ATES@AQ Research Group

Assistive Technologies and Embedded Systems

(https://www.atesaq.it/)

University of L'Aquila

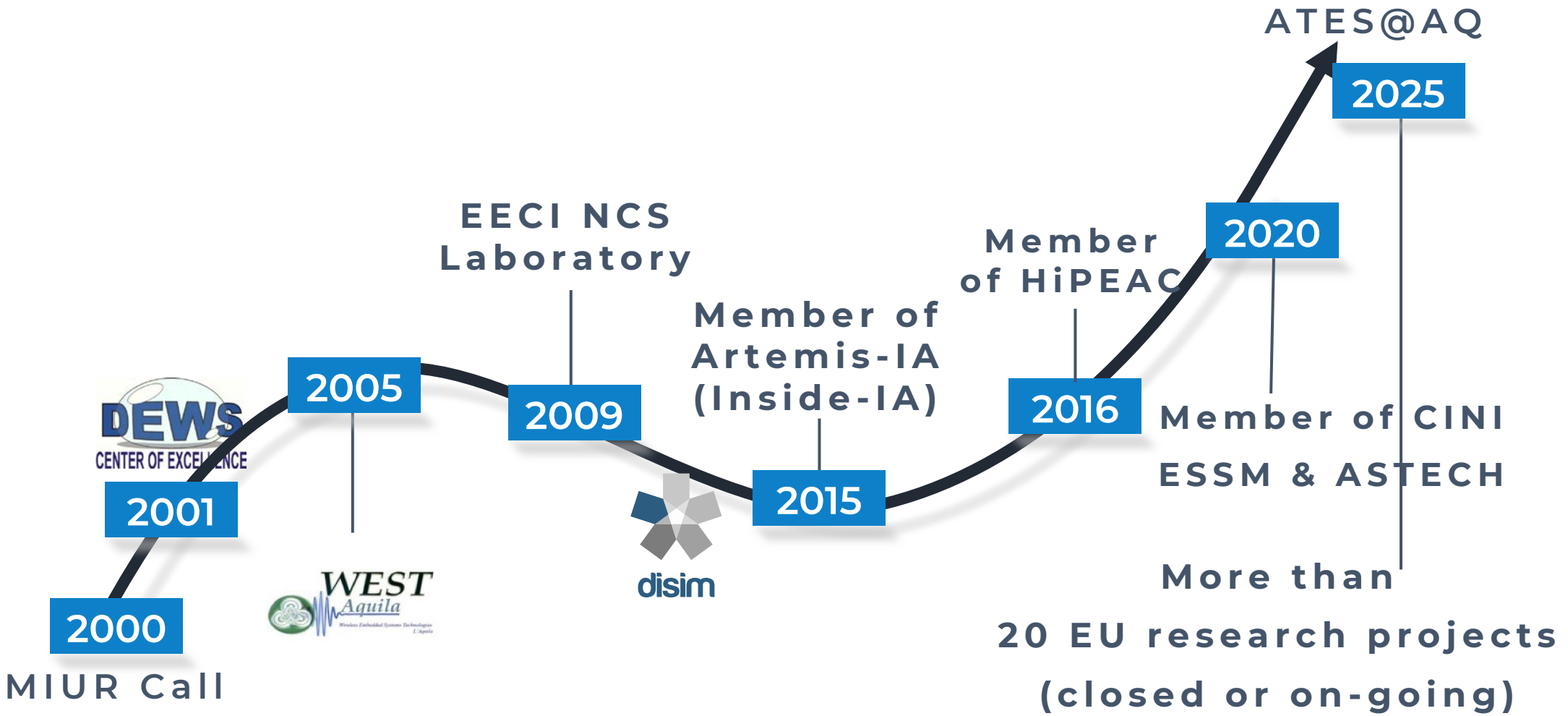
DISIM Department

Information Engineering, Computer Science and Mathematics

Center of Excellence DEWS

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

ATES@AQ - History



ATES@AQ - People

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Master's Graduate

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ATES@AQ - Research Topics

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

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1. embedded ICT (eICT)

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

HW

- **uC**: Microchip/Atmel, ST, etc.
- **DSP**: Texas Instruments, etc.
- **FPGA/SoPC**: Xilinx/AMD

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**
  - Design For Monitorability
    - MONICA Tool (https://monicatool.cloud/)

- **Support on custom generation of on-chip hardware monitors**
  - Library: JOINTER
    - Unobtrusive tracing
    - Runtime characterization of system behavior
    - Tightly coupled bandwidth regulation

