Fleet based range prediction

Topic: COVESA Proposal
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Framing Question
How to overcome customer complaints regarding EV range prediction and building higher trust in the technology using connectivity and cross-brand data.

Insights
Specifically designed around EVs, modern distance estimation features use vehicle internal signals as well as cloud-based computing and connectivity. Weather, traffic and terrain information is considered to compute the most accurate range prediction possible. One example is Ford's "Intelligent Range" feature, which analyzes the average energy consumption on road segments and reports it to the cloud, so that this information can be used for the range prediction of succeeding vehicles of the same type. However, the existing features are based on average values and do not use information about current changes in other vehicles' energy consumption. In addition, the available database is limited, since only vehicle data of the same type and from one brand is evaluated. To get sufficient data, which will raise the statistical robustness and therefore the accuracy of the range prediction, a brand and vehicle type independent feature is required.

Product Vision
A feature that is able to correct on-board EV drive range calculation, using actual energy data generated by x-brand vehicle types, with the aim to improve accuracy and robustness of range prediction. The feature primarily addresses environmental influences impacting energy consumption, with the ultimate aim to improve customer satisfaction.

Product Basis
In another project a feature called Fleet Range Predictor (FRP) was developed. With just two vehicles and limited data, first tests have shown good results.

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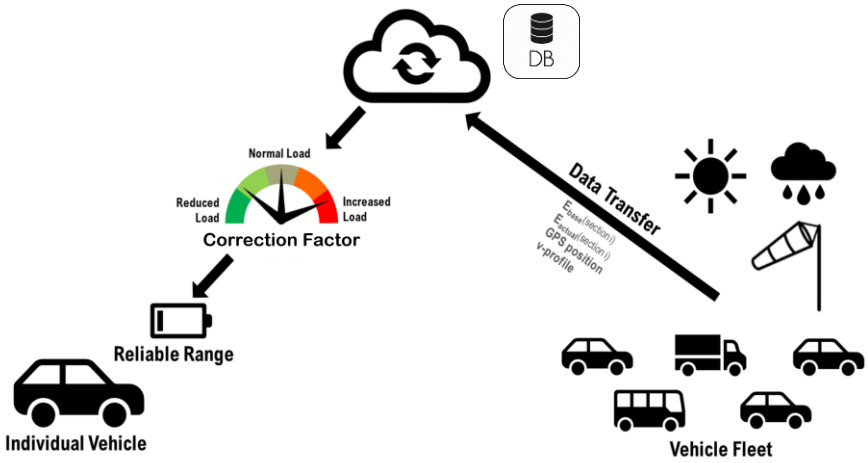

$$\mathbf{E_{prediction}(segment)} = \mathbf{E_{calculated\ ideal}(segment)} * \mathbf{CF(segment)}$$

$$\mathbf{CF}\ [\%] = \frac{\mathbf{E_{measured\ real}}\ [\mathbf{W}]}{\mathbf{E_{calculated\ ideal}}\ [\mathbf{W}]}$$

The FRP is collecting correction factors (CF) from a fleet for each segment in the road network. This segment linked correction factor represents the ratio of real used energy to an ideal energy. This ideal energy is calculated based on physical formulas and is the equivalent to an ideal situation without any wind, rain, traffic or any environmental impact.
To perform an energy prediction along a driver requested route, the calculated (vehicle unique) ideal energy can be multiplied with the correction factor for each segment along the route.
Key benefit of this feature is the vehicle type comparability and the fact that it is sensitive to local environmental impacts. It is often hard to predict factors like wind or road surface conditions. In the FRP approach there is no estimation needed of weather, traffic or road conditions. Any deviation from the ideal consumption is directly affecting the prediction via the CF. Because the CF is linked to a road segment, even geographical smaller effects are included. (e.g., dirty road at construction site exit)

With this method first analyses have shown a prediction accuracy of above 90%, using same day datapoints. In addition, a vehicle type comparison was done with an EV van and a c-class SUV EV, by applying the correction factor from one vehicle type to the other. The correction factor obtained from the other type of vehicle was in both cases within the same range of accuracy as the correction factor from the vehicle itself.

However, the feature was verified by just these two vehicles. Within this basis analysis some constraints were set as well. In the current feature layout propulsion energy is predicted. In addition, there is the need for a speed profile prediction along the route and a very accurate vehicle parameter set for the ideal energy calculation.

Project Proposal
Within the scope of a new project in COVESA, FORD would like to develop the feature further to overcome the current limitations and to get to the point of project vision.
Therefore, fleet data with different type of vehicles across multiple brands is needed. As well as development on vehicle self-calibration and speed profile prediction. Defining the signal structure and leveraging VSS, the FRP database could increase quickly and provide a good customer experience with better range prediction. The pre-development work at Ford has shown that the concept works, however tests were performed with a very limited number of vehicles. From a statistical point of view it is evident, that the more vehicles participate, the more accurate the correction factor calculation becomes. Participation of at least 2 other OEM's would be key to a successful project execution.

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