Cross-layer Modeling for Heterogeneous MPSoCs

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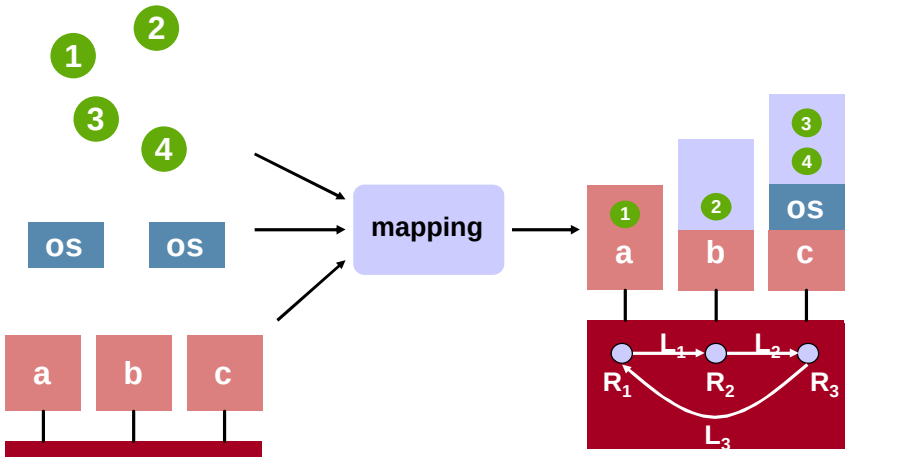
Motivation



ARTS objectives

- System-level modeling framework
- Bridging,
  - Application
  - RTOS
  - Execution platform
    - Processing elements
    - NoC

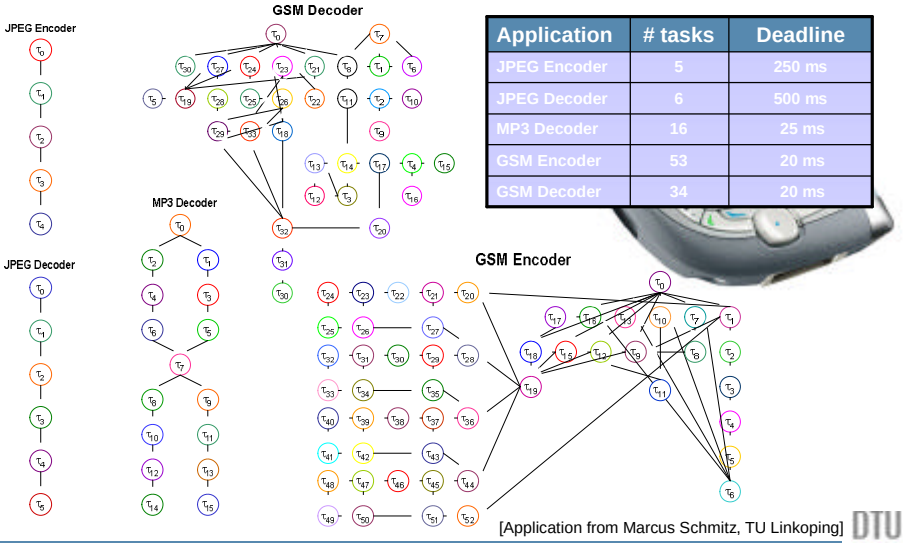
  } ***Cross-layer optimization***

- Supporting
  - System-level analysis
  - Early design space exploration

System-level analysis

- Consequences of
  - **RTOS** selection
    - scheduling, synchronization and resource allocation policies
  - **Processor** selection
    - General purpose, semicustom or dedicated hardware
  - **Network** selection
    - topologies and communication protocols.
  - **Task mapping** to processors
    - software or hardware
- On
  - Performance
  - Area
  - Memory profile
  - Power
  - …

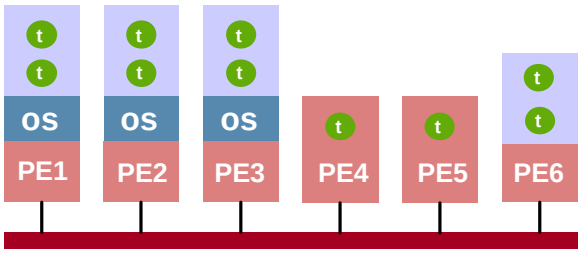
Case study: Simple hand-held multimedia terminal



Application	# tasks	Deadline
JPEG Encoder	5	250 ms
JPEG Decoder	6	500 ms
MP3 Decoder	16	25 ms
GSM Encoder	53	20 ms
GSM Decoder	34	20 ms

[Application from Marcus Schmitz, TU Linkoping]

