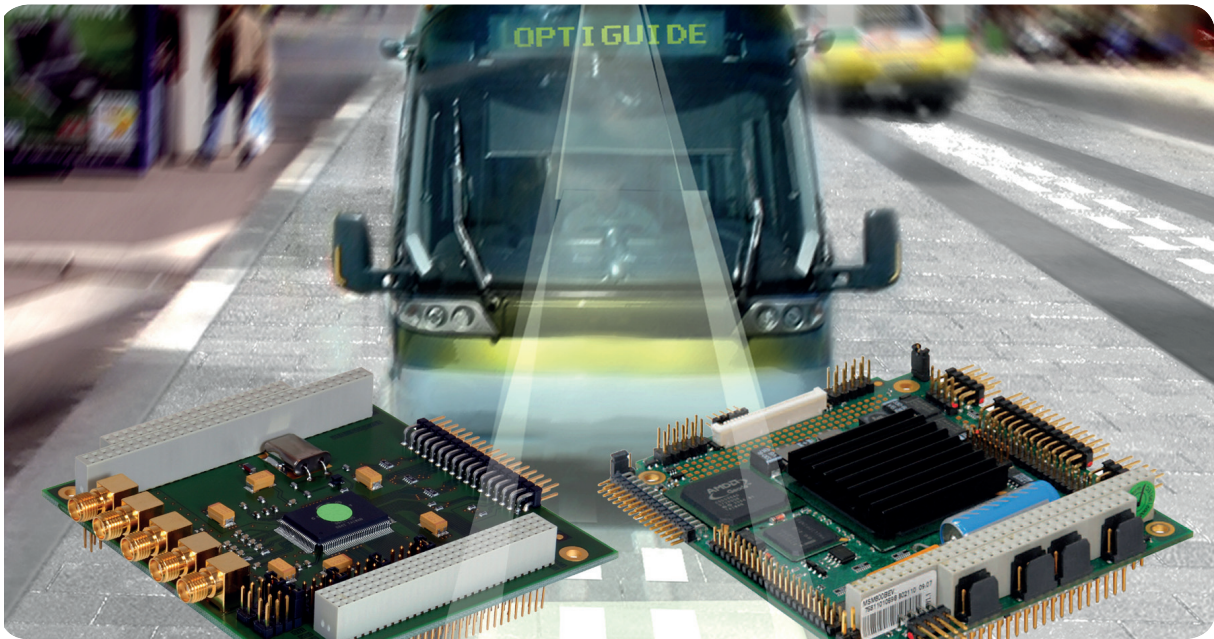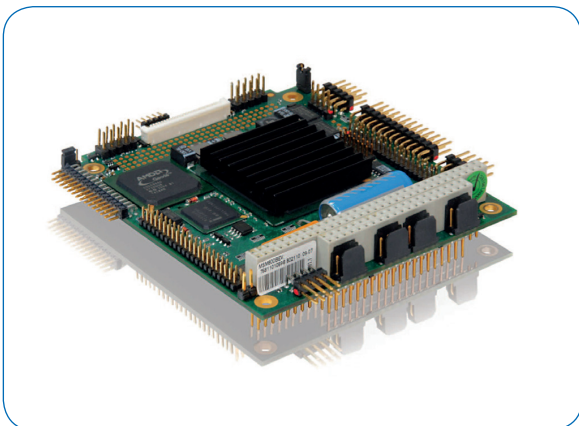# » Application Story «

PC/104-Plus in Transportation

Optical guidance system steers buses as if on tracks

Precise lane recognition with Kontron PC/104-Plus SBCs based on the AMD Geode™ processor

With Optiguide, Siemens' optical guidance system, buses can be driven as precisely as if they were on tracks, making getting on and off the bus an even more comfortable and secure experience for passengers. This is enabled by creating the smallest possible, barrier-free distance to the platform. The Siemens Optiguide steers the bus to within less than 5 cm of the bus stop. For the onboard control computer Siemens relies on the robust and extremely compact PC/104-Plus boards from Kontron with long-term availability. The CPUs are the AMD Geode™ processors which excel through low power requirements and offer long-term availability.

