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8th Annual Spring Technology Panel-- Where is the recovery?

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Thank-you, Tim. It's an honor address such an esteemed group.

My company, NVE Corporation, serves the semiconductor industry. Computers drive a big chunk of semiconductor demand, and in recent years, people and businesses haven't been replacing computers nearly as often as they did in the past.

Why is that? Well, some analysts have said that the computer replacement cycle is over because old computers are fine—they do everything they have to, that theory goes.

That reminds me of the analogy that if cars had developed like computers
they'd go ten thousand miles per hour and get a thousand miles per gallon.

But unfortunately they'd take three minutes to start and they'd blow up twice a year killing everyone inside.

So for all their capabilities, modern electronics have serious limitations—we've gotten used to them, but we haven't been able to fix them. Many of these limitations are related to memory. Semiconductor memories are fast, but they're volatile, meaning they lose data when power is removed. That leads to infuriating problems like short battery life, crashes, and slow memory transfer. I've got lots of megaflops in my computer, but it goes to no flops when the hard-disk light comes on.

NVE specializes in a new memory technology called MRAM, which has been called the ideal memory because it has the potential to combine the best attributes of existing memories: the speed of SRAM, the density of DRAM, and non-volatility of hard-disks, that is the ability to store data permanently.

MRAM is based on a nanotechnology called spintronics, which uses electron spin rather than charge to encode information. Most electronics are based on charge, which is inherently unstable, because if you remove the power, electrons tend to return to a stable state of neutrally-charged atoms. Electron spin, on the other hand, is stable. Electrons have two stable spins, up and down.

Eventually this could enable a new generation of Dick Tracy cellphones and instant-on computers where programs load and execute immediately. It could dramatically simplify computer architecture by eliminating the myriad of data paths needed to move information between fast memory, dense memory, and nonvolatile memory.

Walter Mossberg of the *Wall Street Journal* wrote an insightful article a few years ago lamenting that computers and cellphones don't even have on/off switches that actually work--you saw that when Scott and I turned off our cellphones at the start of this session. He attributed that to poor ergonomic design, but it's actually a symptom of something more fundamental: with current memory technology, you can't recover from true off because the data goes away. MRAM could solve that problem, along with other symptoms of memory limitations.

I'm old enough to remember when semiconductor memory emerged in the early 70s. It forever changed electronics and computing. MRAM could be as important. It's a once in a lifetime opportunity—we feel very fortunate to be a part of it.

But spintronics and MRAM are just examples of emerging disruptive technologies. There are lots of incredible things in the works in electronics, nanotechnology, medicine and other fields.

And so I'm very optimistic for our industry and our economy. I think we'll look back at 2004 as the start of a revitalization as new technnology begins to make an impact.