Big in the City: The ZF Advanced Urban Vehicle

- Maneuverability in urban traffic thanks to innovative front-axle concept and electric motors mounted close to the wheel
- Semi-automated assistance functions enhance comfort/convenience, safety, and efficiency
- Innovative multifunction steering wheel with hands-on detection (HOD) and organic light-emitting diode (OLED) display
- Concept vehicle produced entirely in-house

Extremely maneuverable, locally emission-free, and networked with driver and environment: With the Advanced Urban Vehicle, ZF is demonstrating the potential inherent in intelligently networking individual chassis/driveline and driver assistance systems, and is presenting an exemplary solution for urban individual transport in the compact and subcompact segments. The all-electric rear-axle drive eTB (electric Twist Beam), which is mounted close to the wheel, lies at the heart of the vehicle concept. This drive enables the basic layout of the Advanced Urban Vehicle to be redesigned. The front axle is also highly innovative, with steering angles of up to 75 degrees enormously increasing the agility and maneuverability of the prototype. Two semi-automated driver assistance functions provide additional comfort/convenience as well as safety and efficiency: Smart Parking Assist maneuvers the vehicle into virtually any small parking space – remote-controlled at the push of a button using mobile devices such as a smartphone or smartwatch.

Comfortable, efficient motoring is possible with the concept vehicle thanks to the cloud-based PreVision Cloud Assist assistance function. Where necessary, the system reduces the drive torque, for instance, in good time before entering the bend and thus throttles back the speed without any mechanical braking. The driver is also in direct contact with the Advanced Urban Vehicle via the steering wheel: The hands-on detection function covers the entire steering wheel and thus forms the basis for assistance and automated driving functions. An OLED display
in the driver's direct field of view provides the driver with additional information.

“With the Advanced Urban Vehicle, ZF is demonstrating the kinds of specific solutions that are already feasible for urban individual transport by networking existing technologies and systems in the vehicle, having these functions interact with the driver, with the driver's behavior, and with the environment, or by accessing data which can be provided anywhere thanks to cloud connectivity,” explains Dr. Stefan Sommer, CEO of ZF Friedrichshafen AG. “At the same time, this study also marks to a certain extent a starting point from which concepts for future urban mobility can be derived very specifically – also with regard to the new competency areas opening up for ZF thanks to the acquisition of TRW.”

**Built from scratch**

ZF is presenting an electric vehicle in the shape of the Advanced Urban Vehicle, which was built entirely in-house on the basis of a standard subcompact car. The concept vehicle obtains its power from a traction battery, which is housed in three modules altogether on the front and rear axle. ZF's semi-independent rear suspension eTB (electric Twist Beam) provides the propulsion courtesy of a compact drive unit located on the left and right wheel respectively, each of which produces 40 kilowatts. With axle torque of 1,400 Nm and a maximum 21,000 revolutions per minute, the vehicle, which is tailored to urban traffic, reaches a top speed of 150 kilometers per hour.

**Maneuverable through town**

“At the front axle, we have implemented a new concept with steering angles of up to 75 degrees,” explains Dr. Harald Naunheimer, Head of Corporate Research and Development at ZF Friedrichshafen AG. The innovative chassis concept thus reduces the steering effort substantially during parking and turning maneuvers, and, in turn, increases the maneuverability of a subcompact car in particular: Thanks to the modified wheel deflection, the turning circle diameter of the Advanced Urban
Vehicle is reduced to under six meters fifty – a U-turn, in other words turning through 180 degrees, is possible with no difficulty on a standard two-lane road. The steering movements at the front axle are supported by the torque vectoring system of the rear-axle drive, which distributes the drive force individually to the two rear wheels and enables the vehicle to move off with this kind of large wheel deflection. Hence the concept vehicle can also be maneuvered with ease into extremely small parking spaces.

**Recognized, pressed, parked: The ZF Smart Parking Assist**
The advantages of the new front-axle concept come to the fore in combination with the Smart Parking Assist driver assistance function implemented in the Advanced Urban Vehicle. The system assists the driver not only in recognizing suitable parking spaces, but can also park the vehicle fully automatically in parallel or perpendicular spaces. The parking aid obtains its information from twelve ultrasound sensors and two infrared sensors on the vehicle’s front-end, rear-end, and flanks; these sensors help find a suitable parking space. The control electronics process the information and control all the systems involved in the parking function – for instance, the electric drive and the required steering angle of the electric power steering. The driver can interact with the vehicle during the process via the display in the cockpit or trigger the parking function once they exit the vehicle by using an application on a mobile device, e.g. a smartwatch. The Advanced Urban Vehicle then automatically searches the surroundings at walking pace for a suitable gap and automatically initiates the parking process.

**Enhances comfort for the driver, relieves pressure on cities**
For the future, the Smart Parking Assist opens up potential scenarios which provide additional benefits for the driver: The driver can get out at the destination, leaving the vehicle to head off autonomously for a parking garage, thus saving valuable time in the process. “When implementing the concept, we weren’t only looking at the benefits for the driver,” explains Harald Naunheimer. “If passenger cars in future park without a driver,
parking space can also be used more effectively. As such the door opening angles would no longer need to be taken into account in the parking garage – thus making the parking spaces smaller. All of which also takes the pressure off cities because the freed-up space can then be used productively as additional living and working areas.”

