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Design methodologies for Embedded controllers, Wireless interconnect and System-on-chip

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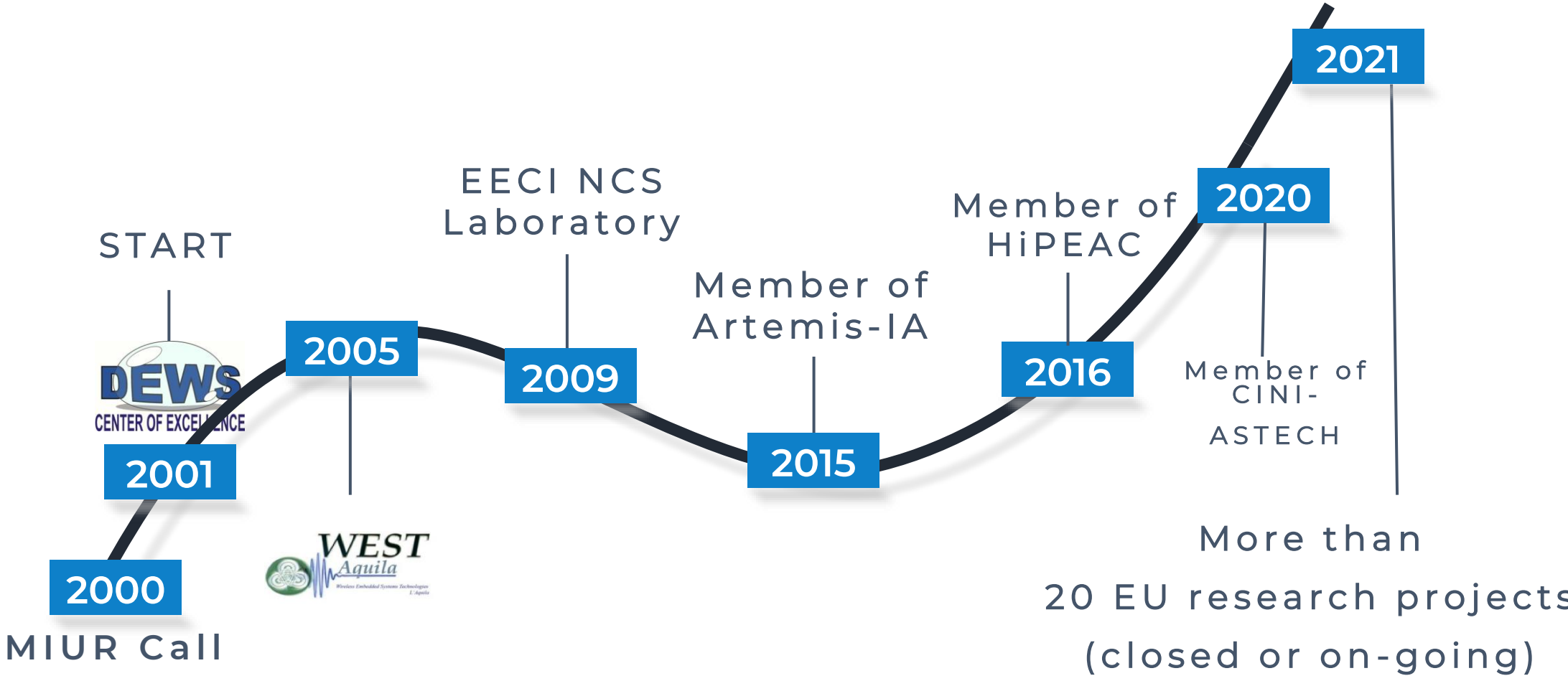

EMBEDDED SYSTEMS DESIGN: TEAM

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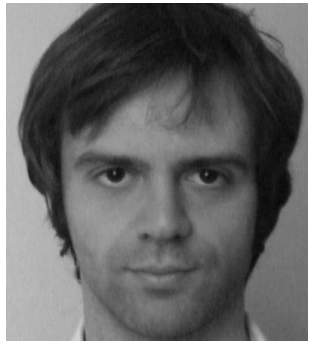

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EMBEDDED SYSTEMS DESIGN: MAIN TOPICS

- 1. Embedded ICT (eICT)
- 2. On-Chip Monitoring
- 3. Support on hardware reconfiguration
- 4. Electronic System-Level HW/SW Co-Design
- 5. AI at Edge layer
- 6. Assistive Technologies

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1. embedded ICT (eICT)

- Experimentation and analysis of all the ICT typically involved in the embedded systems domain (both traditional and high-performance)

HW

- **uC**: Microchip/Atmel, Texas Instruments, etc.
- **DSP**: Texas Instruments, etc.
- **FPGA**: Xilinx, Altera/Intel
- **PSoC**: Xilinx, etc.

