First available from Bolt, Beranek and Newman Advanced Computers Inc. in 1989, the BBN-ACI TC-2000 had a multiprocessing architecture that allowed individual processors to be partitioned into clusters and dynamically reallocated. Because data could be shared within and between clusters, the computer was able to integrate distinct segments of a complex calculation.

Exploring the Future of Scientific Computing

In October 1989, the Laboratory Directed Research and Development office funded the ambitious Massively Parallel Computing Initiative (MPCI), which cut across directorates at the Laboratory and helped redefine high-performance computing as massively parallel computing. The exploratory work performed as part of the initiative—and comparable efforts at Los Alamos and Sandia national laboratories—paved the way for the Accelerated Strategic Computing Initiative (or ASCI, now the Accelerated Simulation and Computing program), which is a vitally important part of the Stockpile Stewardship Program.

Led by Eugene D. Brooks III, the three-year initiative explored the relevance to Laboratory computer applications of then-accelerating trends in commercial microprocessors. Advances in very large-scale integration had increased both computer chip speed and reliability so much that massive, coordinated clusters of microprocessors were sometimes rivaling the performance of custom-designed supercomputers. For example, early tests here with radiation transport codes (used in weapons simulations) suggested a factor of 20 advantage for the massively parallel approach.

In 1990, the MPCI project acquired Livermore's first substantial, onsite massively parallel resource, a 64-node BBN-ACI TC-2000 machine that was upgraded to a full 128-node configuration a year later. Scientists from across the Laboratory's technical directorates probed the software development challenges of effectively using this new architecture by running a variety of computer problems on the MPCI machine. By 1992, early results were already available in such diverse areas as particle-physics event simulation, multidimensional numerical analysis, parallel graphics rendering algorithms, and sedimentation modeling. Each MPCI annual report not only encouraged use of this new approach to scientific computing but also summarized the latest trial programming techniques and output evaluations for Laboratory researchers.

One rewarding long-term effect of the early MPCI work was a heightened desire to widely share centrally managed massively parallel computing resources among many unclassified projects at the Laboratory. In 1996, a formal Multiprogrammatic and Institutional Computing (M&IC) initiative began providing fast, high-capacity parallel computers to program collaborators on and off site, managed by the Livermore Computing program. A Cooperative Research and Development Agreement between the Laboratory and Compaq Computer Corporation led to further design improvements and to the delivery of serial number 1 of the M&IC Tera Cluster 2000 parallel computer in 2000.

The Laboratory's continued investment in such massively parallel computers, in addition to the supercomputers acquired through ASCI, has repeatedly enabled unclassified simulations on groundbreaking projects that complement the classified ASCI work. High-resolution modeling of the response of materials to extreme temperature and pressure, of the consequences of global warming and climate change, and of the interaction of proteins and genes have all resulted from software innovations developed using these parallel computational resources at Livermore.

CIAC: Keeping Cyberspace Safe

On February 1, 1989, the Department of Energy formed the Computer Incident Advisory Capability (CIAC) at Livermore. A continuous stream of security incidents had begun the previous year, affecting computer systems and networks throughout the world. Crackers and intruders made bold headlines with their stealthful entry into government computers, commercial equipment, and telephone systems. The world of computers was proving to be a dangerous one, and clearly something needed to be done. CIAC's primary mission has been to help and protect the DOE computer community. The list of federal clients has grown to encompass other agencies, and in several instances, CIAC has worked with the Federal Bureau of Investigation to respond to incidents.