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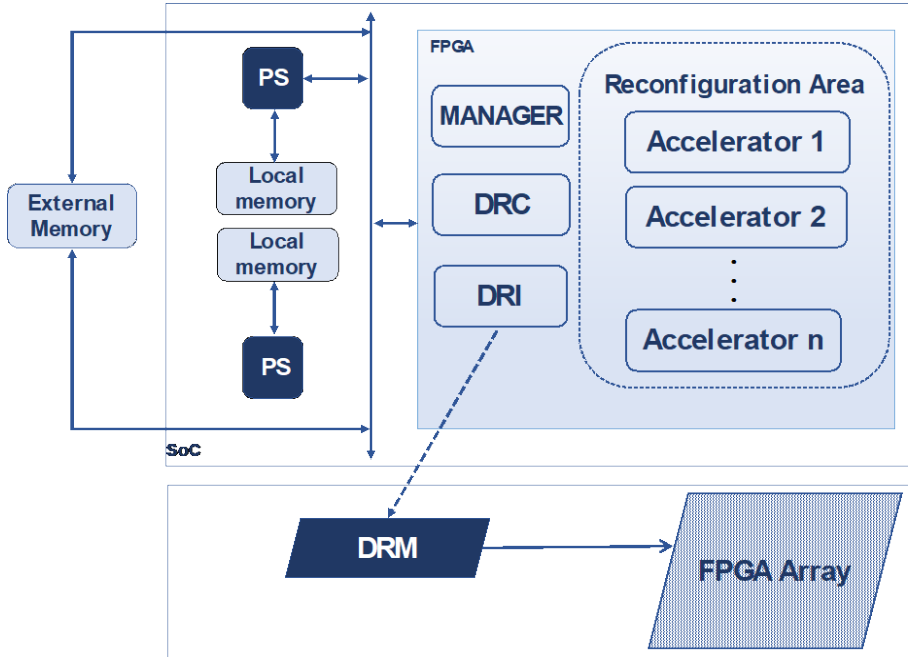
3. Support on HW reconfiguration

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



4. AI @ Edge layer

- **AI inference at the Edge**
  - Support to the designers in the analysis of the trade-offs provided by acceleration alternatives of CNNs on embedded/edge platforms
    - Acceleration on FPGAs, GPUs and dedicated cores
    - Optimization for constrained devices

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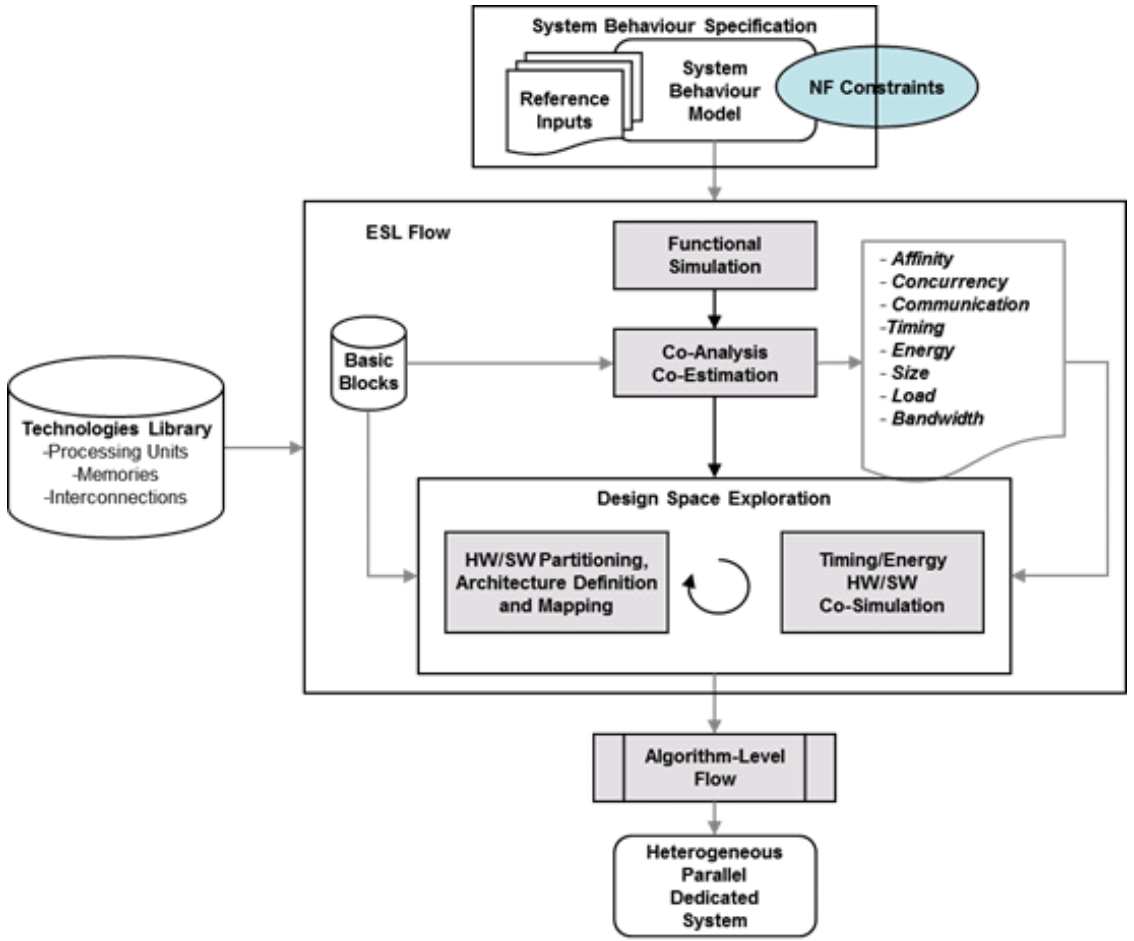
5. ESL HW/SW Co-Design

