Yes we CAN!

How CAN partial networking is set to improve fuel efficiency.

By Graham Pitcher.

Efforts to make cars more environmentally friendly have focused on the internal combustion engine for obvious reasons. The work dates back to the 1950s, when the California Air Resources Board set standards which car makers had to meet. Europe has followed with a succession of emission standards. For instance, US regulations require an average fuel consumption of 37.8mpg by 2016 and 50.6mpg by 2025. In Europe, the EURO 4 and 5 requirements are kicking in and China is following suit.

Alongside those efforts, manufacturers have looked at the use of lighter materials and the replacement of the heavy cable harness as ways to improve fuel efficiency.

While these efforts have made significant contributions to the ‘greening’ of the car, a recent initiative is looking to boost efficiency by another couple of percentage points by targeting the in car networking system.

Alessandro Campailla is market development manager, car body electronics, for STMicroelectronics. “The power consumption of electronics is going in the opposite direction to improved efficiency – and one of the things which is using more energy is the microcontroller. There are more of them and systems are becoming more complicated.”

With top of the range cars now integrating probably 100 or more electronic control units (ecu) to handle everything from the antilock braking system to opening the sunroof, communications has become a central part of car design (see fig.1). These control systems are linked by a range of communications networks, ranging from LIN for applications like electric windows, to Ethernet, for linking control modules. But much in car communication is still accomplished using CAN – the controller area network.

CAN is a child of the 1980s, with the first devices introduced by Intel and Philips (now NXP) in 1987. It takes the form of a multimaster broadcast serial bus. Each node on a CAN network can send and receive messages, but not simultaneously. A message is transmitted serially on the bus and is sensed by all nodes. That aspect is being addressed with the introduction of CAN partial networking, because in current CAN networks, every ecu wakes up each time it sees a message, even if the message is nothing to do with it. And waking up burns energy.

Karsten Penno, marketing director for NXP’s integrated in vehicle networking business, explained the significance of CAN partial networking. “All ecus operate when there are communications on the CAN bus and they consume power, no matter whether they are doing anything or not. Take a seat control module as an example. You might only use it for 1% of the time, but it will draw power. With CAN partial networking, the ecu is off, even though there are communications flowing, and will only wake up if the message is intended for it. That means lower power consumption, lower CO2 emissions and better fuel efficiency.”

Campailla added his example. “When you lock your car from the outside, that module uses CAN and will wake up the engine control unit, the climate control system and so on. With partial networking, when the door is locked, it will only wake up the relevant subsystem.”

The concept has already been well received by some car manufacturers. Riki Hudi, head of electronics/electronics for Audi, said in June: “Audi and Volkswagen have started to introduce partial networking into the next generation of car models.”

Campailla said: “OEMs will start to use partial networking in vehicles with large numbers of mcus. But this requires
new transceivers and will therefore be more expensive. There is demand, but it will probably be a couple of years before it becomes significant."

Partial networking has benefits to consumers and manufacturers alike, says Penno. "Customers get greener cars," he said, "with the potential for tax savings as CO2 emissions are lowered. Manufacturers, meanwhile, have been struggling to reduce emissions and this contributes to more efficient cars."

The approach does, however, require a modification of the existing CAN standards: car manufacturers work to two standards — ISO11898-6 and Autosar RT3.2.1. "There will be the benefit of standardisation," Penno continued. "Partial networking isn’t a differentiator for manufacturers. Although it’s being driven by German companies, it will be written into a global ISO standard."

Campapilla added: "If you want a device that works across a set of customers, you need to comply with both standards. But it’s likely that we’ll see more Autosar compliant parts."

ST has launched the L39PM72FPXP, said to be the result of close cooperation with a leading German car maker. The device integrates High Speed CAN and LIN physical layers, providing all the functions needed to build up an ecu for car body applications. It monitors the CAN bus autonomously and activates the module only when a correctly addressed wake up signal is detected.

NXP, meanwhile, has developed the standalone TJA1145 transceiver (see fig 2) and a more integrated device, the UJA1658 system basis chip. Penno explained the approach. "Previous devices featured only an internal power supply and a CAN transceiver. With partial networking, a number of new elements are needed."

The transceiver now passes information to the CAN protocol decoder, which uses the input from a precision oscillator to track CAN traffic on a bit by bit basis. It outputs information to a message filter, which determines whether or not the associated module should wake up. If it should, the internal supply powers up the mcu.

Configuration also differs from the previous approach. Penno said: "This uses a four wire spi interface with the mcu, rather than the three wires used in the TJA1041."

Although NXP has designed the TJA1145 to occupy the same footprint as the TJA1041, there is a higher level of complexity and NXP discussed whether this should be handled by the host mcu. "We decided that savings could be maximised by putting the partial networking functionality into the transceiver," Penno continued. "There are also coding benefits."

This approach allows tier 1 manufacturers to prepare for partial networking, even if they don’t intend to implement it immediately. "The devices have the same footprint, so manufacturers can decide when they want to use the CAN partial networking enabled part."

The UJA1658, meanwhile, offers more functionality. "This adds such functions as a 100mA/5V regulator, a protected 5V sensor supply and a watchdog timer," Penno noted.

While the immediate focus for CAN partial networking is cars powered by regular fuel, the approach is also likely to have an impact in the emerging electric vehicle/hybrid electric vehicle (EV/HEV) market.

Penno explained: "There will be advantages for ev/hev developers. Every mA saved extends the car’s operating range. So, while manufacturers believe CAN partial networking could save 2.6g of CO2 per km, it is also expected to conserve 100W in EV/HEV applications. This might seem like only a few percentage points, but it will be a key contribution to reducing CO2 emissions."

While the intention is not for ‘mission critical’ modules — such as ABS – to be disabled, this could happen with EV/HEVs during charging. "When you charge an EV," Penno said, “the CAN bus is active and power is being consumed. That’s not efficient. In the future, we might be able to switch off such elements as the engine controller and the ABS to bring faster charging.”