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Security in embedded IP-based systems.
SEIS research project sees BMW Group experts explore the secure use of the Internet Protocol in vehicle networking.

Munich. The Federal Ministry of Education and Research in Germany recently launched a research project headed Security in Embedded IP-based Systems (SEIS) as part of the federal government's high-tech strategy and the research support programme ICT 2020. The initiative sets out to develop a universal security solution for internal and external vehicle networking based on the Internet Protocol. The aim is to reduce the complexity of today's in-vehicle IT architecture and at the same time guarantee operational security. The Innovation Alliance for Automotive Electronics (EIENOVA) project brings together 12 partners from the German automotive industry and six research establishments. This support initiative is able to draw on an overall budget of approximately EUR 18 million spread over the next three years. BMW Group Research and Technology is the sub-project leader for system software/middleware and has taken on overall coordination of the project.

The automotive on-board network – past and present

Just a few decades ago, electrics in passenger cars were decidedly thin on the ground and car electronics something of a rarity. In the engine compartment you would find the battery, alternator, control unit, starter motor and ignition; on the dashboard the controls, warning lights, indicator controls and locks. But between the dashboard and the rear of the vehicle there were only a small number of lights and the requisite cables. Up to the mid-1970s the radio was about the limit of a manufacturer's ambitions when it came to in-car electronics.

Since then, however, the increasing number of functions appearing in response to customers' demands, competitive pressures and legal requirements have turned in-car information technology into an area of pivotal importance; 90 per cent of a vehicle’s innovations involve the use of electronics and software. Up to 70 control units (e.g. for engine management and Dynamic Stability Control

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technology) are fitted in premium-class cars nowadays. Indeed, the latest models boast several hundred electric and electronic functions and, when fully equipped, carry up to one gigabyte of data on board. These functions, together with their control units, are clustered into domains according to their requirements. Up to five different bus systems, such as CAN, LIN, MOST and FlexRay, work side-by-side and via gateways to transport electronic data around today's vehicles. All are perfectly equipped to meet the demands of their individual areas of application, but all speak their own automotive languages, which – to continue the metaphor – have to be translated every time information needs to be used by various systems. This mushrooming level of complexity makes it increasingly difficult to meet a vehicle's full range of requirements in terms of reliability, maintainability, scalability and component sharing within the boundaries of existing vehicle IT architecture.

IP – the automotive on-board network of the future

The BMW Group Research and Technology engineers' search for a standardised language for the vehicle network led them, several years ago, to the Internet Protocol (which was to serve as a basis for the SEIS project). IP is the language of the global Internet, as well as of devices ranging from MP3 players to laptop computers. In order to prove the technology's capability in practice, the experts built a test vehicle with an IP-based on-board network. This vehicle included the use, where possible, of standard PC and embedded components. Also integrated into the car's IP network were control units fitted in today's cars – e.g. the engine management system (DME) and driving control system Dynamic Stability Control (DSC) – and the head unit, which controls systems such as the radio. The vehicle bus communications are connected with the high-performance IP network in real time via gateways developed by the researchers. A multimedia server was also linked up to the IP network, and there was scope to integrate a camera if desired. This development provided evidence that an IP-based network is capable of running chassis systems essential for vehicle safety

in real time and multimedia applications with high data volumes alongside each other.

Establishing and securing revolutionary IP on-board network technology

The experts working on the SEIS project will explore all the fundamental technical aspects involved in the introduction of an IP-based on-board network, e.g. specially adapted versions of Ethernet and FlexRay. Added to which, research is being conducted into a universal security solution for vehicle networking underpinned by IP. The experts at BMW Group Research and Technology are focusing, among other things, on the further development of system software. This will ensure that the necessary software is in place for the full range of functionality currently provided by the traditional bus systems to be included in the IP-based on-board network of the future. Ultimately, all the vehicle manufacturers involved in the project will develop prototype vehicles with an IP-based networking architecture and in so doing present a range of different use cases, e.g. IP-based cameras, infotainment systems, CE device link-up, control systems, anti-hacker devices etc.

The following companies are involved in the project: Alcatel-Lucent Deutschland AG, Audi AG, Audi Electronics Venture GmbH, BMW AG, BMW Forschung und Technik GmbH, Continental Automotive GmbH, Daimler AG, EADS Deutschland GmbH, Elektrobit Automotive GmbH, Infineon Technologies AG, Robert Bosch GmbH and Volkswagen AG. They are joined by the universities of Chemnitz, Erlangen, Karlsruhe and Munich, the Fraunhofer Institute for Communication Systems ESK and the Fraunhofer Institute for Secure Information Technology SIT.

BMW Forschung und Technik GmbH is a 100 % subsidiary of BMW AG and is in charge of the following research topics at the BMW Group since 2003: VehicleTechnology, CleanEnergy (hydrogen technology), EfficientDynamics (intelligent energy management/alternative drivetrains), ConnectedDrive (driver

assistance /active safety systems) and ITDrive (IT-architecture and communication technology). Being a limited company, legal autonomy from the BMW Group allows a maximum of creativity and flexibility.
An internationally established network, with Technical Offices in the USA (Palo Alto, CA und Clemson, SC) and Japan (Tokyo) as well as Liaison Offices in France (with Eurécom in Sophia Antipolis) and in Germany (with German Research Center for Artificial Intelligence, DFKI GmbH, in Saarbrücken) ensures global access to trends and technologies.

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