SW

- **Bare-metal C/C++**
- **EOS/RTOS/HPV**: Linux, FreeRTOS, VxWorks, RTEMS, PikeOS, Xtratum

COMMUNICATION PROTOCOLS

- **Wired**: USB, SPI, I2C, UART, RS485, CAN, etc.
- **Wireless**: IEEE 802.15.11, IEEE 802.15.4, BT, LORA, etc.

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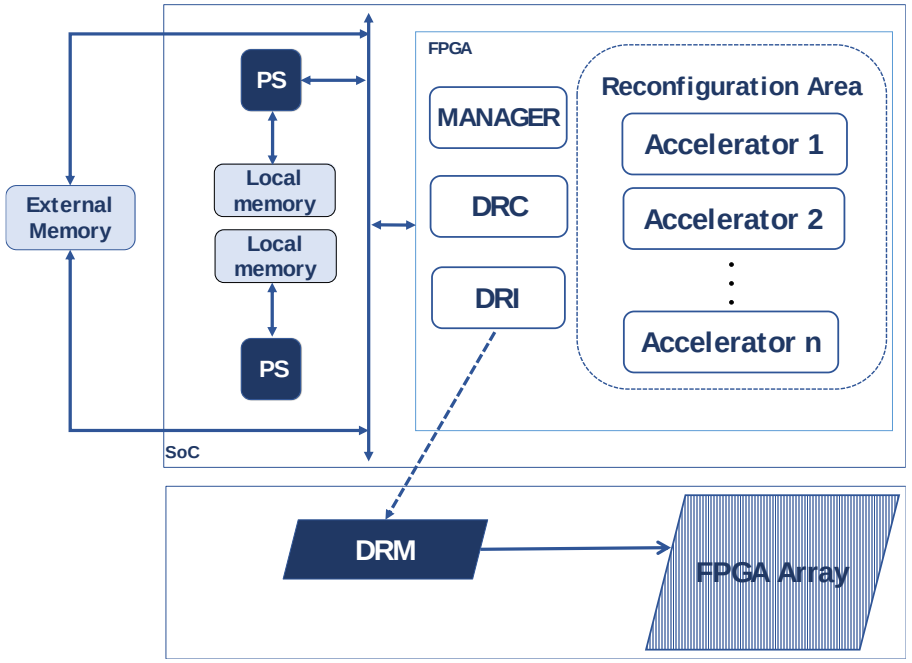
2. On-Chip Monitoring

- Automatically finding on-chip monitors from requirements
  - MONICA Tool (https://monicatool.cloud/)

- Support on custom generation of on-chip hardware monitors
  - Applied to
    - Tightly coupled bandwidth regulation
    - Unobtrusive tracing
    - Runtime characterization of system behavior

