

WP6 Results and Outcomes from UC3M

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RADNEXT 3rd Annual Meeting – 10-11 June 2024

uc3m

Universidad Carlos III de Madrid

**RAD
NEXT**



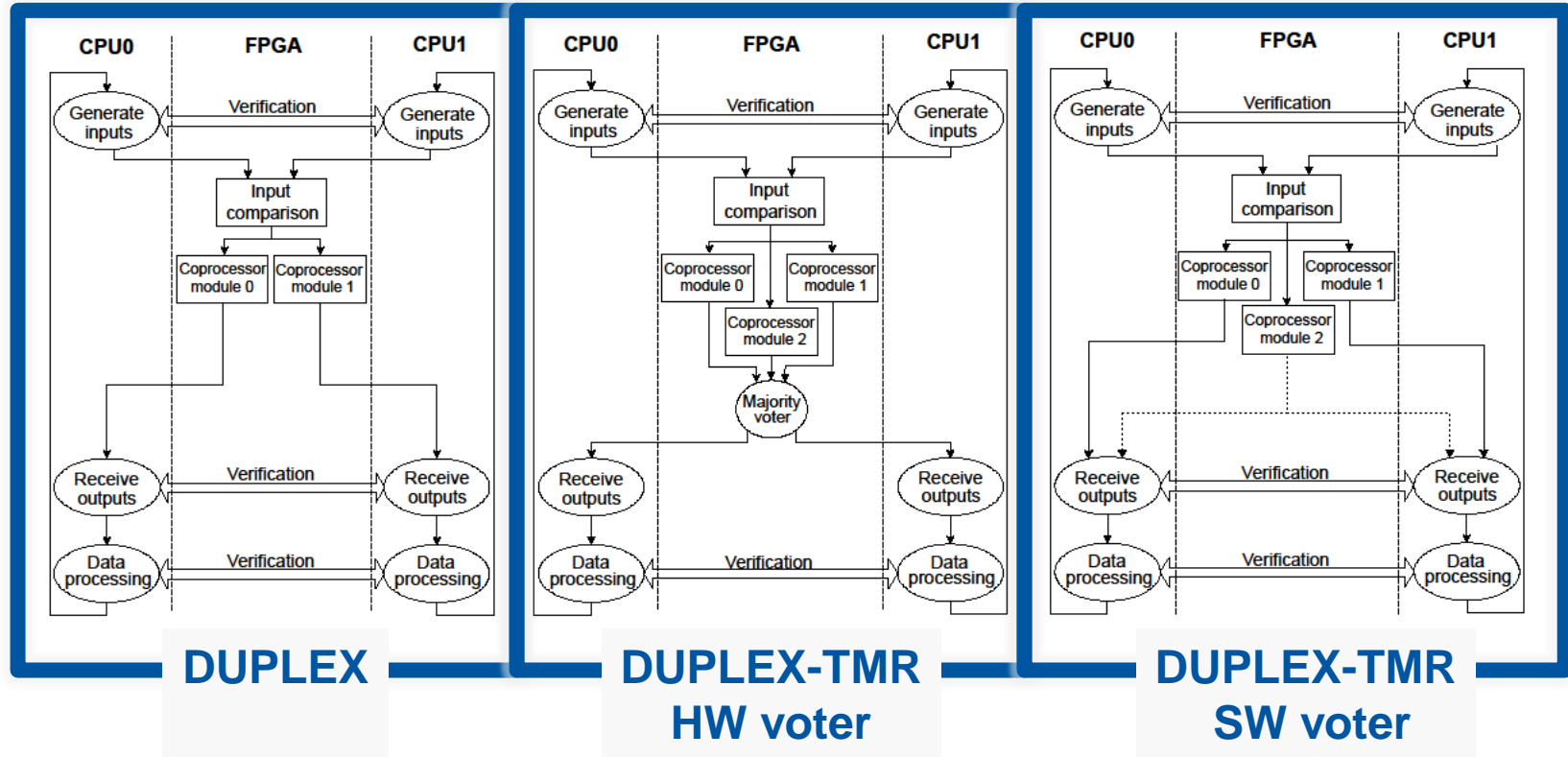
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008126

UC3M: Test Campaigns TA RADNEXT

	Source	Facility	Date	Experiment
1 st year	Protons	PSI	12/21	μp/FPGA/SoC
	Neutrons	Chiplr (1/3)	05/22	μp/FPGA/SoC/GPUs
2 nd year	Neutrons	Chiplr (2/3)	09/22	μp/FPGA/SoC/GPUs
	Mixed field	CHARM	10/22	μp/SoC
	Neutrons	Chiplr (3/3)	11/22	μp/FPGA/SoC/GPUs
3 rd year	Protons	PARTREC (1/2)	09/23	μp/FPGA/SoC
	Protons	TRIUMF (2/2)	01/24	μp/FPGA/SoC
	X-ray (microbeam)	ESREF	Accepted by RADNEXT Rejected by ESREF	μp/FPGA/SoC/Memories
4 th year	Proton	TBD	Under review	μp/FPGA/SoC

