2° Forum della Ricerca Sperimentale e Tecnologica

A.MI.C.O. Space Laboratory

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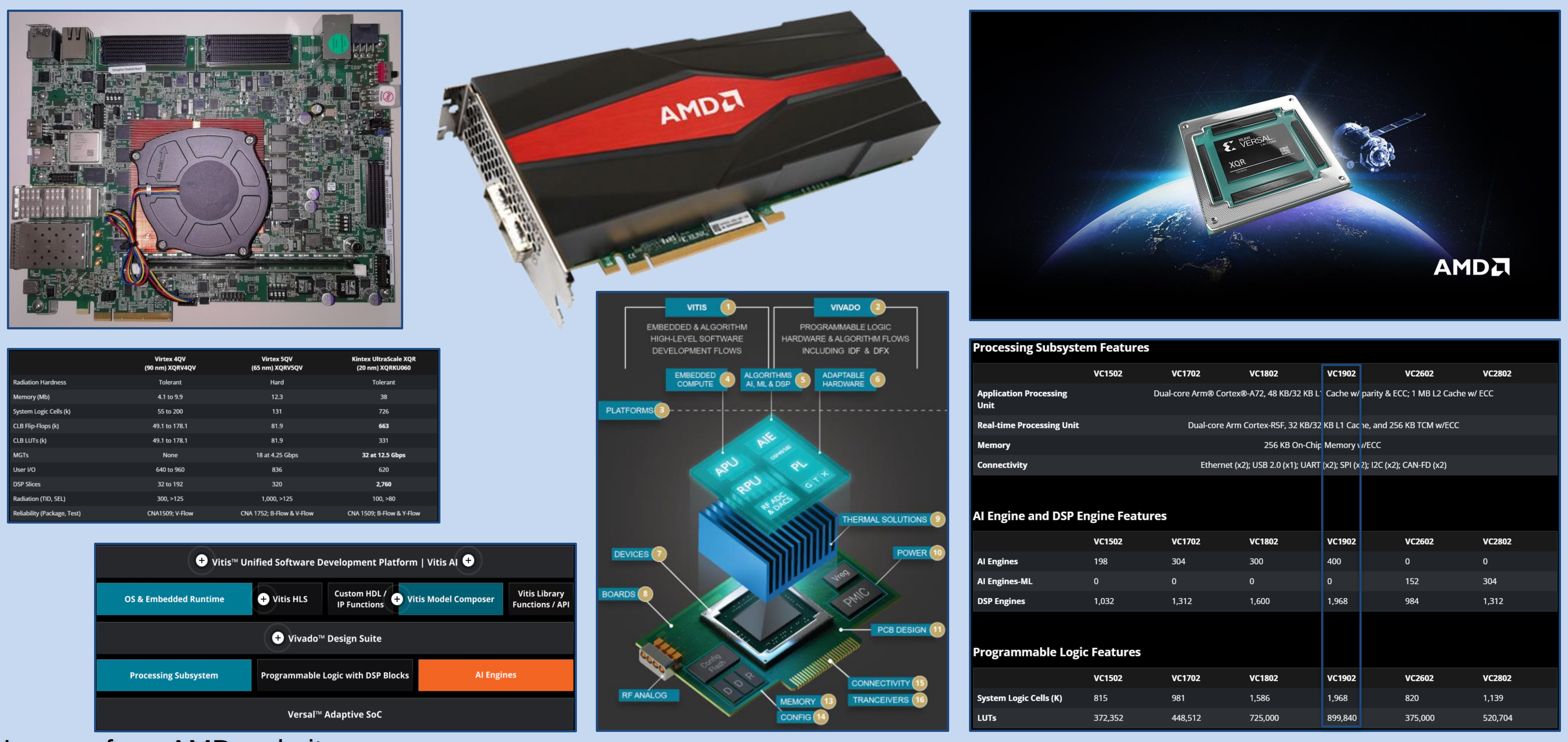
Introduction - The A.MI.C.O. Laboratory is poised for significant advancements following recently approved funding aimed at upgrading INAF's space laboratories. Our programmatic objectives are to create a high-quality virtual workspace providing remote access to hardware platforms with integrated design, simulation and analysis services. We aim to offer opportunities for training, learning and advanced research to enhance expertise in electronic technologies for space applications. Main goals are research teams training and national/international group collaborations. We also aim to foster innovation and development by supporting the creation of advanced applications and collaboration within the INAF community involved in astrophysical research.

