European Processor Initiative

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FRAMEWORK PARTNERSHIP AGREEMENT IN EUROPEAN LOW-POWER MICROPROCESSOR TECHNOLOGIES

Approach

The favoured fundamental approach is a master-slave constellation with one or several automotive-qualified processors operating as masters and one or several HPC-GPP (High Performance Computing General Purpose Processors) and accelerators operating as slaves.

Steps

In order to achieve this goal, the following research work will be done:
Extracting functional and non-functional requirements for the automotive eHPC platform. Apart from aspects like safety, security or energy efficiency, automotive application specific demands such as connectivity are taken into consideration. Moreover, use case scenarios, focusing on how much embedded performance is really needed for future automotive applications will be defined.

- A detailed roadmap for the implementation for the eHPC platform and the eHPC-MCU including arising business cases and revenue models.
- Automotive eHPC platform architecture including all related methods, processes and tools.
- Development of the automotive SDK for the eHPC platform.
- Testing, demonstrating and evaluating the automotive eHPC platform, in order to validate the project findings.
- There is dedicated effort on the partial qualification of the HPC GPP in order to ensure it is adapted sufficiently for the automotive domain.

All in all

The following basic characteristics of an automotive system must be ensured:

- Functional safety
- Data security
- Real-time capability
- Availability and reliability for the entire life cycle
- Lowest possible energy consumption.

Automotive eHPC Compute Platform

Without innovative solutions, the digital progress in the automotive sector will end in a deadlock because of insufficient computing power for new and increasing fields of application like 360-degree environment recognition and other real-time systems.
In order to continue on the road of success, the basic approach is the use of suitable high performance processors from the HPC sector. The specific challenge is the integration of those high performance consumer processors that have to be compliant with the relevant application and environmental requirements in the real-time domain of automotive.
From the system viewpoint, adapting and using consumer processors must under no circumstances have a negative impact on the function, the real-time behaviour, the availability and the reliability of the automotive compute platform.

In the EPI project, the Automotive stream aims at a scalable ECU platform intending to come up with a pioneering automotive processor (eHPC MCU). The latter will be expanded in view of architecture and performance ability so that it is able to act as master and control and survey one or more number crunchers. In the master-slave constellation, EPI partners will provide a number cruncher, in the form of a specific automotive version of the HPC-GPP.
Both parts will be matched concerning their architecture, profile and performance. As to the eHPC MCU, aspects like safety, security, fall back or redundancy for reduced application will be taken into consideration. At the same time, it is of main relevance to achieve the top Automotive Safety Integrity Level D (ASIL-D) at system level which might be expected and necessary for autonomous driving application. All of this will help to open the gates to autonomous driving, this way preparing the way even for use at level5.

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Furthermore

In the extremely cost-driven automotive sector, specific standards must be observed, for example for data communication, interfaces or networks. In light of this, the use of complex and expensive special solutions like active cooling should be avoided if possible.

With respect to the HPC domain, one of the main incentives to adapt the HPC GPP is the expected improved exploitation of the highly expensive development of such a complex processor - not only in the context of the original purpose with local servers and super computers but also embedded domains like automotive. Additional computing power should not exceed given cost and energy budgets.

Since an integration of HPC GPP and HPC accelerators into the automotive eHPC has to be technologically, functionally and economically successful, fundamental questions must be determined and clarified right from the beginning. Some of the central issues in question could be:

- The profile of requirements on the automotive side concerning development process and implementation of the HPC GPP processor, for instance with regard to the documentation.
- Which interfaces or peripherals must be additionally considered in the HPC GPP architecture?
- What kind of automotive proven chip assembly method for GPP chip has to be chosen?
- Which technological adjustments of the HPC GPP can be realised without depleting the targeted economic synergies between the HPC and the automotive type of the GPP?

Other challenges

The system "Automotive eHPC Compute Platform" must operate in the required automotive temperature range from -40°C to 155°C. Defined usage profiles must be observed. The task of the automotive eHPC MCU is to monitor correct function of the slave processors. They must safeguard real-time capability, protect the system for security reasons and perform a reduced application in parallel in order to take over in case of unavailability or degradation of the HPC GPP. The eHPC compute platform has to achieve fail-operational status in order to be suitable for automated driving level 4 and 5.

Highly complex

The complexity of different rule sets to be taken into account for the qualification process in automotive underlines the challenge of the research activities. Although a full chip qualification of an automotive version of the GPP will be impossible, it is intended to test and if necessary, prepare for qualifications of dedicated IP-blocks and interfaces under automotive conditions. The qualification determines not only methods and process flows to be deployed but also relevant responsibilities. After all, the general approach is to define an adequate qualification flow that describes the basic elements of every qualification process. Each qualification covers the items:

- Reliability qualification
- Characterisation of object
- Manufacturability including testability

An efficient qualification methodology is essential to meet optimum turnaround times and optimised costs. The qualification strategy has to be knowledge- and application-based rather than stress-test-based in order to make Q&R concerns, risks and opportunities transparent. Possible failure mechanisms must be explored in advance and studied with utmost effectiveness. The qualification of a processor shall cover not only the product itself, but all materials, used components and processes needed to produce and deliver the device. The production process of the processor has to be qualified together with the processor or a processor-like test vehicle, if the technology is described by key characteristics as having a major influence on the reliability, performance or functionality of the processor.

Complementary to a stress-test-driven qualification, a failure-mechanism-driven reliability qualification is recommended. During the qualification, environmental conditions as well as thermal, electrical or mechanical stress factors have to be respected.

Beyond Automotive

The automotive processor units have to fulfil relevant application requirement specifications. They are characterised by the widely varying use conditions and loads which all have in common: long lifetime expectations and stringent failure rate targets. In the end, customer expectations as well as requirements concerning production quality/stability and reliability performance must be fulfilled.

Taking a general view beyond the horizon, Automotive could be treated as the appropriate touchstone for the deployment of computation technology in a lot of further embedded domains like machinery, medical, avionics and others. The emergence of HPC processor capability in Europe will strongly reinforce manufacturing and service-provision value chains and will enable new synergies that will benefit an important part of European industry.

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