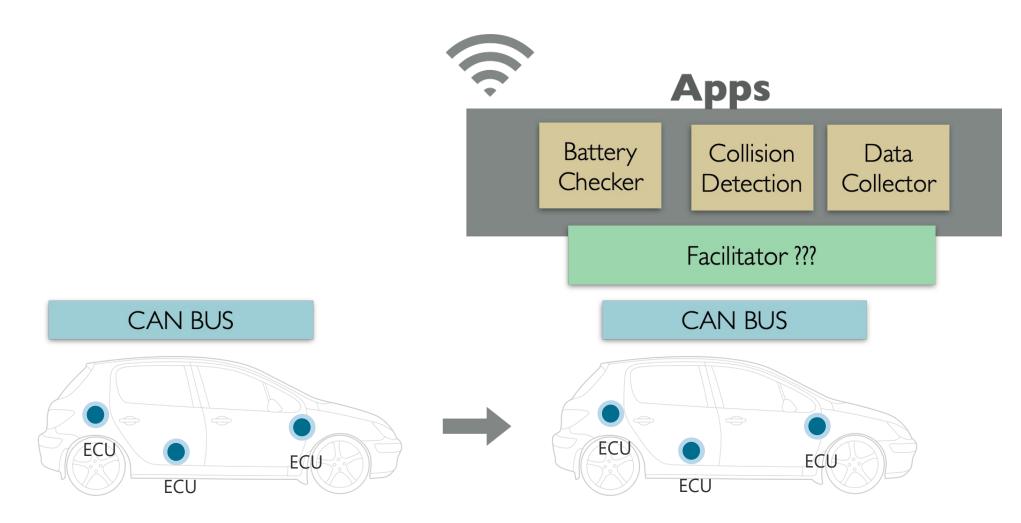
Introduction to QUAD

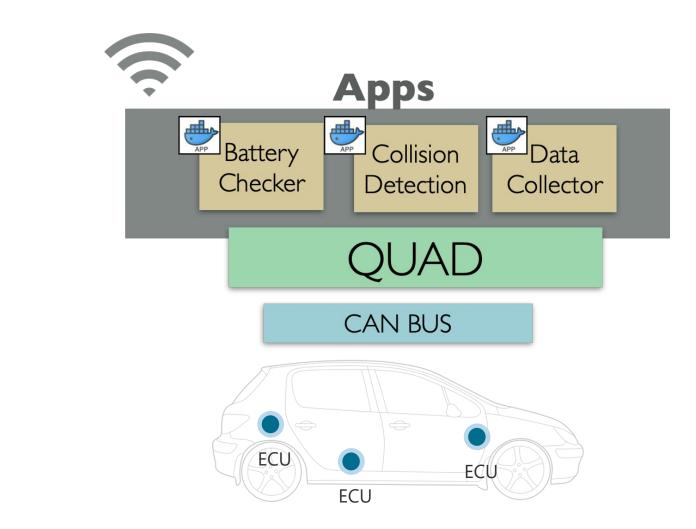
A complete vehicle IOT development platform



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Need for QUAD?





Quad

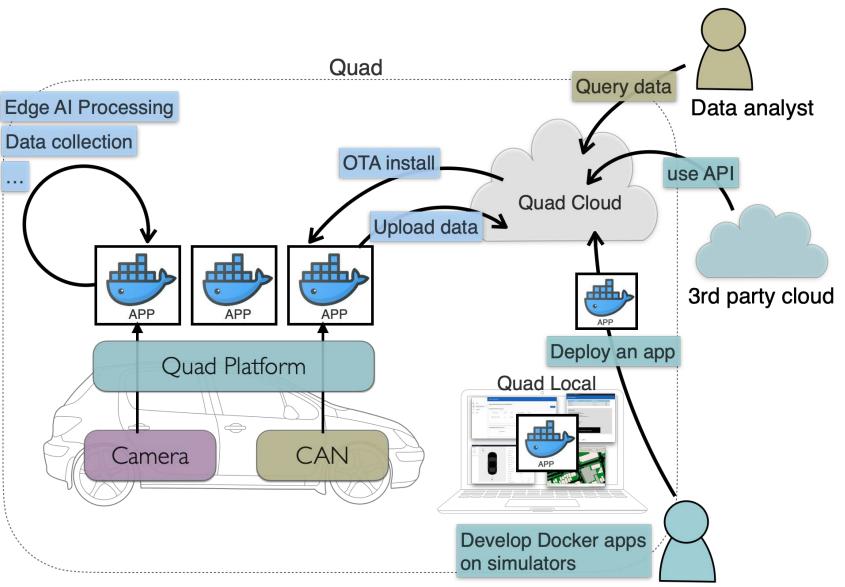
Docker-based 3rd party development environment

