Supercomputing slows down?

IBM’s Blue Gene took a distinct path to become the world’s fastest computer. Ever since the ground-breaking Control Data 6600 of Seymour Cray (BEE ‘49, MS ‘51), designers have made supercomputers ever faster—and ever hotter. Cray cooled his machines with aluminum fins and artificial blood. Supercomputers typically use the fastest chips. For a generation, Moore’s Law made chips smaller and faster. But with Blue Gene, IBM made some surprising choices.

In 1999, IBM set a goal of creating a peta-flop supercomputer for modeling protein folding. To achieve a million billion floating point operations per second, IBM needed a 500-fold increase in speed. A top-of-the-line supercomputer consumes enough electricity for 1,000 households. A standard petaflop supercomputer would generate enormous heat. While desktops were moving to clock rates of 1 GHz or more, Blue Gene’s designers specified dual-core 400 MHz processors. The heat produced by a microprocessor is proportional to its clock frequency. So Blue Gene’s slower chips can be packed tightly together, allowing more processors to operate in parallel and at lower energy cost.

Computing needs quick calculation but also fast communication. Blue Gene’s architecture is scalable: doubling the number of processors doubles its performance—for certain types of problems. IBM developed proprietary networking that permits superfast communication between each compute node—Blue Gene’s building block—and its six nearest neighbors. Each compute node runs a simplified Linux operating system. For Blue Gene/L, gigabit ethernet connects the node cards. A separate ethernet permits booting and diagnostics.