Small form factors – big business: emerging markets and form factors

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Due to ever smaller and more highly integrated processors and chipsets as well as the need to minimize energy consumption to reduce operating expenses, one major trend in embedded computing over the coming years will be smaller form factors.

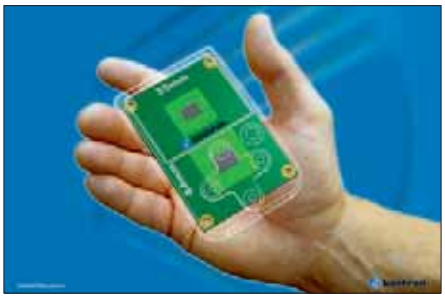
Over the last two years multi-core performance and virtualizsation technology have had a major impact on applications in the embedded computing industries and are still a hot topic for hardware cost savings with 2in1 applications such as hard real-time control and visualisation in one system. But even though high performance and 2in1 (or more in one) continues to be an important issue for a large number of applications, new technologies are emerging that will have a significant influence on future trends in embedded computing. To be sure, multi-core technology continues to provide solutions that are more and more energy efficient – processing power is constantly increasing while power consumption remains stable. But the emphasis here is on performance, and increasing efficiency by boosting performance does not meet all of the requirements. This is particularly true for lower profile applications and/or ultra mobile applications demanded by the business and consumer PC market. Moreover, we need to consider the trend of rising energy prices. In order to reduce energy costs, companies will work hard to develop ever more energy efficient solutions. This combination of, on the one hand, technology for ultra mobile applications and, on the other, the need to address energy consumption, is an ideal ecosystem for the increased usage of extremely low power processor technologies in embedded applications. Let's look at a few examples:

Medical applications

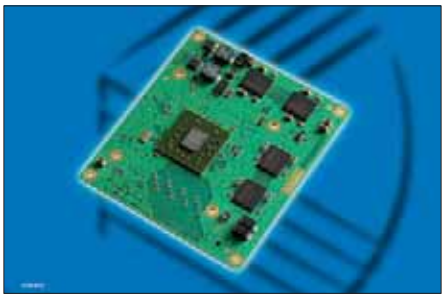
Medical applications are not confined to the electronic medical records that are replacing handwritten versions. A whole new class of devices and technologies will be developed that will not only add new features to existing solutions but also help resolve the growing health care crisis. Early designs might include battery powered handheld systems that are wirelessly connected to the network, such as pocket-sized ultrasound devices instead of stethoscopes. This is just one application medical engineers are currently working on. Other projects include remote monitoring and data acquisition for transmitting diagnostic information directly from the patient's home to the doctor, e.g. blood pressure and blood sugar values. This not only allows doctors to respond quicker, but enables the data from thousands of patients to be used online for further research. Taking things a step further, integrating the latest processor technology, such as Intel® Active Management Technology, would enable doctors and technicians to access and manage home-based and remote medical equipment, increasing the level of patient care at home.

These examples are just the tip of the iceberg. Health care is already one of the fastest growing markets for mobile solutions and future potential is enormous: In a recent analysis of vertical markets for enterprise mobility solutions, Venture Development Corporation estimates the mobility market for health care to grow by 20 percent annually from its current $1.6 billion USD to $3.3 billion USD by 2010. To be sure, mobile medical equipment is already having an impact. Today, medical professionals have access to patient information and decision support tools via handheld mobile devices, helping them make better informed decisions while on the go. For example, mobile clinical decision support systems help physicians determine the possible causes of a patient's symptoms, including uncommon causes that they may not be familiar with. And emergency response teams can receive accurate information and advice on the best course of action and treatment. These applications are already making a difference, but market penetration of mobile medical applications is still only about 10%. As more and more mobile medical equipment becomes available, we will start to see further savings for the health service and improved levels of care through reduced use of materials, the ability to reach patients quicker and the possibility of more preventive medicine as well as the increasing possibility of home care instead of hospital care, for example, for dialysis patients.

Kontron has just introduced the smallest embedded form factor suitable for these kinds of devices: The nanoETXexpress Computer On



nanoETXexpress Computer-on-Module for scalable mobile medical applications



UGM-M72 – first high-end PEG graphics module with long-term availability based on the open standard UGM

The 986LCD-M is based on the smallest ATX compliant form factor, mini-ITX

Modules form factor (COM). The nanoETX-express specification targets the development of extreme power-saving COMs with mid to high performance x86 technologies on a footprint of only 55 mm x 84 mm. This is 39 percent of the original COM Express™ module basic form factor (125 x 95 mm) footprint and 51 percent of microETXexpress (95mm x 95mm). This new COM form factor follows the PICMG COM Express standard and will be 100 percent compliant with the COM.0 Type 1 connector. The locations of the identically mapped pin-outs will also be 100 percent COM.0 compliant. With nanoETXexpress application engineers will be able to develop extremely small and, thanks to COMs, scalable devices.