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Architecture

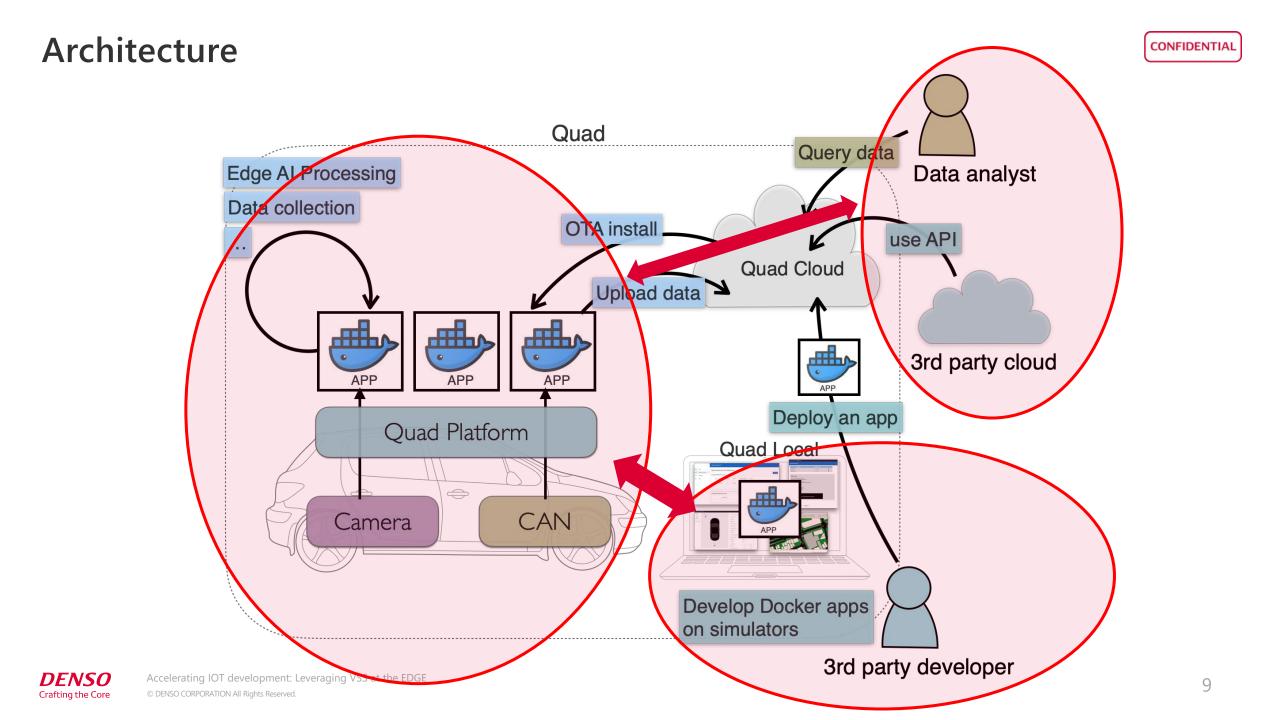
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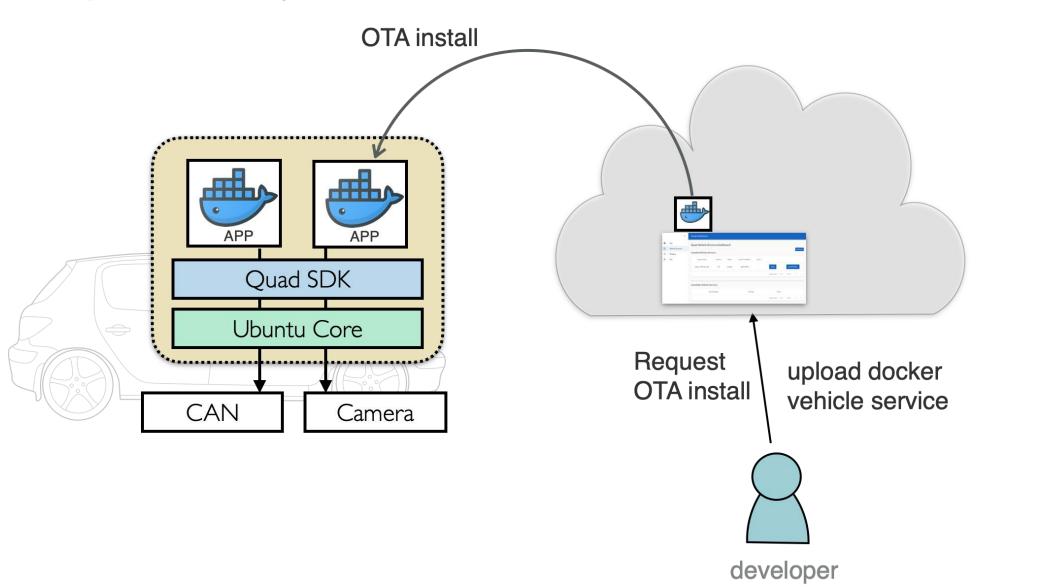