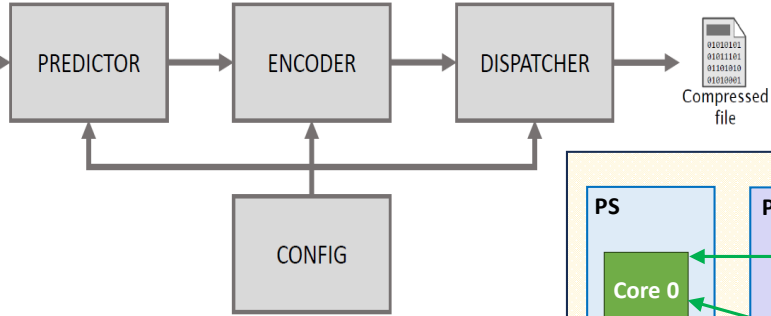
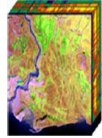
✓ Finally Completed

Hardening architectures for Multiprocessor System-on-Chip

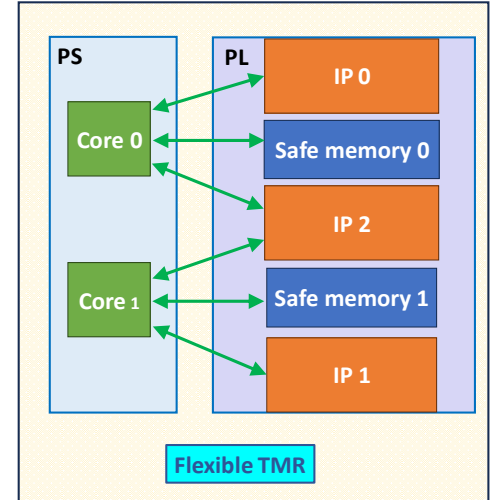
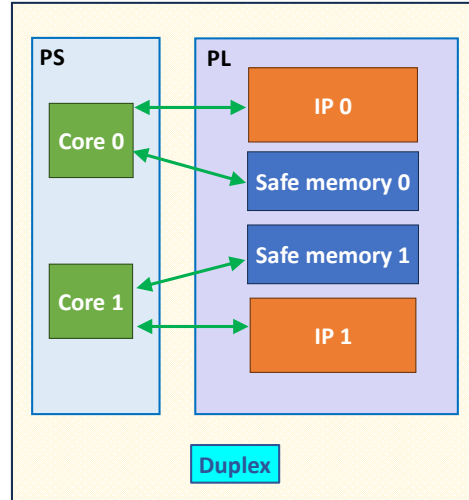


Case study: SHyLoC CCSDS-123 IP core for hyperspectral data compression

Hyperspectral data



AMD Zynq 7020



Experimental results

	ChipIR (UK) Atm. Neutrons		CNA (Sevilla) 15MeV Protons	
	Duplex	Flexible TMR	Duplex	Flexible TMR
Cross-section [cm ²] (Total events)	6.86x10 ⁻¹⁰	1.08x10 ⁻⁹	1.43 x10 ⁻¹⁰	1.38 x10 ⁻¹⁰
Cross-section [cm ²] (Undetected errors)	5.50x10 ⁻¹¹	5.02x10 ⁻¹¹	1.82 x10 ⁻¹²	1.28 x10 ⁻¹²

Between 1 and 2 orders of magnitude cross-section improvement

Publications **uc3m**

1. **RADECS 2022 Data Workshop:** P. M. Aviles, L. A García-Astudillo, J.A. Belloch, L. Entrena, A. Lindoso, “Comparative of proton radiation data for 28 nm Zynq-7000 SoC”
 2. **IEEE TNS (Special issue RADECS 2022)** : L. A. García-Astudillo, A. Lindoso, et al., "Evaluating Reduced Resolution Redundancy for Radiation Hardening in FPGA designs"
 3. **IEEE TNS (Special issue RADECS 2023)** : D. A. Santos, P.M. Aviles, A.M.P. Mattos, M. Garcia-Valderas, L. Entrena, A. Lindoso, L. DiLillo, “Hybrid Hardening Approach for a Fault-Tolerant RISC-V System-on-Chip”
- ✓ *New papers submitted to RADECS 2024!*

Next steps

- TA proposal (May 24): **Test of Advanced Microcontrollers and SoCs**
 - Beam type: protons
 - SEEs in COTS microcontrollers and SoCs
 - Hard core (ARM M) and soft core (RISC-V)
 - AI and space applications



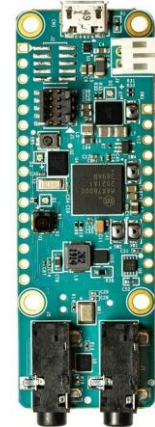
Microchip
ATSAMV71



ST
STM32H743ZI



RISC-V CV32E40P soft core
(to be implemented on
Zynq 7000/Ultrascale+ SoC)



UM

Analog Devices
MAX78000FTHR
(ARM+RISCV+CNN)