(Source: CSS Electronics)

Fleet electrification of Danish police cars

A recent case study by CSS Electronics shows how the Danish National Police uses the CANedge1 data logger with GPS/IMU (global positioning system/inertial measurement unit) in a vehicle electrification evaluation for patrol cars.

The Danish National Police is the highest authority within the Danish police. The Centre for Fleet and Equipment Management is responsible for managing the police vehicle fleet, amongst other responsibilities. The project was led by Carsten Noerregaard, Special Consultant at the Danish National Police.

As part of the green transition, the Danish National Police decided to conduct a pilot test of 10 electric uniformed patrol vehicles (VW ID.4 GTX) with the goal of evaluating their performance in daily operational situations. One key aspect was to determine if the EV-based range would impose any limitations on regular patrol duties.

To avoid purely anecdotal evidence, the police aimed to collect vehicle data from the 10 pilot EVs (electric vehicles) and compare it to a benchmark fleet of 100 fossil patrol vehicles. The data collection was to be conducted through all of 2023 across four police districts (due to geography being a significant factor).

Realized solution

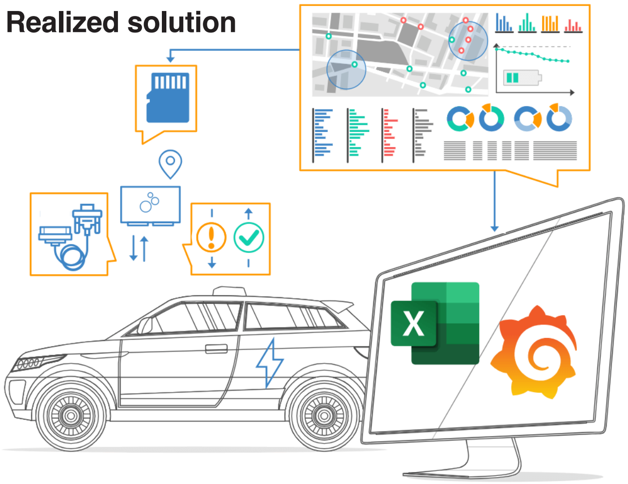


Figure 1: Case study setup (Source: CSS Electronics)

To solve this, the team used the CANedge1 including GPS/IMU from CSS Electronics to collect the vehicle data, as well as provide the GPS data required for the analyses. The data logger enabled the collection of various parameters of interest, including state of charge, speed, temperatures (battery, indoor, outdoor), position, trip distance, and more.

The device was configured to request data via the vehicle OBD2 (on-board diagnostics) connector. The specific CAN-based higher-layer protocols involved were OBD2 (from the ICE cars) and UDS (from the VW ID.4 EVs).

The data was collected from the device SD cards periodically and processed through a Python script in order to create decoded data for analysis. Importantly, the script also added custom geofence information, allowing the Danish National Police to e.g., evaluate the duration a vehicle would spend within a certain police station (i.e., an area with charging facilities) versus on-the-road.

The resulting dataset comprised several gigabytes and was analyzed through the use of Excel pivot tables and Grafana dashboard visualization. This allowed the team to produce reports that could be used as data-based supplements to the first-hand driver experiences. You can view a Grafana dashboard playground for the ID.4 electric car here.

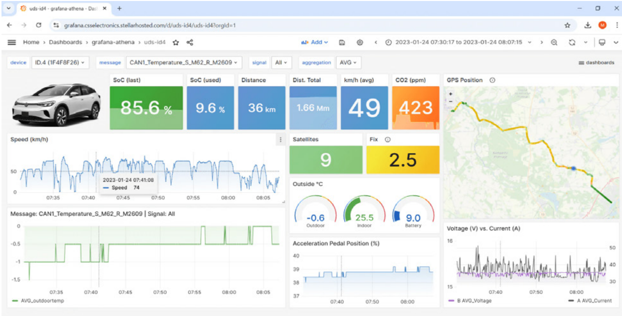
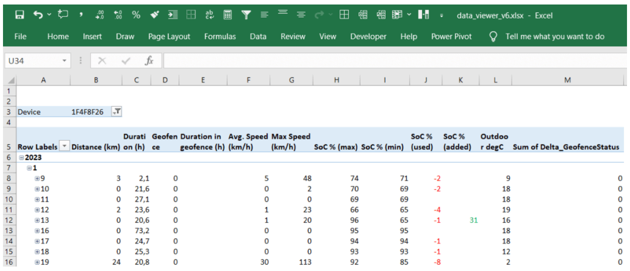


Figure 2: Grafana dashboards were used to provide ad hoc data visualization (Source: CSS Electronics)



data_viewer_v6.xlsx - Excel

Device 1F4F8F26

Row Labels	Distance (km)	Duration (h)	Geofence	Duration in geofence (h)	Avg. Speed (km/h)	Max Speed (km/h)	SoC % (max)	SoC % (min)	SoC % (used)	SoC % (added)	Outdoor degC	Sum of Delta_GeofenceStatus
2023												
1												
9	3	2,1	0		5	48	74	71	-2		9	0
10	0	21,6	0		0	2	70	69	-2		18	0
11	0	27,1	0		0	0	69	69			18	0
12	2	23,6	0		1	23	66	65	-4		19	0
13	0	20,6	0		1	20	96	65	-1	31	16	0
16	0	73,2	0		0	0	95	95			18	0
17	0	24,7	0		0	0	94	94	-1		18	0
18	0	25,3	0		0	0	93	93	-1		12	0
19	24	20,8	0		30	113	92	85	-8		2	0

Figure 3: Excel pivot tables were used in analyzing the aggregated data (Source: CSS Electronics)

In terms of benefits, the collected data has provided extensive and solid knowledge of usage patterns for patrol cars assigned to different types of tasks. In that respect, the data has formed an important and necessary part of the foundation for the decision to phase in electric vehicles for operational tasks in the coming years.

Figure 4: Ten VW ID.4 GTX vehicles were used in the electrification project (Source: CSS Electronics)

Carsten Noerregaard stated: "The CANedge1 made it possible to investigate and document usage patterns for existing ICE-vehicles to evaluate the potential for deployment of EVs – and we received perfect support. We needed a data acquisition device that could reliably collect data through the extended period of time for our trial period. We did consider more classic telematics devices, but ended up deciding on the offline solution provided by the CANedge1, in part to secure sensitive data from exposure. Other key factors included the compactness of the device and the detailed support provided by CSS Electronics in both device configuration and post processing."

Outlook

This collaboration has also helped inspire CSS Electronics to introduce new software/API (application programming interface) tools that ease the analysis of 'big data' resulting from CAN/LIN data logging. In particular, users are now able to deploy automated integrations that DBC-decode their data (using a data base CAN file) into [Parquet data lakes] for visualization/analysis in Grafana, Python, and Matlab. You can learn more about [more than 100 other case studies] from CSS. ◀

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