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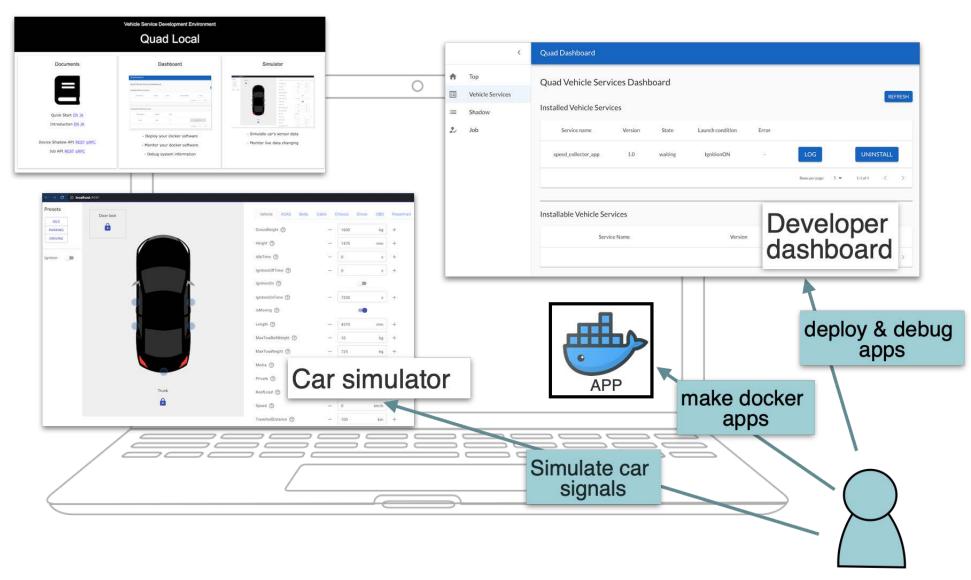
Car Developer's Journey