Case study: Execution platform



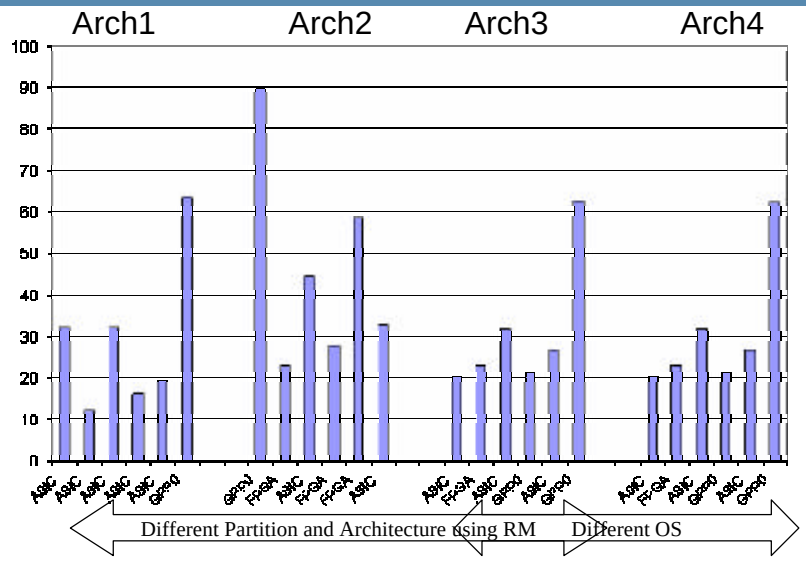
PE	GPP0	GPP1	GPP2	FPGA	ASIC
Frequency (MHz)	25	10	6.6	2.5	2.5

OS	RM (Rate Monotonic)	EDF (Early Deadline First)

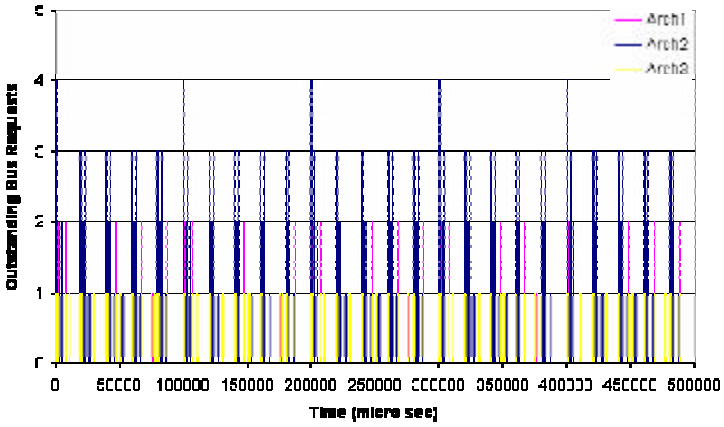
Case study: Architectures

	PE1	PE2	PE3	PE4	PE5	PE6
Arch1						
IP Type	ASIC	ASIC	ASIC	ASIC	ASIC	GPP0
OS	-	-	-	-	-	RM
Tasks	21	15	15	18	13	32
Arch2						
IP Type	GPP0	FPGA	ASIC	FPGA	FPGA	ASIC
OS	RM	RM	-	RM	RM	-
Tasks	18	15	21	18	18	24
Arch3						
IP Type	ASIC	FPGA	ASIC	GPP0	ASIC	GPP0
OS	-	RM	-	RM	-	RM
Tasks	15	15	15	18	19	32
Arch4						
IP Type	ASIC	FPGA	ASIC	GPP0	ASIC	GPP0
OS	-	EDF	-	EDF	-	EDF
Tasks	15	15	15	18	19	32