Team Expertise - Our team, with extensive experience from various astrophysics terrestrial and space research projects, excels in FPGA architectures, digital and analog electronics, radiation mitigation techniques, communications protocols and data analysis software programming.

Laboratory Enhancements - The funding includes investments in AMD/Xilinx FPGA/ACAP platforms to create wide hardware resources and will be also allocated for high performance servers, development tools, integrated simulation environments and software licenses.

AMD/Xilinx FPGA/ACAP – Devices, Boards and Software.



Images from AMD website.

Applications - The new AMICO Space Laboratory will play a pivotal role in advancing FPGA/ACAP technologies, which are essential in various critical aspects of space missions. Some key application areas include:

Real-time Data Processing - FPGA/ACAP platforms offer high-speed, real-time processing of vast amounts of data generated by space instruments. This capability is essential for handling the continuous data streams from astrophysical observatories and sensors.

Space Communication Management - The flexibility of FPGA/ACAP technologies allows for the development of advanced communication systems for space missions. These systems are capable of efficiently managing data transmission and reception between spacecraft and ground stations.

AI and Machine Learning for Data Analysis - FPGA/ACAP platforms can integrate AI and machine learning algorithms to analyze space data in real-time. This can enhance the detection of astrophysical phenomena and improve decision-making processes during missions.

Radiation Mitigation and Fault Tolerance - The ability to implement radiation-hardened circuits and error-correction algorithms makes FPGA/ACAP solutions ideal for operating in the harsh conditions of space, ensuring mission reliability.

A.MI.C.O. LAB's environments.

Photos courtesy by Massimiliano Belluso

Virtual Environment - We will develop an intuitive web interface for seamless resource access and allocate resources to create pre-built libraries, predefined modules and educational materials for users. Promotion and outreach will be supported through online campaigns and presentations within INAF structures.

Benefits -The enhanced laboratory setup will bring several specific benefits to INAF's space research and development efforts:

***High Performance and Flexibility* -** The customizable nature of FPGA/ACAP platforms allows for the development of specialized circuits that can be tailored to meet the precise demands of space applications, ensuring high levels of performance and adaptability.

***Accelerated Development Cycles* -** The integration of cutting-edge simulation and prototyping tools in the lab will reduce development timelines, allowing for faster deployment of new technologies in space missions.

***Collaboration and Innovation* -** The virtual workspace will promote collaboration among researchers, enabling shared access to hardware resources and design tools, fostering innovation across INAF's institutions.

***Cost-Efficiency* -** Centralizing the hardware resources and offering remote access, the lab will help to optimize hardware usage, reducing both acquisition and maintenance costs for research teams.

Shape the future of Space Technology in INAF: join our National Center of Excellence in FPGA/ACAP!

Future Goals - The AMICO Space Laboratory aims to become a central hub for INAF's future space technology projects, driving innovation in FPGA/ACAP systems for astrophysical applications. We will focus on fostering collaboration across INAF's research institutions, supporting the development of advanced electronic systems tailored to the specific needs of space missions. Our long-term objectives include the continuous enhancement of our hardware and virtual environments, enabling faster prototyping and experimentation. Additionally, we will expand educational and training programs to equip INAF researchers with cutting-edge skills, ensuring that the laboratory remains a key contributor to INAF's ambitious space exploration and astrophysics projects.

Conclusions - The enhancement and integration of the AMICO Space LAB into a national INAF network with remote access represents a crucial step in promoting education, research and innovation in advanced AMD/Xilinx FPGA/ACAP technologies for space applications. By combining strategic funding with programmatic and structural planning, the AMICO Space LAB will provide a cutting-edge learning and development environment. This will enable users within the INAF network to fully leverage the capabilities of AMD/Xilinx FPGA/ACAP platforms, as well as promote the laboratory to develop a National Competence Center.

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