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Is the Semiconductor Industry Mature?

Good morning. It's a pleasure to be here.

I want to thank Semico for convening this conference to share insights, perspectives and thoughts on the state of the semiconductor industry. As we all battle through what is inarguably one of the most challenging periods in our history, I'm pleased that we continue to have opportunities to come together and discuss current views of where we are as an industry and where we are headed.

As someone who for over 40 years, has lived through many of the highs and lows of our industry, I've often been asked if I believe the semiconductor industry has become "mature" and what levels of growth we should expect in the years to come. It's a valid question and I'd like to use our discussion today to share, through four brief chapters, my response.

Chapter One
Why Markets Mature

When reviewing the growth numbers of our industry the last couple of years, it would be easy to conclude that our industry is maturing. However, remember that the semiconductor industry has been through tough economic times before, and we recovered to become more important to our customers, more productive, and more profitable. After the 1984-1985 slowdown when revenues fell 16.5 percent, we recovered to the previous peak in revenues within two years. After the 1995-1998 downturn, we recovered to the previous peak in revenues within four years. And today, even with the uncertainty that surrounds us, I believe we will return to a secular CAGR of 10-12 percent and exceed our previous peak of \$204 billion in 2004, again within four years of the previous peak.

We are a cyclical growth industry.

As we think about how we will recover and reach these levels of growth, I ask you to remember two things: one, after the magnitude of the dot.com/telecom bubble we experienced in the late 1990's, it should be of no surprise to anyone that the corresponding downturn would be severe. And indeed, with the unprecedented 32 percent decline in chip revenue we saw in 2001, recovering by 2004 will be a challenge.

But before we let the Cassandra's of our industry break our spirit by dwelling on what may be wrong, let me remind you what continues to be right with our industry: today we have with us the same powerful phenomenon that brought our industry growth for more than four decades.

You see, I believe that – by definition - industries can only be considered “mature” when the phenomenon that fueled their growth is satisfied. Take, for example, the railroad industry, where the phenomenon of nation-wide commerce drove the creation of 254,000 miles of track linking nearly every city and town in America. Once the tracks were laid, and the phenomenon of nation-wide commerce was satisfied, the railroad industry settled into what was effectively a “mature” state as a business.

The automobile industry was sparked by the phenomenon of personal freedom; the desire of individuals to go wherever they wanted, whenever they wanted. As modern manufacturing techniques helped to drive unit costs down and the quality of paved streets and motorways improved, the automobile industry boomed. But, eventually, almost every American of driving age was able to acquire a car, and their need for personal freedom was satisfied. At that point, the automotive industry achieved a more “mature” state, like the railroad industry many years earlier.

Both of these industries grew at a double-digit pace, only to reach more mature rates of growth when the phenomenon that spurred their growth was satisfied.

The phenomenon that characterizes the semiconductor industry, the ability to reduce device feature size enabling us to produce ever more functionality at ever lower cost may be best described by the observation we all know as Moore’s Law.

Fortunately, the phenomenon that spurred our growth for more than 40 years is far from exhausted. According to Dr. Gordon Moore, a co-founder of Intel, the phenomenon that has driven our industry will still be with us for at least another 10 years. This past February, speaking at the International Solid-State Circuits Conference (ISSCC), he told the audience that the prediction he made in 1965 that the number of transistors on a

semiconductor will double every couple of years would continue for at least the next decade. Gordon's pronouncement means our industry's engine of innovation, the ability to deliver ever-greater functionality at an ever-lower cost, is firmly intact. So, with at least a ten-year runway of technical promise ahead of us, I believe our industry is far from mature.

Chapter Two

Building on Moore's Law: True Innovation

While I believe the phenomenon identified in Moore's law is the force driving our industry and future prosperity, I do not believe that it alone will guarantee growth. It is not enough that we can put a billion transistors on a chip. It's what we do with those transistors that matters. It is unfortunate today that some in our industry are employing the power of Moore's law yet still innovating to the wrong ends.

Over the years, we have all seen new technologies that hold almost no relevance to people's lives. New technologies that cost far too much to buy. New technologies that are too complicated to successfully adopt. Are these technologies truly innovative? I say, "No."

I believe we can and should do better. Simply developing the "Next Big Thing" is not good enough for our industry or for our customers. I believe in a capitalist system where free and open competition reigns. Where innovation is not defined by the fastest, biggest, most complex or revolutionary product. But where innovation – true innovation – is defined by making the greatest possible technology available to the widest possible audience. Yes, True Innovation is what we are capable of today.

Chapter Three

True Innovation in Action: The Enterprise

Few segments of the market are more poised to benefit from the principles of True Innovation than the enterprise, the Fortune 1000 companies that make up the largest purchaser of Information Technology. And few markets are as vital to the health and relevance of the semiconductor industry.