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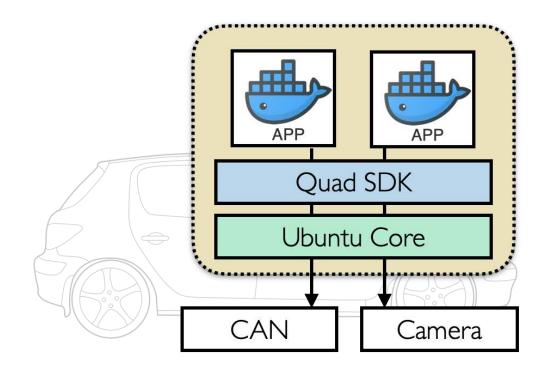
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QUAD's Development tools



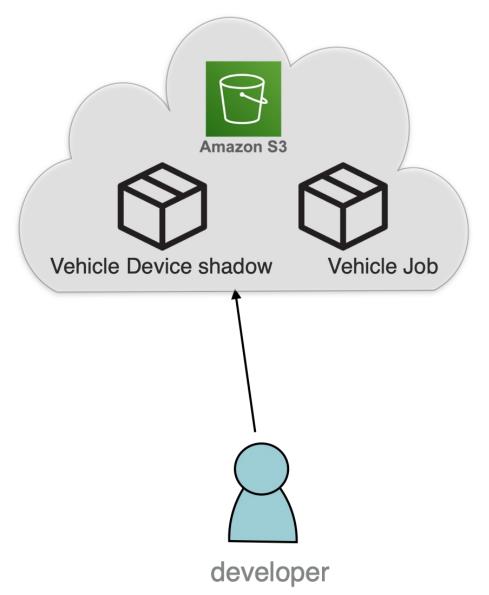
QUAD's Development tools

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		App Debug Terminal	A service of the serv		traffic simulator (OSS)	



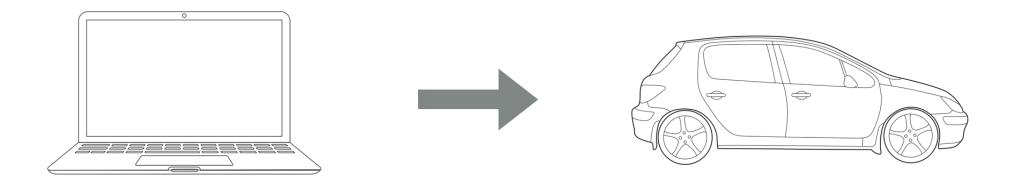
In-vehicle APIs

- 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 $< 1 \, day$



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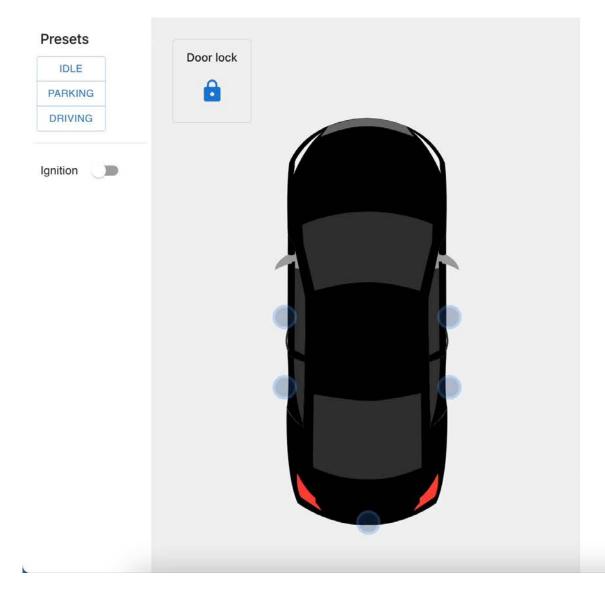
The Role of VSS Signals

