MAPS Project

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Mapping of Applications to MPSoCs
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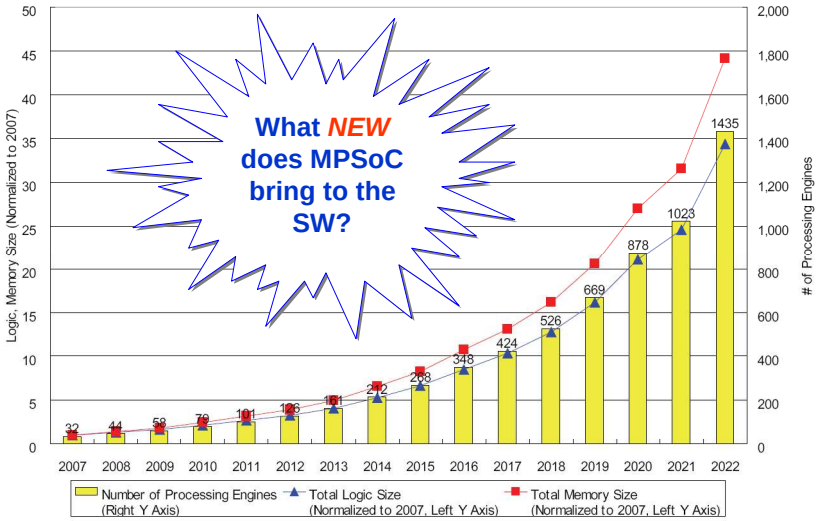
Institute for Integrated Signal Processing Systems

Agenda

MAPS - MPSoC Application Programming Studio

- MAPS Project Motivation/Overview
- MAPS-TCT Framework Demo
- MVP (MAPS Virtual Platform) Demo

MPSoC Age Has Come



SoC Consumer Portable Design Complexity Trends (Source: ITRS 2007)

MPSoC Application Drivers

- **Versatility: we have *MANY* applications running on the MPSoC.**

Portable/Consumer

Source: Chen, NTU, MPSoC 2008

Automotive

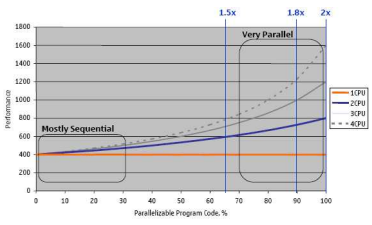
Source: NXP, MPSoC 2008

- **Complexity: and at the *SAME* time.**

Example: Parallel Usage Scenario

"Advanced end-user Ari does multiple things at the same time."

- Beginning:
  1. **Streaming audio** from XM Radio.
  2. **Browsing** website www.CNN.com (very tricky Java/tables/css).
  3. **Recording news video** received from DVB-H.
- Suddenly:
  4. **Push email** downloads 1MB JPEG image (background).
  5. **Voice call** comes in.
- At the same, time many OS features are used in parallel:
  VoIP stack, HTTP/TCP/IP stack, Bluetooth stack, WLAN driver, telephony, MP3 decode, RTP/UDP stack, Java virtual machine, window server, fileserver, etc.
- Requires high performance peak. Overload shows as bad user experience for the foreground application.
- Any system stutter or unresponsiveness considered harmful.



Source: Nokia, MPSoC 2006

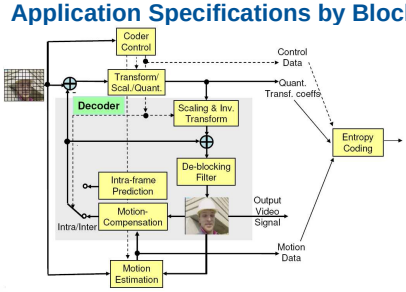
Mixed MPSoC Programming Models/Languages

- **Programming Models/Languages Currently Used/Evaluated (Percentage of Survey Respondents Identifying Each)**

