Off the back foot

Electronic braking systems are fast establishing their credentials across the bus, coach and truck industries – and that is only likely to accelerate as the race towards fully autonomous vehicles gathers momentum, reports Brian Wall

Electronic braking systems (EBS) are starting to loom large as the system of choice for many large manufacturers of buses, coaches and trucks – and the reasons why aren't hard to see. The load-independent brake pedal set-up and smooth deceleration control they deliver are just two key advantages over ABS (anti-lock brake system), which is reactive, rather than proactive – in other words, with ABS, an emergency situation is already happening before the alarm is raised.

The shift from reactive to proactive has major implications on a wider scale. The European Commission estimates that, by equipping all vehicles with electronic stability control (ESC), at least 188,500 crashes involving injury have been avoided and more than 6,100 lives saved since the systems were introduced in 1995 (*www.is.gd/ahovop*).

This divergence between the two systems has seen the European Commission become a powerful advocate for active safety systems to be installed in cars, buses, coaches and trucks. The EC points to how ESC, as an extension of anti-lock brake technology, employs speed sensors and independent braking for each wheel, stepping up safety levels in the process. "[ESC] aims to stabilise the vehicle and prevent skidding under all driving conditions and situations, within physical limits," the Commission points out. This the system does by identifying a critical driving situation and immediately applying specific brake pressure on one or more wheels, as required. If necessary, the engine torque is also adjusted automatically.

"In city buses where stability control is not mandatory by regulation, ESC has become particularly relevant," says Thomas Dieckmann, technology and innovation officer at WABCO, which supplies truck and bus OEMs globally with EBS systems at their core. "Also, for coaches travelling at 100kph, the importance of such controllability and directional stability support is having a huge impact. Equally, EBS is delivering far better opportunities to carry out brake management and blending wherever there are retarders and, in the future, much more prevalent electric components in the drivetrain to increase recuperation and to save fuel."

These factors alone make EBS far superior to anything that is possible with ABS, he adds, and, in a world where automatic driving is commanding ever greater attention, that dominance will only accelerate. "Where you have no driver on board, you need a much better ability for self-diagnosis [of what is occurring on the vehicle]. In other words, an in-built 'health monitor' to ensure your systems are operating okay. This is where EBS comes into its own, by constantly monitoring the controlled pressure. Certainly, that is why Europe has largely become an EBS market."

When EBS came into being more than 20 years ago, it was designed as a kind of 'brake by wire' system, with an

TRIPLE SAFETY

At MAN Truck & Bus, the approach taken to electromechanical braking is one of 'triple safety' through its EBS electronic braking system, which incorporates ABS anti-lock braking, along with traction control system (TCS or ASR) components. The MAN BrakeMatic intelligent electronic braking management system automatically coordinates the application of the service brake systems. A further recent innovation is the MAN EVBec (electronically controlled exhaust valve brake), which enables continuously variable brake output that delivers greater braking torque at lower speeds.

underlying mechanical backup, although in normal operation that redundancy is not used at all.

Instead, the system feeds back information between the foot pedal and brake sensors continuously, multiple times per second, enabling the central control module to assess what actions need to be carried out. Is the braking on the axles correct? Could more be done with a retarder or recuperative braking to increase fuel efficiency perhaps? "Essentially, everybody talks to everybody else all the time within this 'mini-computer network'. Wherever a malfunction is detected, there is an intelligent reaction towards that," explains Dieckmann.

One compelling aspect of EBS is the use of diagnosis function for all of its sensors – for example, wheel speed sensors, which, he says, are constantly under plausibility checks for safety reasons. "If a sensor shows deviation outside of the operating range expected – such as one of the four wheel speed sensors behaving entirely differently to the other three – that signals up something to be investigated."

But the next system generation will go deeper by not only detecting existing defects, but also, through predictive maintenance, potential future defects – and far earlier in the process. Yet even this is the tip of the iceberg, he states. "Below this lies much greater granularity, investigating what has actually happened. Imagine a huge [computer spreadsheet], in which we define various system reactions in case of defects – what is operable and what is not – in order to keep as many functions active as possible. That is the vast potential we are looking at."

AUTONOMOUS DRIVING

Certainly, with autonomous driving added to the equation – combining sensors and software to control, navigate and drive the vehicles of tomorrow – EBS has become something of an irresistible force. Today, the driver does the integration of propulsion, braking and steering. To reach full autonomy, the subsystems need to control accurately and communicate back for the system to be able to analyse the data and make the right decisions.

System integration is thus seen as the key for autonomous driving to become successful. "System integration requires open communication," points out Andreas Jähnke, SVP R&D at Haldex, one of the leading suppliers of brake and suspension solutions, with a keen eye on the autonomous driving market. "Today, only selected data of the wheel end performance is shared in the system, even though most of a vehicle's behaviour is determined by the wheel end performance. Haldex wants to change that. We fully believe in open systems where the OEM gets full access to the data from the wheel end. By developing the brake systems jointly with OEMs, we re-shape the principles for the vehicle system architecture."

One of the new products from Haldex, based on this concept, is the Fast Acting Brake Valve (FABV), a high-performance valve, placed at the wheel end together with an ECU, which is said to act ten times as fast as conventional modular-based systems. The result is 15% less stopping distance, but also the ability to control the lateral and longitudinal friction levels on each wheel. According to Jähnke, the FABV ensures the vehicle runs in the path intended, with stability and predictability. "When replacing the driver, you need redundancy on different levels," he adds. "We are not unique in providing steering by braking, but our wheel end accuracy with the FABV is unique." TE