In towns and municipalities buses are the preferred method of local transportation. To ensure that the bus services are used as frequently as possible, operators must ensure the service they offer is as attractive as possible in comparison to other alternative methods of transportation. When comparing railway vehicles with buses, buses have many advantages but they also have one small downfall: the non-definable, variable distance between the platform and the bus. This distance can often be too large and becomes a hazard for passengers. For passengers in wheelchairs or with pushchairs or trolleys this can prove to be a major obstacle. However, the driver must also avoid the bus hitting the pavement edge. At elevated bus stops, which have to guarantee ground-level entry, this can result in costly damage to the vehicle or the tires, as well as the potential bumping jeopardizing the passengers' comfort and safety. At the bus stop, the driver has to be fully aware of potential dangerous situations for or by his passengers. Furthermore, the driver has to observe the traffic and concentrate on steering precisely to achieve a spot on landing at the bus stop and carry this out numerous times during a working shift.

Riding as if on tracks

The solution to address this complex problem is Siemens' Optiguide, an optical guidance system which steers the bus as if it is on railway tracks and directs it to within under 50 mm of the platform using special road markings for orientation. In the buses, a video camera at the front of the vehicle and a control computer are installed. Similar to railway engineers, with the Optiguide system, bus drivers can leave the steering system and concentrate fully on accelerating and braking. This works at speeds of up to 70 km/h, allowing for automated steering operation even beyond the bus stops.

Image 1: By using road markings the Siemens Optiguide steers the bus automatically to within 5 cm of the bus stop.

Less costs, more passengers

With its compact, modular build and large range of in- and output connectors the Siemens Optiguide can be integrated into all new and existing buses - from the classic diesel vehicle to hybrid buses or even trolley buses. Bus lengh can be up to 24m and because of the simple installation and the easy-to-

apply road markings, the cost for the infrastructure is only about a third of what comparable rail systems cost. Because of the automatic steering and Optiguide road markings, passenger usage actually increases: Studies show that optical landmarks such as trolley wiring, railways or special road markings create a much higher level of passenger attention of public transport. These landmarks encourage passengers to use the services more frequently, as the performance promise is always visible and present, thus creating more awareness of the service.
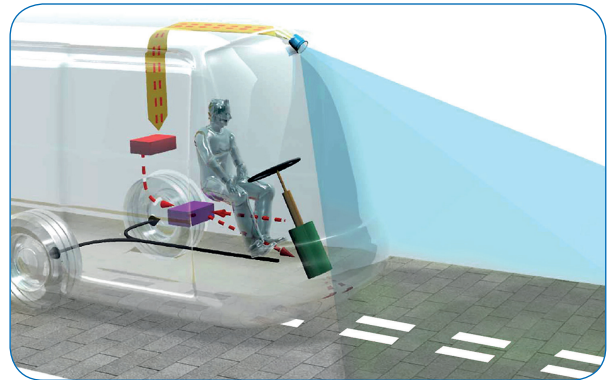

Image 2: Optiguide uses information from video cameras and other sensors to automatically steer the bus.

Keeping an eye on the road

The camera at the front of the vehicle constantly films a defined area at the front of the vehicle. The video signals are then processed in real time in the control computer in order to detect the specific road markings. With this information the system calculates the exact position of the bus in relation to the guidance lines. But this alone does not suffice for the optimal calculation of the trajectory to bring the bus to an exact halt at the platform. The system has to use other parameters of the vehicle. The values that have to be analyzed are for example the current vehicle speed, the yaw rate (turning rate around the vehicle's vertical axis) and the current position of the wheels or rather the steering wheel angle. In order to be able to read this data the control computer has to be integrated in the existing controller network of the vehicles.

Image 3: The control computer is based on the Kontron PC/104-Plus SBC MICROSPACE® MSM800SEL and the framegrabber MICROSPACE® MSMG104.