Another important factor to bear in mind is that the health care services require devices that are more robust than standard commercial solutions while at the same time more cost-effective and convenient to use than typical rugged devices. Kontron is working together with OEMs in the medical technology industry to develop and supply not only the required electronics but also specially designed custom housings for specific applications. By relying on specialists to supply the required computing power, form factors and if required also the housing, medical equipment manufacturers are free to concentrate on their core-competence, i.e. the research and development of new equipment for radiology, cardiology dialysis etc. Even though small form factors are set to have a huge impact in this area, we should also remember that such developments are also based on high-end computing technologies such as long term available 19-inch severs or CompactPCI, AdvancedCTA or MicroTCA systems.

Gaming

Bearing in mind that gaming industries have used Intel® Pentium™ ® M technologies with approximately 30 Watt power consumption in the past to run hundreds of gaming machines in one casino, it is easy to convince casino managers to ask for new processors with far greater power savings to save costs-of-ownership. And this is not simply a question of these 30 Watts per slot machine. It is also a question of the energy used for air conditioning which is much more cost intensive compared with computer power. So we are talking about tremendous overall savings in primary and secondary energy. In addition, gaming machines do not require many extension slots, except for high-end graphics. This supports the trend to use even smaller form factors with higher integrated chipsets and processors. Thus, following the idea of modular and space saving designs with COMs, we should also have a look at the Universal Graphics Module standard recently introduced by XGI and Kontron. The UGM open standard, created for scalable, high-end PEG graphics with long-term availability, was made available via the UGM Consortium's website earlier this summer. The UGM standard will provide off-the-shelf embedded graphics on an industry-standard modular platform with multiple display configurations to guarantee customers, such as gaming machine vendors, the shortest time-to-market. The trick to designing small form factors is placing the UGM parallel to the baseboard. Developers don't need to worry about the right angle and can implement a uniform conduction cooling concept. This is completely different to conventional high-end computer graphic cards used in the commercial sector.

But not only COMs and graphics modules are a perfect fit in the gaming industries. Embedded motherboards are also extremely attractive due to the fact that they compete against the consumer boards with the one very powerful argument: long term availability of 5 to 7 years. Especially small motherboards will profit

AMC module AM4010

MOPS/PM – PC/104-Plus compliant single-board computer equipped with Intel® Pentium® M processors

form the higher integrated processors and chipsets. So there is definitely a perceptible shift form "the mother of motherboards" - ATX - to smaller form factors such as mini-ITX. Mini-ITX is the smallest ATX compliant form factor available in the market and profits on the one hand from the smallest size and on the other hand from the wide range of existing mechanics for ATX compatible chassis with lowest costs. But OEMs using Mini-ITX will save not only hardware costs. By using smaller form factors with higher integrated chipsets they will also be able to reduce their client's energy costs, thereby increasing their profits. So, in the future, processor and graphics performance will not be the only arguments for selling embedded computer technologies to gaming industries. The reduction of the total costs of ownership will become one major secondary argument. And, physically, it is absolutely clear that the smaller the form factor of a processor, the lower the power consumption.

Telecommunication

Keeping in mind the scenario of gaming industries, we can easily explore the cost savings for the telecommunication industries. The savings will be significantly greater compared with the gaming industries. The carrier grade environments work with hundreds of cores in a single branch. Thousands of watts are consumed and energy savings are the only operating expenses that can be saved. This might not influence the use of AdvancedTCA or 6U CompactPCI as the main blade technologies at the telecom backbone level, but the idea of using the smallest processors on the smallest form factors will accelerate the use of AdvancedMC modules on AdvancedTCA carrier blades to generate even more compact and modular architectures with the smallest scalable and maintainable units. In addition, these new processors will fit perfectly into the concept of MicroTCA or 3U CompactPCI for de-central telecom carrier equipment, such as base station transceivers as well as the foreseen rugged versions of MicroTCA. They will also fit into other vertical markets such as military/homeland security, offshore or even industrial controls.

Transportation / POI / POS

Similar to the trend towards mobile computing for PC-technologies and infotainment, there are now, for example, infotainment and wireless or wired communication infrastructures in aircraft and trains, requiring rugged and long term available data processing capabilities. These applications will also profit form lower power consumption on the smaller form factors such as PC/104 plus (and PC/104 express in the near future), AdvancedMC (in rugged MicroTCA housings) or 3U CompactPCI. The same is true for railway infrastructure with 19-inch severs. 2U servers will be used instead of 4U Servers and 1U servers will be used instead of 2U. And infotainment is going outdoors: with only 5 watts there is a great opportunity for developing colour display based POI/POS applications with solar energy. This will add greater convenience, reduce the number of physical buttons and save overall costs.

