Journal Article

16X Speedup in Maxwell DSO on 32-Core High-Performance Compute Farm Doubles Traction Motor Design Productivity at General Motors

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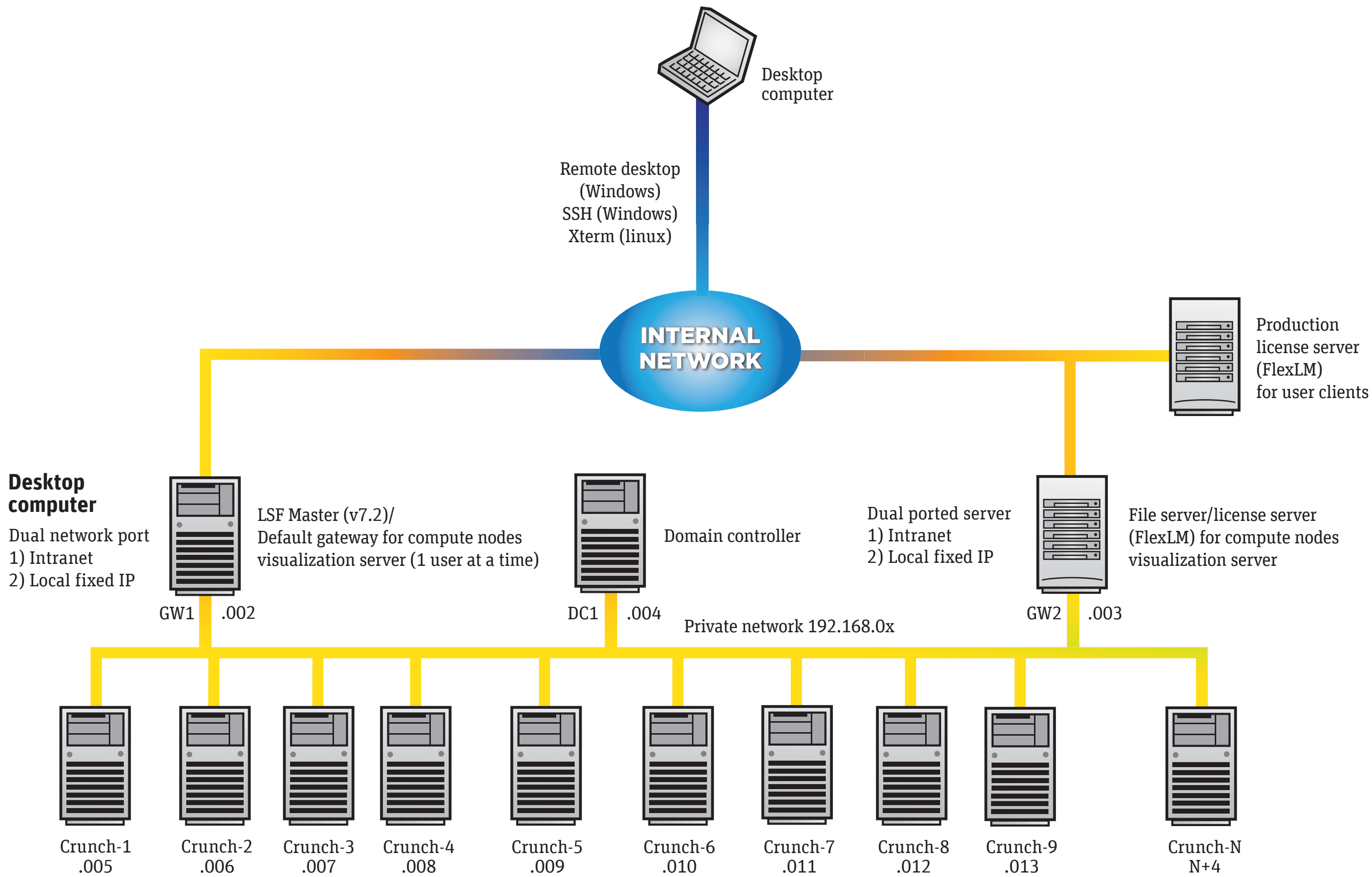
Automakers have little experience in designing traction motors used to drive electric vehicles (EVs) and hybrid electric vehicles (HEVs), so engineers must consider a very wide range of design alternatives to optimize their designs. Electromagnetic simulation plays a critical role by evaluating the performance of design concepts, such as by computing the torque profile of the machine. As with many HEV and EV OEMs, GM uses ANSYS® Maxwell® electromagnetic field simulation software to compute the torque profile of the motor, how the torque ramps up over time in motor mode, and the electrical resistance in stopping the vehicle in regenerative brake mode. In the past, it took hundreds of hours to perform electromagnetic simulation on a single design iteration, which hurt productivity by leaving engineers waiting for results.

General Motors developed a high-performance computing (HPC) environment HPC platform using surplus hardware to create a 16-computer, 32-core compute farm that served as a stepping stone to the current more-sophisticated approach. The details of the current approach are confidential but we can provide information on the stepping-stone approach, which can be used to inexpensiely enter the HPC supercomputing arena.

The stepping-stone configuration shown on the next page uses 16 compute nodes in addition to an LSF master gateway, domain controller and license server. LSF by Platform Computer (now IBM) was used as the parallel task manager and queuing software. The domain controller served as the file server and had 2 TB disk storage for all the user files. It also served as the server for the Maxwell files so that it was not necessary to install Maxwell independently on each box. The stepping stone system required 32 DSO, six Maxwell 2-D, six Optimetrics and 16 LSF Server licenses.

Performing simulations running on 16 computers with 32 cores reduced solution time by a factor of 16, to 4.5 hours. Let’s assume that a fully trained engineer costs about $100,000 per year. To perform the same work as two engineers in the stepping stone environment in a non-HPC environment would require at least four engineers. So the stepping stone environment saves about $200,000 per year in personnel costs. The cost of the HPC software is roughly $30,000 per year. So with software costs factored in, the stepping stone system saved $170,000 per year with virtually zero upfront investment. In addition, the ability to evaluate more design alternatives reduced time to market, reduced manufacturing costs and improved the quality of traction motors.

Further improvements are on the way. When ANSYS Maxwell supports graphic processor unit (GPU) computing by offloading highly parallel number-crunching algorithms from the central processor unit (CPU) cores onto GPUs, it will result in a substantial increase in speed. A GPU such as the NVIDIA® M2070 Tesla™ Accelerator offers immense floating point speed and array manipulation features, typically providing a two-times speedup compared to an HPC system without GPUs.



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