TETRACOM: Technology Transfer in Computing Systems

FP7 Coordination and Support Action to fund 50 technology transfer projects (TTP) in computing systems. This project has received funding from the European Union’s Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 609491.

Functionality assignment to partitioned multi-core architectures
Florin Maticu and Paul Pop, Technical University of Denmark
Christian Axbrink and Mafijul Islam, Volvo Group Trucks Technology

Motivation
Taking into consideration that:
• Federated to partitioned architectures
• Multi-core ECUs
• Increase complexity of software functionalities.
• Safety according to ISO 26262
• Schedulability of tasks running of different cores
• Bus bandwidth utilization.

Problem Formulation
Given an application model and an architecture model we want to determine:
• A mapping of software components to ECUs
• A mapping of runnables to OS-Tasks
• A mapping of OS-Task to OS-Applications

Such that we want to minimize:
• The overall communication bandwidth
• The variance of core utilization of the system

Taking into consideration that:
• Mapping constraints, if specified, are satisfied
• The runnables are schedulable (U < 0.69)
• The runnables with different safety integrity levels are spatially and temporally isolated.

Mapping Optimization
NP-Hard problem, so Simulated Annealing based optimization strategy is used which searches, using transformations, for solutions minimizing a given cost function.
• Cost function:
  \[ cost = W_1 \times \sigma + W_2 \times U_b + P_1 \times \alpha + P_2 \times \beta \]

Where:
- \( W_1 \) and \( W_2 \) denotes weights
- \( P_1 \) and \( P_2 \) denotes penalties
- \( \sigma \) the total variance in core utilization
- \( U_b \) the aggregated bus utilization
- \( \alpha \) denotes the amount of cores which utilization has been exceeded
- \( \beta \) denotes the amount of busses which utilization has been exceeded

Expected added value from the technology transfer:
Efficient utilization of multicores and compliance with functional safety standard ISO 26262 are among the key business needs and challenges while designing the next generation of architectures for commercial vehicles. This project will contribute significantly to meet these needs by providing an efficient method and tool to harvest the full potential of multicores.

The tool will allow Volvo to reduce the costs (by using multicores and reducing the number of ECUs), maximize performance and resource utilization and handle the increased software complexity.

Volvo Use Case
• Application Model: 50 Software Components with 75 runnables in total.
• Hardware Model: one ECU with 3 cores
• Output within 2 minutes

Contact: Prof. Paul Pop, TU Denmark
E-mail: paupo@dtu.dk
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TETRACOM coordinator: Prof. Rainer Leupers, leupers@ice.rwth-aachen.de
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DTU Compute
Department of Applied Mathematics and Computer Science