This also applies for controlling the auxiliary engine on the steering column which then steers the vehicle fully automatically and with such precision as if it were on railway tracks. The driver however is still responsible for using the accelerator and brake. In case of emergency, it is possible to override the automatic steering with a varying movement of the steering wheel so that the driver can react to unforeseen obstacles.

The need for powerful computing performance

When reviewing the performance profile of the system, it becomes apparent that the processing capacity is very demanding when compared to other driving dynamics control systems for ESP or ABS. Not only does the system have to include the dynamic vehicle parameters in its calculations but it also has to carry out an analysis of the video stream parallel to this. The required processing capacity exceeds the typical driving dynamics control systems including the requirements for spacing control using radar. Because x86 processors offer both long-term availability and flexibility, they are the ideal fit to evaluate and analyze video and senor data. In addition a large range of COTS hardware components are available, which enables efficient and fast development.

Wanted: Small Form Factor

In order to fit into a variety of bus superstructures, the control computer must be very compact to have the ability to be integrated into existing infrastructure. Naturally – as is typical for requirements in the transport sector - reliable operation, high availability and long life cycles are required. One of the most important prerequisites for this is a fanless, closed system design, as fans can have a negative influence on the MTBF of a system. The system also has to be armored to cope with extreme environmental conditions. High shock and vibration resistance are required, as potholes in the road or the engine's vibrations are real challenges which the system has to meet. Furthermore, high insensitivity to high and low temperatures and a good EMC are mandatory.

Compact, robust, expandable: PC/104

To fulfill this "job profile", one embedded form factor and its feature set are particularly suited - PC/104. With dimensions of 90 x 96 mm, PC/104 is one of the most compact form factors in the market. Another feature of PC/104 is its wide range both CPU boards and extension cards. For Siemens, the required components could all be obtained in the COTS market and were quickly installed and the development of the target system. Standard housing solutions are available, however, Siemens opted to design an individual housing in order to achieve the most compact and space-saving solution, which was ideal for integration in buses.

Components especially designed for vehicles

Siemens selected following components: the Kontron PC/104-Plus Single Board Computer MICROSPACE® MSM800SEL and the Kontron framegrabber card MICROSPACE® MSMG104+. Both boards are characterized by excellent thermal and mechanical resistance qualities and good EMC. Both boards also support the preferred RT-OS from QNX. In the automotive sector, QNX is a widely-used, real-time OS, however not every embedded manufacturer supplies drivers for its boards. With Kontron's background in in-vehicle applications, Siemens was able to take full advantage of the chosen PC/104 form factor. This greatly reduced the amount of effort in terms of supply management.. Apart from QNX support, Kontron also supports further operating systems which are popular in the transportation segment like VxWorks, WES 7 and WEC 7.

Extended temperature range

The SBC MICROSPACE® MSM800-SEL which was integrated is based on the extremely energy-efficient AMD Geode™ LX processor. With it extended temperature range of -25 °C to +70 °C it is ideal for deployment in tough environments such as buses. The 500 MHz performance of the embedded SBCs is more than sufficient to ensure safe steering of buses at up to a speed of 70 km/h under these operating conditions. And this will apply for years to come as the availability of the processor is secure until at least 2015. The framegrabber board MICROSPACE® MSMG104+ features a high MTBF of 200,000 hours and thermal resistance of up to -40 °C to +85 °C, proving it to be the ideal extension for the Optiguide control computer.

10 years of successful deployment

For more than ten years, Siemens has been implementing both Kontron PC/104-Plus boards in the Optiguide system. The system is used in buses in France, Spain and Italy and the fleet operators are convinced of the solution's efficiency, extreme reliability and failsafe operation. Currently Siemens is planning an upgrade for the available system. There is no desire to change the SBC, as it provides sufficient performance reserves even for further new tasks. Siemens will continue to optimize the system around this proven AMD processor technology.
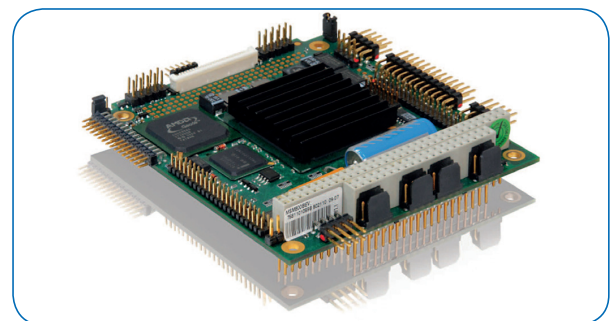

Image 4: The Kontron PC/104-Plus Single Board Computer MICROSPACE® MSM800-SEL is the brain of the Siemens Optiguide.