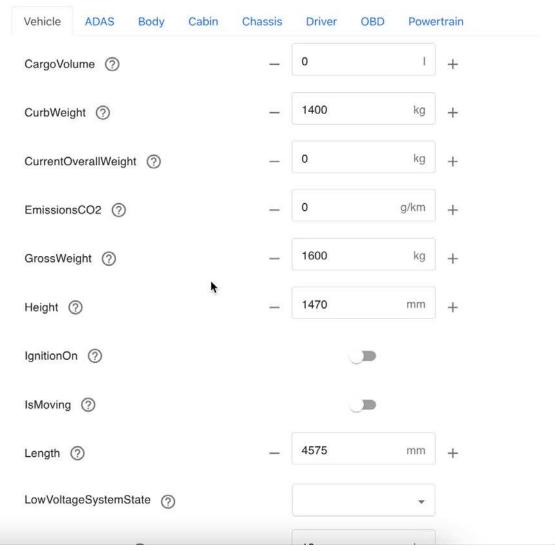
Leveraging VSS in QUAD



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Car Simulator

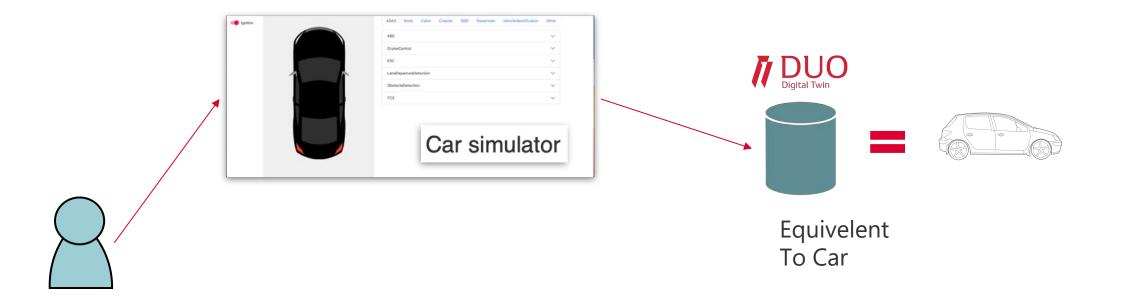




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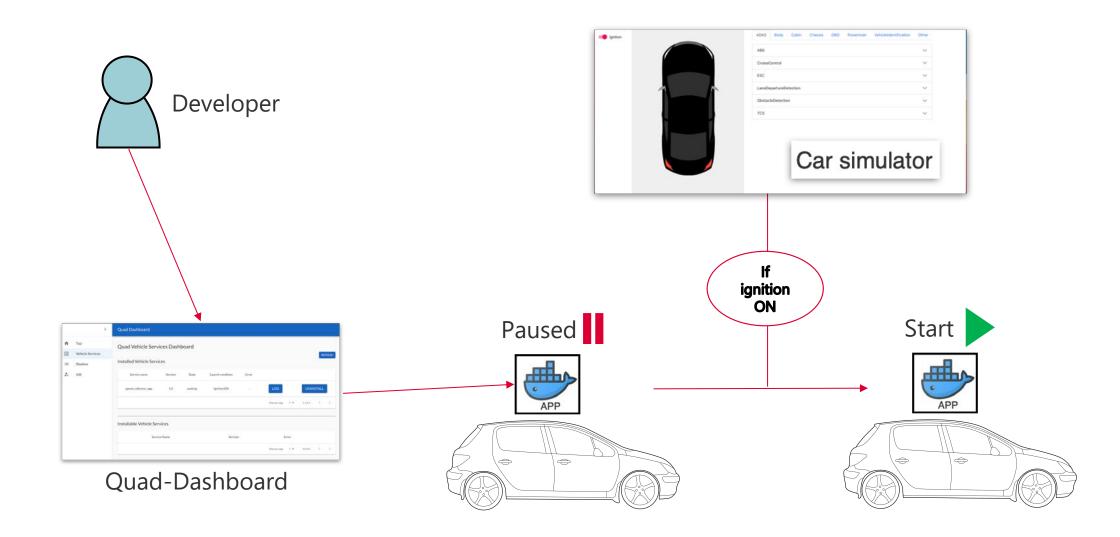
Car simulator