Automation industries and other markets

Power saving features will not be so important in the automation industries in the near future, since most machine builders do not pay a great deal of attention to the efficiency of most power consuming components, such as asynchronous motors. But things might change. Either change in the law will force industries to become more and more energy efficient or clients will force their vendors to build in energy saving features as a result of energy becoming more expensive due to greater global consumption and declining resources. Energy hungry machines could therefore benefit from an energy efficiency makeover. This includes embedded systems inside machines and/or the shop floor computers. Industries with hundreds of rugged PCs in use on the shop floor will be the first to demand low power profiled rugged systems. The automotive industry is a good example. Finally, all other markets benefiting form mobile and/or battery driven applications instead of fixed, installed systems with constant power supply will use smaller form factors with higher integrated processors. The sufficiently small SBCs that we have not mentioned until now, and that will profit form these more high-

ly integrated processors, are in particular the instant and stackable PC/104 family with PC/104plus, EPIC and their forthcoming PCIe based versions - PC/104-express and EPIC express. JRex/JFLEX 3.5" SBCs will also do well thanks to its similarly small footprint with the advantages of full SMT assembly and pure PCI. Bearing in mind that it was extremely difficult to design a 100 percent PC/104 compliant design with Intel® Pentium™® M processors, these form factors will have a reliable roadmap for years to come, underlining the stable market for this oldest small form factor.

Embedded processors for small form factors

We have talked about the new, more highly integrated small form factors and their markets. Now it is time to mention the processors and chipsets that deliver the basic functions for these platforms. Intel® Core™2 Duo processors are currently the most power-saving and space-saving high-performance processor, making them the ideal choice for developments starting today. The Intel® Core™2 Duo processor provides two energy-efficient, mobile-optimized execution cores in a single processor which deliver, compared to its predecessors at the same performance, as much as round about 50 percent energy savings. This makes it perfect for lightweight portable imaging, diagnostic and monitoring devices that require processors with a combination of high performance and thermal efficiency. One example application is both cart-based and portable ultrasound scanners, depending on which chipset you choose. This processor is available now on nearly all small form factors from Kontron apart from the PC/104 family which is currently waiting for PCI express and nanoETXexpress and does not meet the footprint requirements of these processors and chipsets.

Future generations of Intel processors are also likely to be good candidates for small form factors. For example, Intel has recently disclosed plans to integrate multiple chip functions on a single processor. These system-on-chip (SoC) processors will potentially enable a reduction in board space requirements up to 45 percent and power consumption by as much as 20 percent when compared to a standard multi-chip design, while at the same time largely improving throughput performance and processor efficiency in applications ranging from Enterprise Security to Small Form Factor modular designs. There is no doubt that SoCs would be useful in tight designs requiring a reduced footprint. One can imagine many applications that can benefit from this consolidated, smaller area such as industrial control, small medical devices such as pulse oximeters, communications control and Enterprise class security appliances. We see high performance, low power SoCs as a perfect fit for nanoETXexpress or PC/104 modular offerings, as well as options for AdvancedMCs, ETXexpress and Mini-ITX. Most of you will probably wholeheartedly agree. Further combinations and possibilities for small form factor designs are only limited by one's imagination. In any case, Kontron is very interested in this technology and looks forward to further plans around SoCs and upcoming low power technologies for UMPC (Ultra Mobile PC).

As Intel's embedded processor family evolves over time, existing designs can be easily ported to new technology. Because of the commonality of the x86 Architecture, coupled with the modularity of Standardized Small Form Factor designs, customers can utilize their existing small form factor designs for products today, and migrate these designs as new technologies and efficiencies enter into these small form factor offerings. So if you are looking for nanoETXexpress, use an ETXexpress or microETXexpress as a reference design for the development of a work-around. And Mini-ITX as well as JRex are very attractive "ready to use" SBC. And don't forget that PC/104 related form factors will again gain importance when the PC/104 Org finalizes the PCI Express specifications. And think also about AdvancedMCs for rugged designs that will be available in one or two years. But don't forget that PICMG rugged specifications for MicroTCA are not finalized yet, making 3U CompactPCI much more attractive for today's rugged designs.

Finally, small form factors have a bright future and they are the ideal alternative for centralized 2in1 technologies promoted with the launch of Multi-Core and virtualization technologies. So the world will not only be black or white but striped like a zebra, since AdvancedTCA blades or 6U CompactPCI systems are also attractive high density and extreme performance solutions. But, of course, the future will bring even more new applications with even smaller form factors. ■