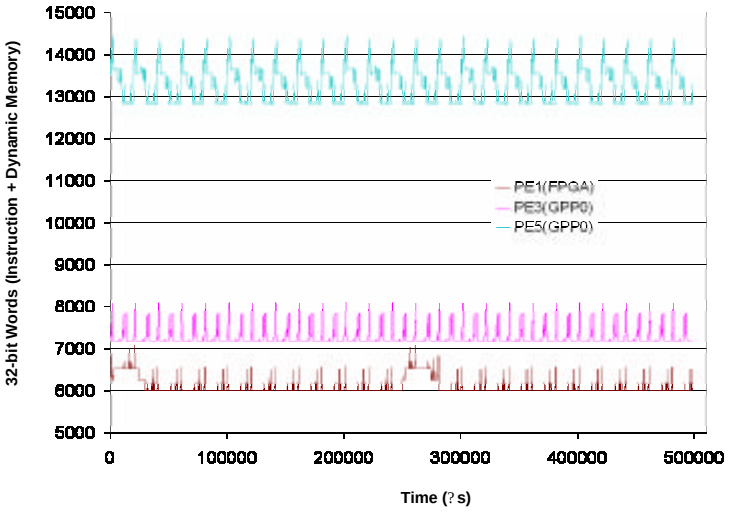
Processor Utilization



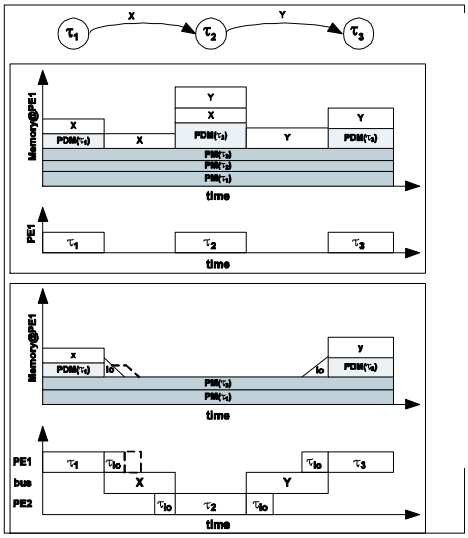
Bus Contention



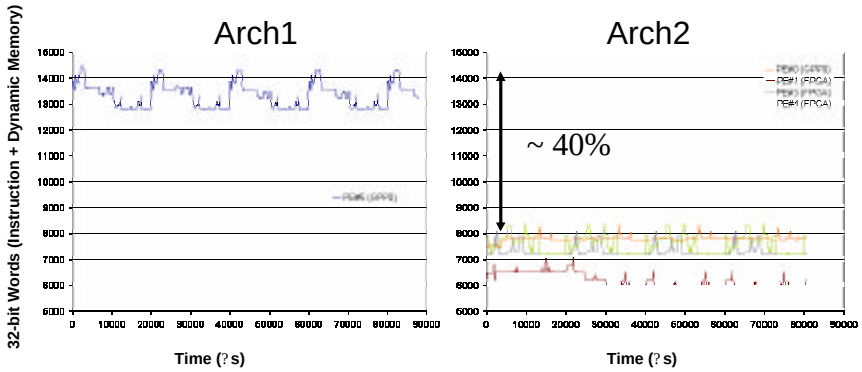
Memory Profile of Arch3



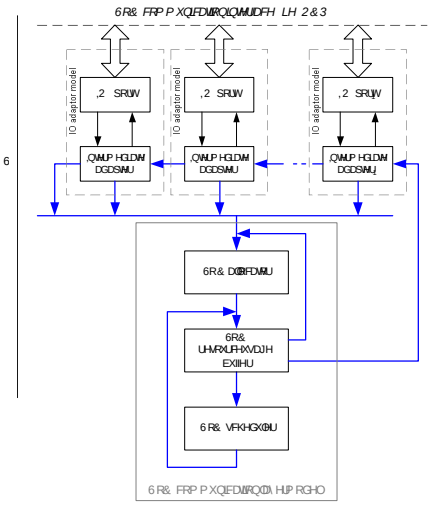
Simple memory model



Memory Profile

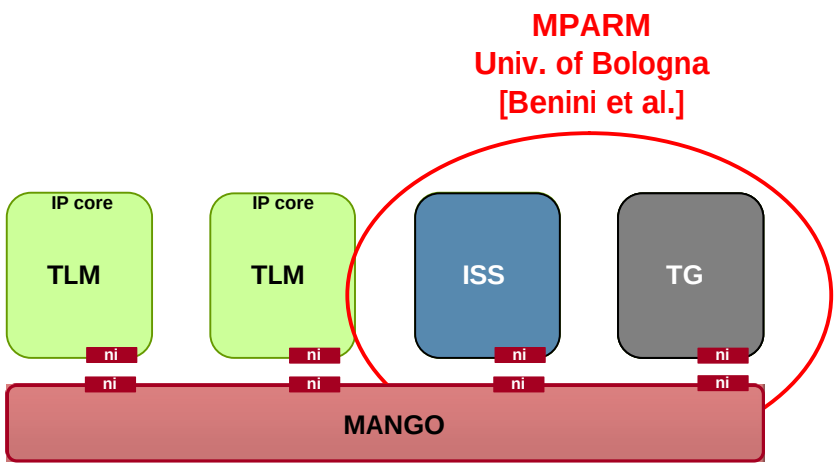


ARTS Framework



- ARTS Simulation framework based on SystemC
- ARTS PE module:
  - Application
  - OS
  - IO ports (OCP 2.0 interface)
  - IO device drivers
- ARTS Communication module:
  - Network topology and protocol
  - Network adapters
  - IO ports (OCP 2.0 interface)
- Applications of ARTS:
  - MPSoC (NoC exploration)
  - Wireless sensor networks
  - Automotive systems (TT vs. ET)
  - Dynamic reconfiguration

ARTS: Mixed Abstraction Levels



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