Space-based supercomputer in design at Los Alamos

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Los Alamos National Laboratory today announced funding of a new space payload which dramatically increases on-orbit computational capabilities.

The project is jointly sponsored by the National Nuclear Security Administration's (NNSA) Office of Nonproliferation Research and Development (NA-22), and the U.S. Department of Defense.

The experimental payload will demonstrate and validate technologies offering more than 1,000 Giga Operations-per-second (GOps) processing capability for Software-Defined Radio (SDR) functions in space. SDR is a technology of interest to the military to support tactical communications and to commercial television and radio broadcasting. The payload computer's signal-processing capability of 1,000 GOps is approximately the same as supercomputers of the last decade, which occupied 50,000 cubic feet and used 50 kW of power. This new payload, by contrast, is designed to weigh 40 pounds and consume only 80 watts, a performance which is enabled by state-of-the-art, 90-nanometer Virtex(tm)-4 silicon-chip technology from Xilinx, Inc.

NNSA Program Manager W. Randy Bell said, "Los Alamos' new payload project will be a path-breaker for our Space Nuclear Explosion Monitoring (SNEM) program, enabling us to meet stringent new requirements for less weight and power, while growing our ability to discriminate nuclear-explosion-related signals versus natural and man-made background signals."

The portfolio manager for space nuclear explosion monitoring, Mark Hodgson, came to Los Alamos from a career in USAF space innovation. He discussed the new technology's potential: "Our sensors on the Global Positioning System and Defense Satellite Program platforms have been severely constrained by the data downlinks available."

Hodgson continued, "This new reprogrammable, supercomputing-payload technology enables our science staff to use in space the algorithms and methods previously only possible in ground-based mainframe computers, and to continually modify those methods in-situ, for better performance as science knowledge improves."

Los Alamos senior project leader Mark Dunham helped pioneer Reconfigurable Computing (RCC) at Los Alamos, the technology upon which the Software Defined Radio payload is based. DOE, DOD, and DARPA began sponsorship of RCC at Los Alamos in 1993, leading to the successful development of the CIBOLA Flight Experiment, which is set to launch this fall on a U.S. Air Force Atlas-V rocket.

The new payload draws heavily on the high-performance system-on-chip capabilities provided by Xilinx Inc.'s latest Virtex-4 family of platform field-programmable gate array (FPGA), on Atmel Corporation's new AT697 RadHard SPARC processor, and on BAE Systems' new chalcogenide C-RAM.

"By using these and other new technologies, our design advances the state of space processing by two generations, enabling dramatically more flexible commercial and military communications satellite capabilities. Two of the major obstacles for lower-cost satellite systems have been payload obsolescence and excessive development time," Dunham said.

Xilinx, Inc.'s partnership with Los Alamos in space-based reconfigurable computing was announced in a joint press release in 2000, and it

continues today with the Virtex-4 90-nm domain-optimized FPGA. Aerospace and Defense Director Rick Padovani said, "The space and defense business is a major growth segment for Xilinx and we look forward to continuing the successful cooperation with LANL for Virtex-4 and beyond. Quick migration of our latest generation silicon into space is a key goal of our program. We are proud to be part of a team enabling this leap in defense capability." The Virtex-4 device is now being tested for space use by the team of Los Alamos, Aerospace Corporation, Jet Propulsion Laboratory, and Xilinx, Inc.

Source: Los Alamos National Laboratory