Tezzaron's High-Density Interconnect 3-D Chips Yield Significant Power Savings

Tezzaron's Project Orion produced a set of 3-D stacked demonstration parts. These parts showed that 3-D stacking, using Tezzaron's very high density interconnect, can enable chips that are more than 4 times faster than normal chips, up to 3 times denser, orders of magnitude more reliable, and much cheaper to produce – all this while using **far less power**. But just how much power might be saved in a typical application? This brief paper illustrates an answer to that question.

Consider a moderately large data center, or "server farm," equipped with 10,000 blade servers. A typical server consumes about 250 watts of power and requires an equal amount of power for cooling, for a total energy consumption of about 500 watts per server.[*] The data center's 10,000 servers therefore consume about 5 megawatts of power. Using industry averages, this is the approximate amount of energy used by 5,000 homes. A conservative extrapolation of the results from Tezzaron's Project Orion suggests that almost half of that energy can be saved by full adoption of Tezzaron's 3-D stacking technology.

This estimated energy savings is the result of two improved efficiencies produced by Tezzaron's 3-D stacking. The first efficiency reduces the number of servers needed in the data center; the second reduces the amount of power consumed by each remaining server.

1) Tezzaron's FaStack® 3-D DRAM memory performs as fast as today's typical SRAM memory, enabling at least a 25% system performance improvement. This enables 25% fewer servers to do the same amount of work and handle the same amount of data traffic. In the example we are using, this eliminates 2,500 servers for an immediate savings of 500 watts per server, or 1.25 megawatts of power.

2) Within each of the remaining 7,500 servers, about 35 watts is used to power the memory[*] and an estimated 30 watts to drive signals back and forth through the memory bus between the CPU and the memory modules. Using high-density 3-D stacked chips would consolidate the many memory modules into a few. These few modules could be stacked directly onto the CPU core, eliminating the memory bus altogether. This reorganization would save approximately 90% of the original 65 watts per server, plus an equal amount for cooling; in all, nearly a megawatt.

Taken together, these two efficiencies can save almost half the energy consumed by the servers, plus an equal amount of energy for cooling, resulting in a total savings of almost half the energy consumed by the data center – about enough energy to power more than 2,000 homes.

Data center energy consumption more than doubled between 2000 and 2006; under current trends, it is likely to double again by 2011[*]. If this happens, industry experts predict that 90% of companies will experience power failures and interruptions[*]. Federal and industry groups alike see an urgent need to change this scenario. From the example outlined above, it is easy to see that the adoption of Tezzaron's 3D stacking technology could significantly change the current energy trends, saving enormous amounts of energy and providing benefits to the industry and to society. Even without regulatory intervention, data center owners will be eager to apply a technology that provides significant cost savings in both energy and capital equipment (deploying 25% less equipment to do the same amount of work).

Hypothetical Data Center Energy Savings Illustration

Current Consumption: (10,000 servers x 250 watts per server) x 2 (to account for cooling) = 5 megawatts

Estimated Consumption Using Tezzaron's FaStack® DRAM: (10,000 x .75) x [(250 – (65 x .90))] x 2 = 2.87 megawatts

Result: *A savings of almost half the total energy used!*

[*] EPA "Report to Congress on Server and Data Center Energy Efficiency" Public Law 109-431, August 2007

1415 Bond Street, Suite 111, Naperville, IL 60563
(630) 505-0404
www.tezzaron.com