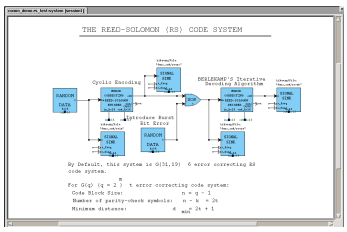
	N	Users of Multiple Discrete Processors, N=108	Users of Multicore, N=115	Users of Both, N=123
Normal C/C++	307	88.0%	88.7%	89.4%
Titanium (Java)	42	13.0%	11.3%	12.2%
OpenMP	27	13.0%	4.3%	6.5%
MPI	18	10.2%	3.5%	8.9%
Unified Parallel C	23	7.4%	3.5%	8.9%
CAF (Fortran)	4	2.8%	0.0%	0.8%
Other	28	7.4%	6.1%	10.6%

Source: VDC (Multicore Expo 2008)

- **Application Specifications by Block Diagrams/etc.**



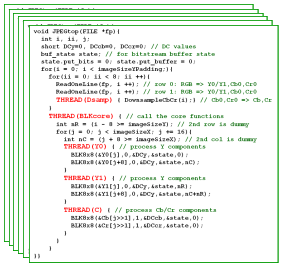
H. 264 Encoder Block Diagram

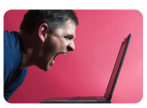


Efficient/Fast Multi-task Processing

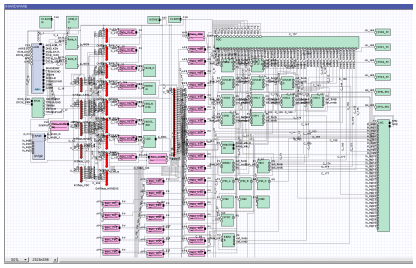
Keys to success of embedded real-time systems

- **Smart spatial/temporal task mapping**
- **Efficient task-scheduling functionalities**

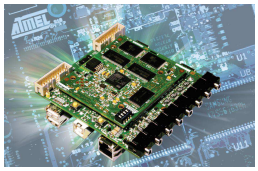




Mapping



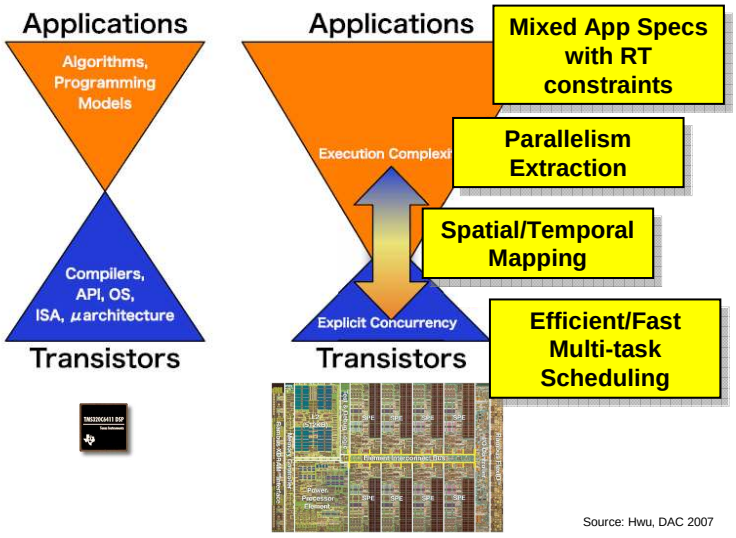
Source: Virtual Platform of Shapes RDT, RWTH Aachen



Source: Diopsis940, Atmel

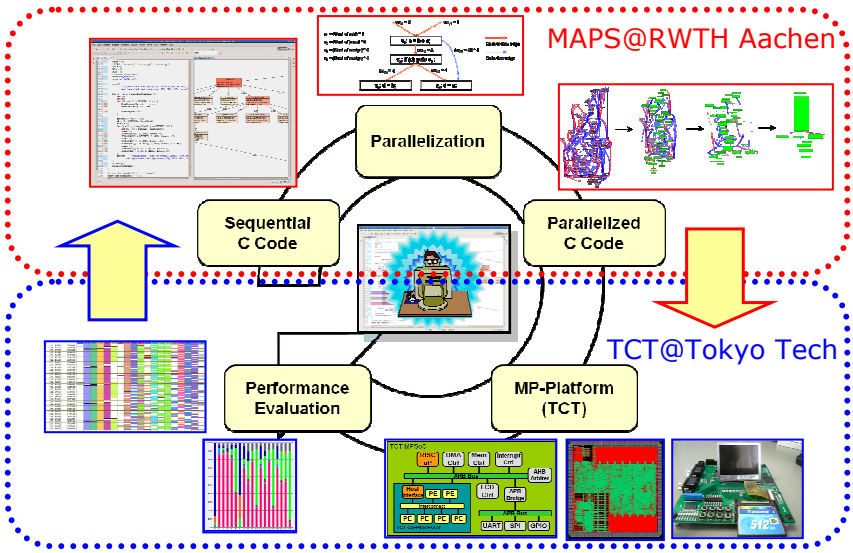
Summary – embedded SW from Uni-core to Multi-core

