Partial networking reduces CO₂ emissions

The automotive industry is under pressure. The CO₂ emissions generated by cars shall be reduced. In Europe, Euro 6-regulations will replace Euro 5 in 2014, and the average CO₂ emissions limit will be 95 g/km by 2020. Chinese 4 standards, similar to Euro 4, came into force in China in 2011 and the city of Beijing is planning to adopt Chinese 5. In the USA, Corporate Average Fuel Economy (CAFE) requirements for passenger cars will increase from 30.8 to 27.5 mpg by 2016 and 35.5 mpg by 2025. To meet these increasingly stringent regulations, while electronic control units (ECU) become more complex and consume increasingly energy, carmakers are pursuing many ways to improve fuel efficiency. However, most of the ECUs are powered even in times, when their functions are not required. To be serious, many of the ECUs are needed quite rarely. This means, partial networking is a solution. All not yet required ECUs are going into sleep mode and can be woken individually, when their function is really needed.

A consortium of carmakers and semiconductor manufacturer has pre-developed a specification for high-speed, low-power transceiver chips with additional partial wake-up functionality. These transceivers will be compliant to ISO 11898-2 and ISO 11898-5. The consortium has already submitted its specification to the International Standardization Organization (ISO), which will review the submitted document and publish it as ISO 11898-6 international standard. The ISO process for the development of international standards of the CAN partial networking specification has already been started. As chairman of the consortium, C&S group has actively contributed to establish the requirements for CAN transceiver with selective wake-up functionalities. In the related ISO task force, C&S acts as the chief editor in order to guarantee a smooth adopting process when converting the document into an ISO standard.

The first silicon... 

Although the partial-wake-up standard is under development, the first chipmakers have announced CAN transceiver chips with this functionality. Elmos (Germany) was the first one. The last year announced E3013 transceiver realizes CAN partial network operation. The partial network mode enables the possibility to individually activate ECUs whose permanent operation is not required. It is for example, the case with ECUs in a vehicle are designed for partial network operation. CO₂ emission can be reduced by approximately 5.5 g/km. The chip has been already pre-tested in a vehicle by a German carmaker. The IC represents an HS-CAN transceiver according to ISO 11898-5, featuring remote wake-up by means of an individually configurable wake-up frame (WUF). In addition to the usual wake-up sources, if the transceiver is directly battery-supplied it partial network operation, as is common practice in deep sleep mode today, all other components of the ECU can be deactivated. The partial network transceiver monitors the bus traffic, analyses it down to the bit level, and, according to the control device’s individual wake-up message, in this partial network mode, the power input of the central device is below 200 µA.

One application example is the wind ECU: If the function of this ECU is selected, the device is activated selectively for the period of time required for operation. Other candidates for partial wake-up are the trailer, door, air-conditioning, rear-view camera, auxiliary heating, and power supply of the car.

The basic idea is selecting and reading out the individual wake-up message, configuring parameters and controlling state transitions are facilitated by an SPI compatible interface (Serial Peripheral Interface) to the ECU’s microcontroller. The transceiver chip guarantees that both partial network transceivers and conventional high-speed CAN transceivers according to ISO 11898-6 can be operated together in one network (interoperability). Samples of the chip are available.

The second partial networking IC... 

NXP has launched its ISO 11898-6-compliant transceiver end of this summer. The TJA1145 is the response to government call around the world for a reduction in CO₂ emissions from vehicles. Carmakers are increasingly focused on finding ways to produce more environmentally friendly vehicles. As such, car manufacturers are now pushing for CAN partial networking to become an industry standard and ISO and Autosar.

The stand-alone TJA1145 CAN transceiver and system basis chip UJA1168 – the world’s first highly integrated solution to support CAN Partial Networking – gives designers precision control over a vehicle’s bus communication network. By activating those ECUs that are currently not needed, engineers are able to significantly reduce vehicle fuel consumption and CO₂ emissions without sacrificing performance or consumer experience.

In current in-vehicle networking architectures, all ECUs are always active and consuming power when the vehicle is in use. This is the case even when the applications they control aren’t continuously required, such as window lifting, adjusting the mirrors, etc. CAN partial networking changes this model by activating only those ECUs that are functionally required, while the other ECUs remain in a low-power mode until needed. At a major international automotive conference held in Ludwigsburg (Germany) in June 2011, Audi, BMW, Daimler, Porsche, and Volkswagen made a public announcement in favor of establishing new industry standards. Rolly Hult from Audi, appealed to semiconductor suppliers and engineering partners to actively support the rapid introduction of CAN partial networking architectures and solutions. “CAN Partial Networking is an area where we see great potential for energy savings,” he said. “In addition, intelligent wake-up concepts improve the lifetime of ECUs and increase the operating reach of electrical vehicles.” Audi and Volkswagen corporations have therefore started to introduce partial networking into the next generation of models. Audi addresses a mid-term reduction potential of 5% CO₂ emissions of about 4.0 g/km and fuel savings of 0.11 liter per 100 km, when using CAN.

TJA1145 and UJA1168 are two generation networking solutions, which combine analogue circuitry and high-speed digital circuits. The TJA1145 is a high-speed CAN transceiver, while UJA1168 is a CAN system basis chip with 150/190 mA micro-controller supply. Both support CAN partial networking by employing “Selective wake-up” and “Selective sleep” functionality. Both chips come with a footprint based on the HNS9V14 package. For backwards compatibility reasons, the TJA1145 is also available in a SO14 package. Engineering samples for TJA1145 and UJA1168 are available with volume shipping in 2012.

The third chip... 

ST Microelectronics (Franco) has announced the UAAW72XP, which will support partial networking functionality as described in ISO 11898-6. “Automakers worldwide are setting progressively tougher environmental performance targets for new cars, and carmakers must maximize efficiency throughout the vehicle in order to comply,” said Nick Demont from ST’s Automotive Electronics Division. “Integrating two partial networking provides around 4 g/km CO₂ in drive to meet the new standards.”

The chip is housed in a 1.5 µSMD 36-pin rated for volume operating in 16/32V. It is a member of power management systems I/O. By integrating both High-Speed CAN (ISO 11898-6) and LIN physical layers, it provides all the functions to connect ECUs to car body applications to the in-vehicle network. It’s features are tailored to particular uses such as: on-climate control modules and door control units, as well as actuators, trunk and trailer modules, sunroof and rear-view modules. Unlike general CAN transceivers or system-based chips currently on the market, the announced transceiver is able to monitor the CAN bus lines autonomously, without the modules’ main processor being active. It activates the module only when a correctly addressed wake-up signal is detected. By allowing parts of the CAN network to be deactivated in this way, the transceiver contributes to reduce overall electrical energy consumption.

Advanced fail-safe functionality is an additional feature, which improves the safety and reliability of ICs. Built in features such as supervision of the micro controller, supply voltages and temperatures provide protection against causes of failure. In addition, peripheral functions such as high-side and low-side gate drivers, operational amplifiers and voltage regulators reduce the number of external components and lower overall system costs.