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



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Car simulator with QUAD





Car simulator with QUAD

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ę,	V QUAD-VEHICLE-ARM-V1.3.9	3 "version": "1.0", 4 "launchCondition": "IgnitionON"	-
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		⇒> [internal] load build definition from Dockerfile ⇒> transferring dockerfile: 307B	0.0s 0.0s
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		<pre>=> [internal] load build context => => transferring context: 7628</pre>	0.05 0.05
		<pre>>> [1/5] FROM docker.io/library/debian@sha256:b4042f895d5d1f8df415caebe7c416f9dbcf0dc8867abb225955006de50b21f3 => CACHED [2/5] RUN mkdir /uploader</pre>	0.05 I 0.05
		⇒ CACHED [3/5] COPY run.sh /uploader	0.05
		=> CACHED [4/5] RUN chmod +x /uploader/run.sh => CACHED [5/5] RUN apt-get update && apt-get install -y —no-install-recommends jq curl && apt-get -y clean && rm -rf /var	
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8	> OUTLINE	<pre>=> writing image sha256;4e50cbe8e4569f1cc93dd8e51172f25ccec6b88a8a7fc143a9787db8270b99d3 => => naming to docker.io/library/corp-speed-collector-app</pre>	0.05 0.05
553	> TIMELINE	Use 'docker scan' to run Snyk tests against images to find vulnerabilities and learn how to fix them	
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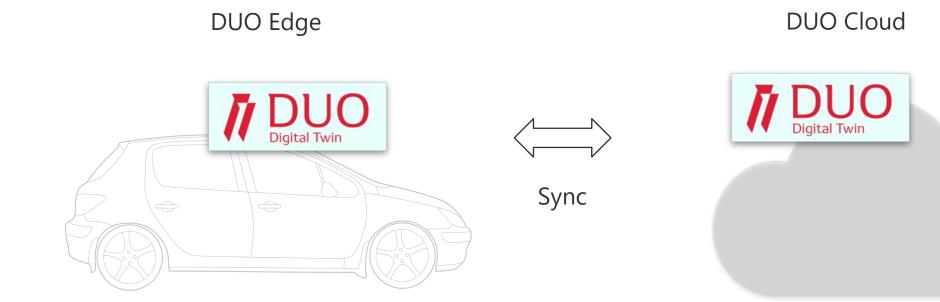