Multi-core brings more software complexity in multi-orders!



Source: Hwu, DAC 2007

MAPS-TCT Framework

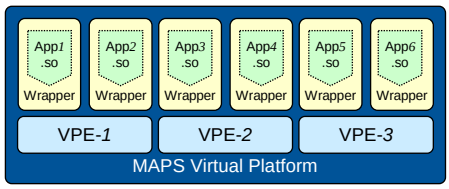


Ceng et al, „MAPS: An Integrated Framework for MPSoC Application Parallelization“, DAC 2008

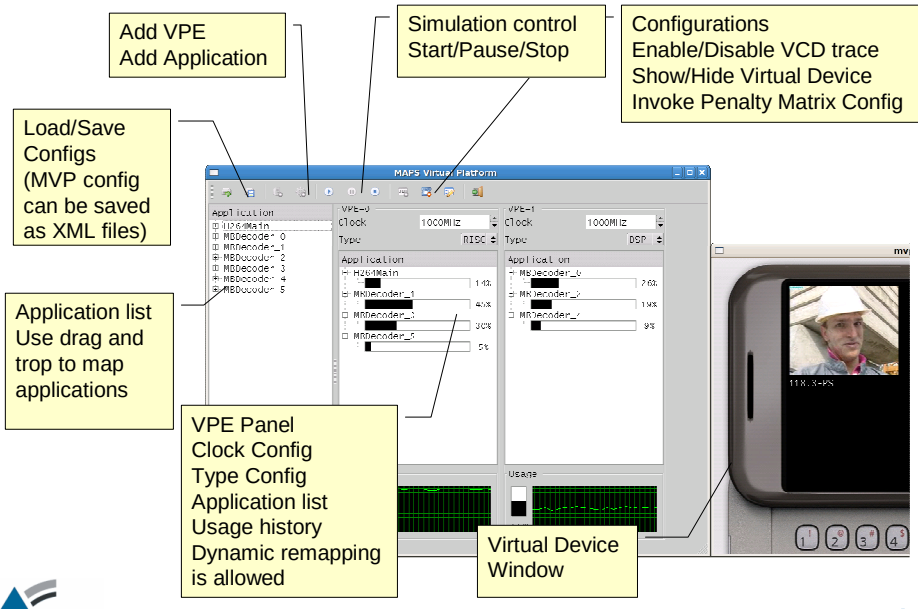
MAPS-TCT Demo

MAPS Virtual Platform (MVP)

- **A SystemC based high-level virtual platform**
  - No instruction-set-simulator is employed
  - Simulate software natively
- **Processing elements are modeled with abstract Virtual Processing Elements (VPEs)**
  - Include a simple scheduler to enable temporal mapping
  - Multiple VPEs can used to model MPSoC
- **Run applications written in C**
  - Application source code is decoupled from the simulator
  - No SystemC code is needed from the MVP user



MVP GUI



MVP Demo

Summary of the MVP

- **A ready-to-use high-level virtual platform is demonstrated**
  - No SystemC coding is needed
- **Applications are developed standalone independent from the simulator**
- **Multiple applications can be simulated simultaneously in the platform**
- **A simple scheduler is currently included to support temporal mapping**
- **Spatial mapping exploration is supported through**
  - Configuration files created by the MVP user
  - Dynamically drag-and-drop tasks during the simulation
- **Still a work in progress**
  - Implement more sophisticated scheduling algorithm
  - Integrate the MVP into the MAPS programming environment

Thank you!