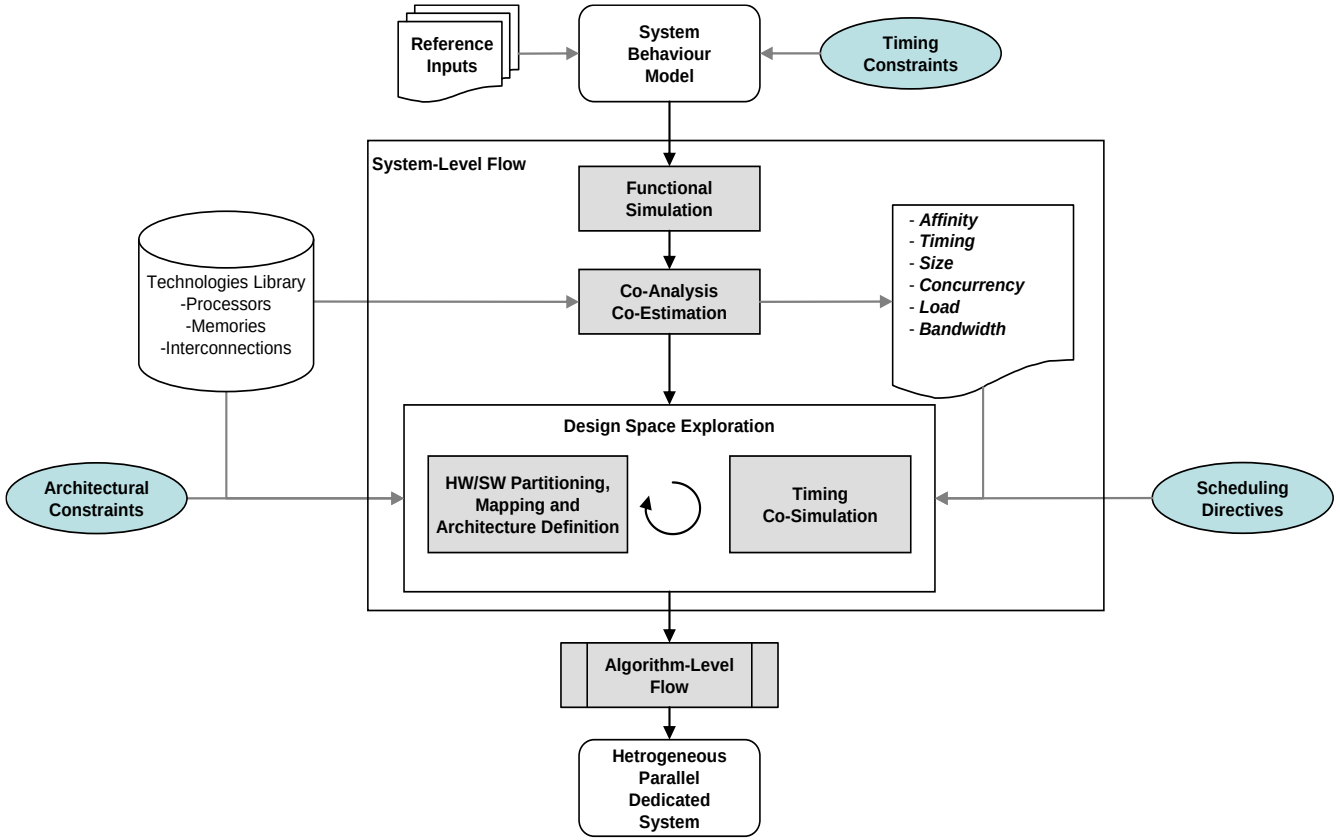
3. Support on hardware reconfiguration

- Dynamic Partial Reconfiguration Profitability & Off-Loading
  - Accurate evaluation on DPR time
    - Reconfiguration Time
    - Multiple DPR requests
  - Support on context-switch of HW-tasks



4. ESL HW/SW Co-Design

HW/SW Co-Design of Heterogeneous Parallel Dedicated/Embedded Systems



http://www.hepsycode.com

5. AI at Edge layer

- AI inference at the Edge
  - Acceleration on FPGAs and GPUs
  - Optimization for constrained devices
  - Work-sharing among different edge-devices

- *Moving toward a Federated learning*
  - *Nodes collaborating in a fractal way*
  - *Accurate age and gender recognition*

6. Assistive Technologies

- The CrazySquare Project
  - ICT-Game based system for music education learning
    - *Android based application available*

- IVR-based Serious Game for ASD People
  - Serious games for the treatment of autistic people using immersive virtual reality technologies

EMBEDDED SYSTEMS DESIGN: MAIN ROLES

- 2010/2021
  - More than 15 funded EU/National research projects
  - More than 10 industrial research contracts
    - Thales Alenia Space Italy, Thales Italy and several SMEs
  - Member of several international/national associations
    - ARTEMIS-IA, HiPEAC, ESSM & AT CINI National Laboratories

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