DUO

The Digital Twin

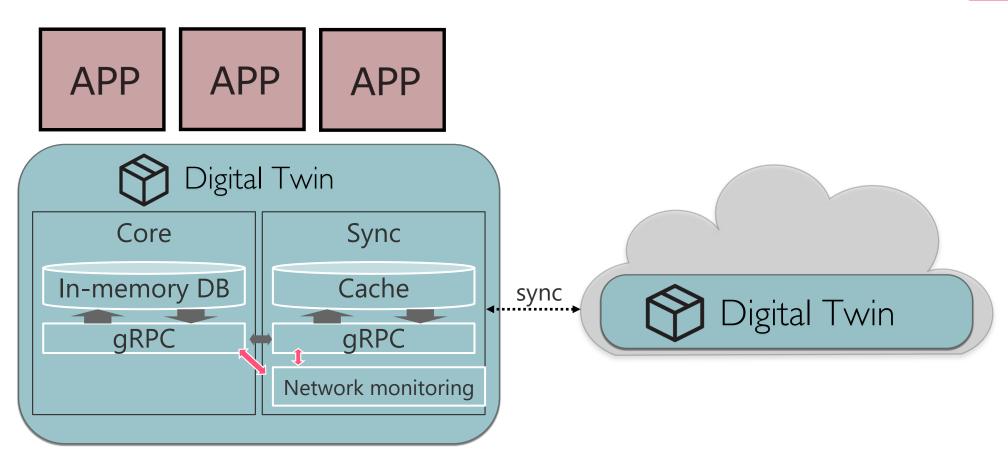


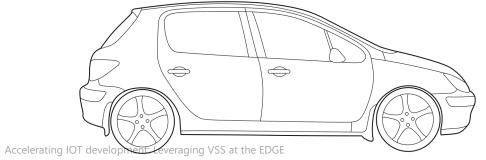
DUO



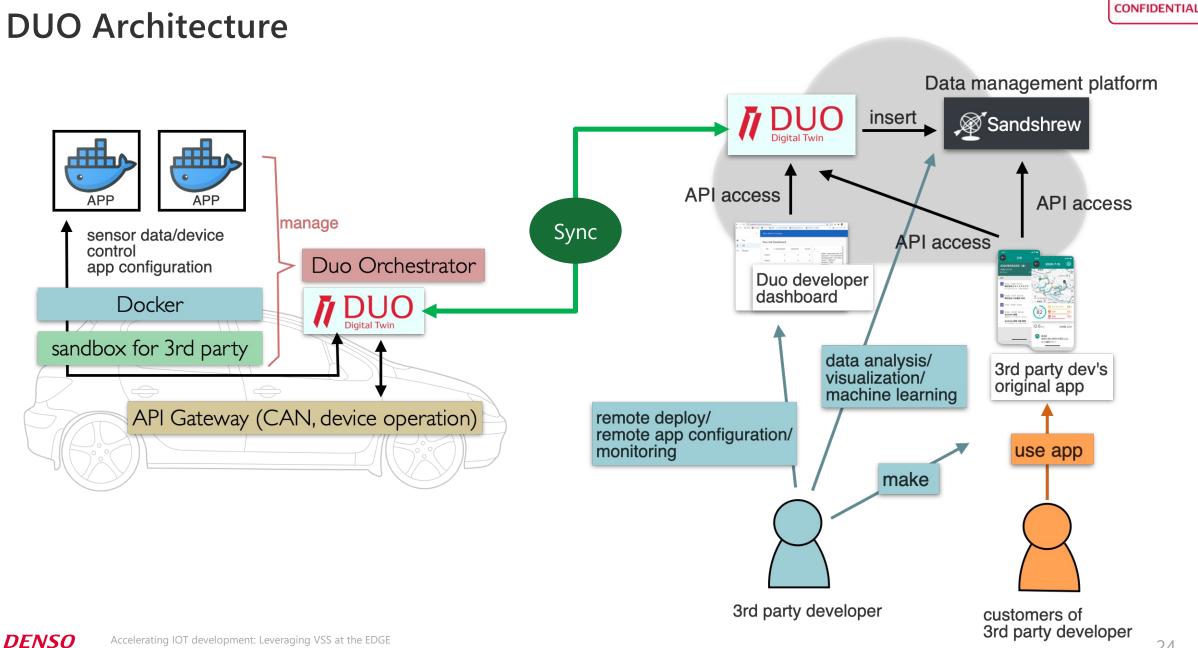
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QUAD DASHBOARD

Remote Application Management



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Quad-dashboard



Vehicle Services

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 ✓ ✓	Quad Vehicle Services Dashboard Installed Vehicle Services Service name Version State Launch Conditions Error corp-accident-report-app 1.0 waiting IgnitionON - LC	REFRESH	 ▲ Top ☑ Vehicle Services IIII Shadow ▲ Job IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	Quad Dashboard Service Repository REGISTER SERVICE REFRESH Service Name Version corp-accident-report-app 1.0	Status ready FILES Besisper sage: 5 • bil of 1 < >
	Installable Vehicle Service Name Version	Error			

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

• Can be used to directly install an available service.