**Driver experience from the cloud**

The cloud-based ZF PreVision Cloud Assist driver assistance function provides maximum range and driving safety in the Advanced Urban Vehicle. Unlike purely GPS-based systems, the ZF study not only takes into account geometry data and information on the permissible top speed, but also stores data in the cloud on the vehicle position, currently driven speed, and lateral and longitudinal acceleration for every journey. If the driver follows the same route again, the system calculates the optimum speed for an approaching bend on the basis of these empirical data and actual vehicle data. The assistance function then throttles back the torque early on before entering the bend, to the point where the bend can be negotiated without any mechanical braking. All of which not only protects the vehicle's battery and braking system, but also provides greater safety particularly on blind corners.

**Communication via the steering wheel**

The driver is kept informed at all times about the intervention of PreVision Cloud Assist: The multifunction steering wheel, which ZF uses in the Advanced Urban Vehicle, features an OLED display in the steering wheel rim in the driver's direct field of view. This display shows, for instance, how much drive torque the driver assistance system throttles back before entering the bend – or provides again after the bend.

The driver, however, remains in direct contact with the Advanced Urban Vehicle using HOD. The capacitive system covers the entire steering wheel and detects whether the driver is holding the steering wheel. The electronic control unit built into the steering wheel converts the identified state into a digital signal and sends
this to the vehicle via the LIN (Local Interconnect Network). Depending on the situation, this alerts the driver or activates the available assistance systems.

“With the hands-on detection, we are creating the basis for assistance and automated driving functions which reduce the driver's workload – such as in urban traffic, which is characterized by strenuous stop-and-go phases during rush-hour periods,” explains Dr. Alois Seewald, Technical Director of Integrated Active & Passive Safety Technologies at ZF TRW. These assistance functions automatically maintain, for instance, a sufficient distance to the vehicle ahead or reliably initiate braking as required. “Thus we can improve active safety – even if the driver does not have their hands on the steering wheel.”

Captions:
1.) Smart Parking Assist combines innovations in chassis, driveline, and electronics. The parking process can also be triggered from outside the vehicle using smart device and parks the vehicle fully automatically with minimal moves.
2.) Anticipatory concept: The cloud-based driver assistance function PreVision Cloud Assist provides maximum range and driving safety in the Advanced Urban Vehicle.
3.) Extremely maneuverable, locally emission-free, and networked with driver and environment: With the Advanced Urban Vehicle concept, ZF is presenting an exemplary solution for urban individual transport in the compact and subcompact segments.
4.) The electric axle drive eTB (electric Twist Beam) mounted close to the wheel features a torque vectoring function at the rear axle, which assists the steering movements of the front axle – ideal for automatic parking in a single move even in the tightest parking spaces.
5.) ZF’s innovative front-axle concept paves the way for turning angles of up to 75 degrees on the Advanced Urban Vehicle concept vehicle. It forms the basis for a highly effective parking assist system.

6.) The steering wheel in the Advanced Urban Vehicle with hands-on detection and OLED display is the ideal interface between driver and vehicle, thus forming the basis for assistance and automated driving functions.

Photos: ZF

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ZF is a global leader in driveline and chassis technology as well as active and passive safety technology. The company, which acquired TRW Automotive on May 15, 2015, is now represented at about 230 locations in some 40 countries. The two companies, which were still independent in 2014, achieved a sales figure exceeding €30 billion with 134 000 employees. As in previous years, both companies have invested approximately 5 percent of their sales in Research and Development (recently €1.6 billion) in order to be successful with innovative products. ZF is one of the top three automotive suppliers worldwide.

In 2015, the company is celebrating its centennial. Originally named Zahnradfabrik GmbH, ZF was founded in Friedrichshafen in 1915 by Luftschiffbau Zeppelin GmbH among others. In its early years, the company developed, tested, and manufactured aircraft transmissions. After 1919, the company focus shifted under Alfred Graf von Soden-Fraunhofen, the first Managing Director and later member of the Board of Management and CEO, to the automotive and commercial vehicle industry. In this sector, the company established itself once and for all as a major technology supplier, registering numerous patents for innovative transmission technology. The first location outside Europe was founded in Brazil in 1958, launching a globalization drive that continues today. In addition, ZF constantly expanded its range of expertise – also
through acquisitions. For instance, in 1984 ZF acquired the majority share in Lemförder Metallwaren & Co. KG, a move which extended the product portfolio to include chassis technology. Later, in 2001, ZF took over Mannesmann Sachs AG to strengthen its value creation chain with driveline and chassis components. It adopted the current name of ZF Friedrichshafen AG in 1992. Today’s product range includes driveline and chassis technology such as transmissions, driveline and chassis components, as well as complete axle systems and modules. ZF products are used in passenger cars, commercial vehicles, construction and agricultural machinery, rail vehicles and marine applications. The company also focuses on the wind power and electronic components business. In addition, ZF Services represents the Group on the international aftermarket. In May 2015, ZF completed the acquisition of the U.S. automotive supplier TRW which had been previously announced in 2014. The shareholders of ZF Friedrichshafen AG are the Zeppelin Foundation, administered by the City of Friedrichshafen, holding a share of 93.8 percent, and the Dr. Jürgen and Irmgard Ulderup Foundation, Lemförde, with 6.2 percent. The "Motion and Mobility" slogan clearly states the company’s core mission: Right from its foundation, ZF has developed and manufactured innovative products for all people around the globe who want to move things reliably, comfortably, and safely, and experience the ultimate in efficient mobility. Quality, technological leadership, and innovative power have always defined the Group’s identity – today as much as ever.

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