Future-proof

Both the groups of components which are being used are actively produced and are available after the EOL thanks to the appropriate supply agreement with Rochester Electronics. Rochester Electronics offers AMD and customers the longest availability requirements, ensuring authorized delivery times can be secured over decades. The success of this established form factor is further promoted by the current trend in the processor technology to the SFF processor platforms with low power requirements. In comparison to other similar form factors PC/104 offers a wide range of COTS I/O extension cards ensuring many individual system solutions can be designed with standard components. An example is the new Kontron MICROSPACE® MSM-eO, a PC/104-Plus design which is ideal for applications without display connection. The variant on the basis of the headless version of AMD Embedded G-Series offers real dual core performance for deeply embedded cost-efficient and energy-sensitive system designs. With such new processor platforms PC/104 will remain up to date for decades to come.
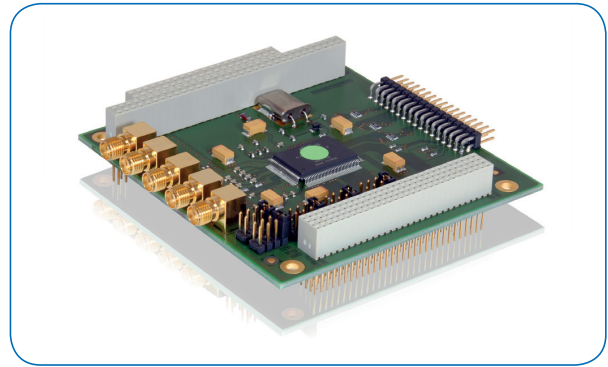

Image 5: The Kontron framegrabber board MICROSPACE® MSMG104+ is the ideal extension and is simply attached to the SBC.

Andreas Kammermann

Sales and Marketing Director at Kontron

Denis Marchand

Optiguide Business Manager At Siemens SAS, Industry Sector, Mobility Division in France

About Siemens

The Mobility Division, Industry Sector, of Siemens SAS (France) is the Group's center of competence for fully automatic metros and one of the world leaders in automatic urban transport systems. Its wide-ranging experience covering implementation of turnkey projects and maintenance services efficiently completes its range of competencies.

www.siemens.fr/mobility

About Kontron

Kontron is a global leader in embedded computing technology. With more than 40 % of its employees in research and development, Kontron creates many of the standards that drive the world's embedded computing platforms. Kontron's product longevity, local engineering and support, and value-added services, helps create a sustainable and viable embedded solution for OEMs and system integrators.

Kontron works closely with its customers on their embedded application-ready platforms and custom solutions, enabling them to focus on their core competencies. The result is an accelerated time-to-market, reduced total-cost-of-ownership and an improved overall application with leading-edge, highly-reliable embedded technology.

Kontron is listed on the German TecDAX stock exchanges under the symbol "KBC". For more information, please visit: **www.kontron.com**

CORPORATE OFFICES

Europe, Middle East & Africa

Lise-Meitner-Str. 3-5
86156 Augsburg
Germany

Tel.: +49 (0) 821 4086-0
Fax: +49 (0) 821 4086 111
sales@kontron.com

North America

14118 Stowe Drive
Poway, CA 92064-7147
USA

Tel.: +1 888 294 4558
Fax: +1 858 677 0898
info@us.kontron.com

Asia Pacific

17 Building,Block #1, ABP.
188 Southern West 4th Ring Road
Beijing 100070, P.R.China

Tel.: +86 10 63751188
Fax: +86 10 83682438
info@kontron.cn