Services Repository



Quad Cloud Dashboard



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Quad-dashboard



Job Dashboard

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•	Top Vehicle Services	Quad Job REFRESH	Dashboard					
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		Send Job Thing	Thing			_		
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Shadow Dashboard

	¢	Quad Dashboard	DeviceID: device123
↑	Top Vehicle Services	Quad Shadow Dashboard	
=	Shadow	Thing	
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		corp-speed-collector-app	"error": "", "launchConditions": ["IgnitionDN"
		orchestrator], "running": "waiting",
		service >	"serviceName": "corp-accident-report-app", "version": "1.0"
		uploader }, }	
		Romperpage S = 15 or 5 < 3	
		Send Shadow Message	
		Thing Thing	
		Payload Payload	
		REPORT 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

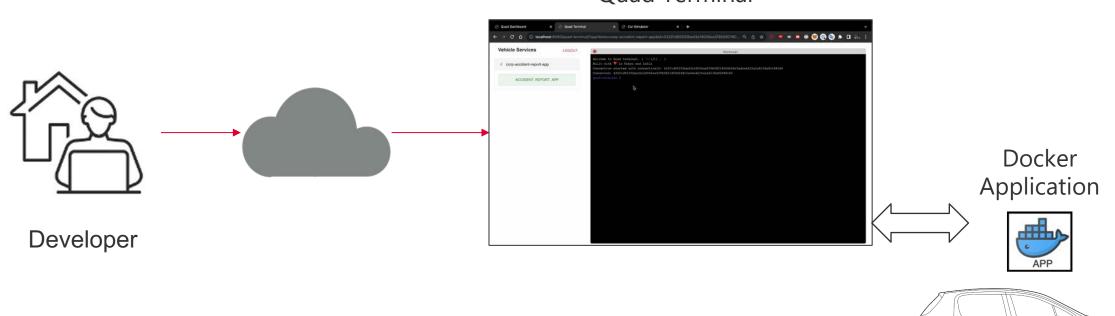
Debugging containers remotely

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		Installable Vehicle	Services						
		Se	rvice Name	Version	Error				
		corp-ac	cident-report-app	1.0		INSTALL			
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Accessing QUAD Terminal Remotely



Quad Terminal



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REAL WORLD APPLICATIONS

QUAD USE CASES



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Food delivery company

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

Ρ Panda-Food-Corp owned vehicles + own app 1 (Food Delivery Company)

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

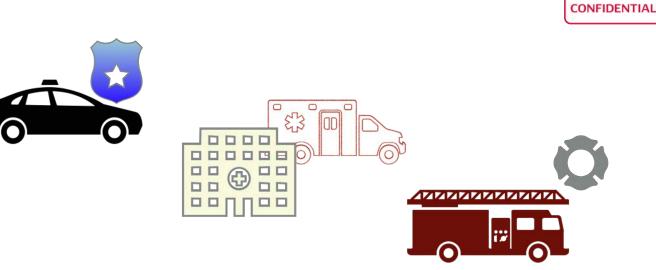
- **Develop & Deploy application** ۲
- Debug a vehicle remotely
- Everything in one place ۲



Government owned vehicles

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:

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



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Future roadmap



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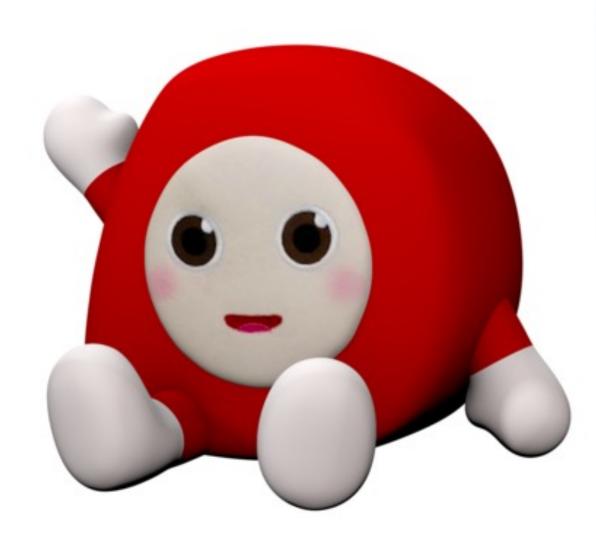
Future roadmap

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











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Extras (Data Management in QUAD)



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Data management





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