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Variability of CVT extends the repertoire of the electric car

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Most electric vehicles on the market today apply a single speed transmission. In some areas of operation, improvement is possible. While several years ago the first multi-speed transmissions for electric vehicles were presented we now see some of the designs reaching mass production. In the higher classes, multi-speed transmissions are introduced to extend functionalities like better performance, high speed driving, off-road capability and towing. They altogether provide a better compromise between these increasing customer demands and therefore also start to attract attention for vehicles in other classes.

Multi-speed transmissions offer differentiation of electric powertrains as they enable further optimization of the main KPIs performance, energy consumption, comfort and cost. This paper presents simulation results of a Continuously Variable Transmission (CVT) for electric drivetrains (CVT4EV) applied in vehicles from C to Light Commercial Vehicle (LCV) class and highlights specific use cases such as vehicles driving in low-speed cycles and AWD vehicles. With its large ratio coverage, the CVT variant offers enhanced drive torque to fulfil the wider set of actual vehicle requirements at the highest comfort level. The smooth variability of this typical transmission feature offers benefits in comfort, energy, performance and cost for several use cases.

A simulation study on AWD vehicles shows that a CVT4EV axle can considerably reduces drag losses by using it as the boost axle. Both the primary single speed axle and the CVT4EV boost axle can be optimized in their own area of operation. For an E-segment SUV, this improves energy consumption over the WLTC cycle by up to 3% and enables increased top speed and launch acceleration. The study reveals that launch acceleration can be improved by up to 50%.

A further study evaluates vehicles that typically travel at cycles with low average velocity. Typical examples are delivery trucks, city buses and shuttles that must be able to drive off fully loaded on steep hills but still reach highway speeds during shorter periods of use. For these specific use cases, CVT4EV reduces both the required motor torque and energy consumption. Smooth launches and the absence of torque interruptions provide the highest level of comfort. The studied LCV example shows energy savings by up to 6%. Together with the reduced torque demand this offers a potential decrease of total cost of ownership (TCO) by reduced operational costs and reduced electric motor, inverter and battery cost. This KPI is especially relevant for commercial transportation of passengers and goods.

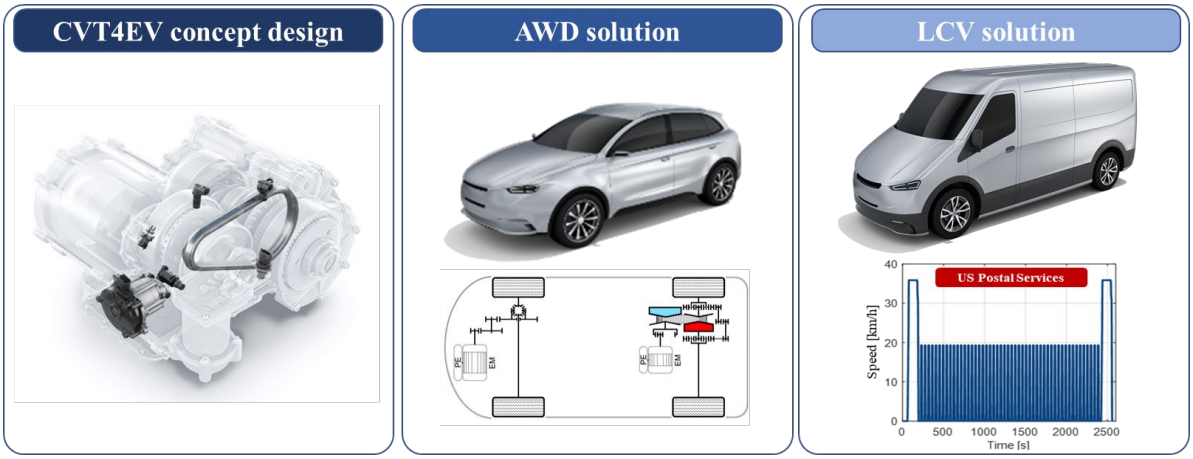

Fig.1 CVT4EV concept design and special use cause for AWD/LCV

Bosch Transmission Technology has designed a universal CVT concept that improves vehicle performance for all evaluated use cases by adapting only the pre-reduction and final gear ratio.
The benefit of variability of the CVT in the driveline of an electric vehicle extends the benefit of electric vehicles to special use cases. It furthermore improves the capabilities of electric vehicles in various cases of use.