Hepsy Code

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



http://www.hepsycode.com

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6. Assistive Technologies

- **The CrazySquare Project**
  - A Gamified smartphone application for music education learning targeting pre-adolescents attending Italian Middle Schools
- **The VirtuOR Project**
  - Immersive Virtual Environments for Pain Management in operative rooms
- **The SeriousGXcraft Project**
  - A comprehensive Framework for the design, implementation, and evaluation of Video Games and Serious Games
- **DeeJay**
  - An action research-based methodological approach oriented to multidisciplinary Technology-Enhanced Learning projects

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ATES@AQ - Figures

- **2010/2024**
  - 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
    - INSIDE-IA, HiPEAC, ESSM & AT CINI National Laboratories

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EMBEDDED SYSTEMS DESIGN: FUNDED RESEARCH PROJECTS

- **VISION (ERC-2009-StG 240555) [CLOSED]**
  - Video-oriented UWB-based Intelligent Ubiquitous Sensing
- **SMILING (RIDITT 2009, national project) [CLOSED]**
  - SMart In home LIviNG
- **PRESTO (Artemis-JU ASP 2010-269362) [CLOSED]**
  - ImProvements of industrial Real Time Embedded SysTems develOpment process
- **CRAFTERS (Artemis-JU ASP 2011-295371) [CLOSED]**
  - ConstRaint and Application-driven Framework for Tailoring Embedded Real-time Systems
- **EMC2 (Artemis-JU AIPP 2013-621429) [CLOSED]**
  - Embedded Multi-Core systems for Mixed Criticality applications in dynamic and changeable real-time environments
- **CASPER (H2020-MSCA-RISE-2014) [CLOSED]**
  - User-centric MW Architecture for Advanced Service Provisioning in Future Networks
- **SAFECOP (ECSEL-JU RIA-2015) [CLOSED]**
  - Safe Cooperating Cyber-Physical Systems using Wireless Communication
- **MEGAM@RT2 (ECSEL-JU RIA-2016) [CLOSED]**
  - MegaModelling at Runtime - scalable model-based framework for continuous development and runtime validation of complex systems
- **AQUAS (ECSEL-JU RIA-2016) [CLOSED]**
  - Aggregated Quality Assurance for Systems

EMBEDDED SYSTEMS DESIGN: FUNDED RESEARCH PROJECTS

- **FITOPTIVIS (ECSEL-JU RIA-2017) [CLOSED]**
  - From the cloud to the edge - smart IntegraTion and OPtimization Technologies for highly efficient Image and VIdeo processing Systems
- **AFARCLOUD (ECSEL-JU RIA-2017) [CLOSED]**
  - Aggregate Farming in the Cloud
- **COMP4DRONES (ECSEL-JU RIA-2018) [CLOSED]**
  - Framework of key enabling technologies for safe and autonomous drones' applications
- **FRACTAL (ECSEL-JU RIA- 2019) [CLOSED]**
  - A Cognitive Fractal and Secure EDGE based on an unique Open-Safe-Reliable-Low Power Hardware Platform Node
- **IREL 4.0 (ECSEL-JU IA- 2019) [CLOSED]**
  - Intelligent Reliability
- **OPTIMIST (H2020-MSCA-RISE-2019) [RUNNING]**
  - OPTIMised video content delivery chains leveraging data analysis over joint multI-accesS edge computing and 5G radio network infrasTructures
- **AIDOART (H2020-ECSEL-2020-2-RIA) [CLOSED]**
  - AI-augmented automation for efficient DevOps, a model-based framework for continuous development At RunTime in cyber-physical systems
- **Reslient Trust (KDT-JU RIA 2022) [RUNNING]**
  - Trusted SMEs for Sustainable Growth of Europeans Economical Backbone to Strengthen the Digital Sovereignty

EMBEDDED SYSTEMS DESIGN: INDUSTRIAL CONTRACTS

- **LE**
  - Thales Alenia Space Italy
    - Hipervisors and on-board SW
      - Xtratum HPV Qualification
      - RTEMS over XtratuM HPV Qualification
      - CFDP over specific OBC with PUS-C compliance
    - Satellite Simulation Framework
    - Advanced processing
      - SDR on RAD-hard many-core processor
      - On-board AI
  - Thales Italy
    - Advanced multi-core platforms
    - Embedded profiling mechanisms for multi-core platforms

EMBEDDED SYSTEMS DESIGN: INDUSTRIAL CONTRACTS

- **SME**
  - Tekne (Italy)
    - Embedded profiling mechanisms
  - RoTechnology (Italy)
    - Wireless Sensor Networks Security
    - Embedded Systems Security
  - Kondor CS (Italy)
    - CNN for Age&Gender estimation
  - HIPPEROS (Belgium)
    - Experimentation of the HIPPEROS ARIA software stack
  - TEcnoJest
    - CNN for noise&sound classification

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