Besides being one of the largest consumers of semiconductors, the enterprise is the crucible for True Innovation in information technology. It is the market where technology is tempered, where technology is put through its toughest test - often before being deployed into other markets. And today, given current economic conditions, new technologies are facing as tough a test in the enterprise as they have seen in the last 10 years.

Today's enterprise is asking us to work harder. Over the last decade, the role of information technology has grown from simply automating business processes to serving as a key leverage point for strengthening customer relationships and driving productivity. We are now an industry that is critical to our customer's ability to grow profitably. As such, I believe simple, incremental improvements in technology functionality are no longer good enough.

We all have our own perspective on recent research and statistics showing the deceleration of IT spending in the enterprise. Some technology companies accept that slower spending as inevitable - a part of the inherent business cycle of any industry - and they are waiting it out by slowing their own R&D spending until the enterprise is ready to buy again.

This reactive behavior – slowing down as opposed to bringing forth new solutions that could spur new enterprise spending – is how mature industries behave. I believe it implies a lack of leadership, a lack of vision and a lack of courage.

I call on each of you to balance these short-term microeconomic figures with what I'm sure you are also hearing: that technology continues to advance its role as a crucial part of any business's ability to be competitive, serve their customers, grow and prosper.

If we take the time to listen to our customers inside the enterprise, they are not saying they do not need new technology. They are not claiming technology isn't a priority. They are saying that for the first time since the acceleration of the technology boom 10 years ago, spending is tight and there will be a much more disciplined look at which technology can best deliver on its promise while existing in today's economic realities. Those of you who view this state of affairs as an obstacle probably believe our industry has hit maturity. Those of you who believe this state as an opportunity waiting to be seized will agree with me when I say our industry has great and profitable years ahead of it.

So how do we seize this opportunity to serve our enterprise customers? We must act and think differently about their needs and the conditions they're facing. We must respond to the economic conditions of one of our most important customers through the application of True Innovation - innovation that addresses their needs at the lowest cost possible, even if it threatens the very business models that made our industry rich during the recent bubble. The engine for growth of the semiconductor industry has always been offering greater functionality at lower cost. We must get back to these roots that made our industry one of the most important in the world. We must get back

to competing openly and fairly and by creating breakthrough technology that is available to the widest possible audience.

To understand the effect True Innovation could have on the enterprise, look no further than to a class of technologies that are already responding to the economic crisis in enterprise computing and, with further development, will push the limits of productivity yet do so from a radically different and cost effective platform. The relatively rapid assimilation of these technologies is proof that the enterprise is asking for more than the incremental functionality improvements we have been providing. To get the enterprise buying again we should not just wait for IT spending to recover, we should develop technology with radical and relevant advances in functionality at dramatically lower costs. Those of you who think this is not possible, I remind you the IT community has delivered such technology before when we challenged our existing ways of doing business and brought to the enterprise operating system standards, personal computing, and the Internet.

Among today's class of technologies that abide by the laws of True Innovation is open source software. Few technologies are disrupting the economics of enterprise computing more than the open source movement. E*TRADE Financial recently replaced 60 \$250,000 computers running on a proprietary operating system with 80 machines costing just \$4,000 apiece each running on an open source OS. Not only is the software more than just incrementally cheaper to buy, it is also proving to be more than incrementally cheaper to own because of its improved capacity for integration and customization over pre-packaged solutions.

A second example of Truly Innovative technology is wireless networking, which promises to not only lower the cost of attaching workers to the Internet, but also increase

productivity – one of the surest signs of health for our national economy. Not only does wireless networking permit the connection of 30-50 users to the network for about the cost of provisioning a single wired attachment for a single user, it also permits tremendous flexibility in the location of the client with respect to the Internet connection. This flexibility generates substantial productivity enhancements. According to research by Gartner Consulting, business users with notebook computers who spent 20 percent or more of their time out of the office realize an annual benefit of \$34,560 in productivity and efficiency. A study commissioned by Cisco Systems observed that wireless connectivity saved workers in the healthcare and finance industry 15 hours a week. The productivity gains that wireless networking enables are not incremental – they are substantial. As the kinks of wireless networking continue to get worked out – such as concerns over security and reliability – and I’m sure they will, I’m convinced it is a technology that will represent one of the key inflection points in the IT industry.

As bullish as I am on the ability of wireless networking to deliver on its promise of True Innovation, it can only do so within an environment of free and open competition. Perhaps you have seen the teaser ads that on “March 12 Intel will not only change how you work but where you work.” This is the beginning of a \$300 million ad campaign to promote Centrino, an inadequate narrow-band solution based on an aging architecture that stifles product differentiation and keeps costs high while subsuming ever more of the profitability of the semiconductor industry into a single company. This is not True Innovation and should be rejected.

Other technologies that do represent True Innovation are just a bit further out on the horizon. One of these is small form factor computing. The productivity enhancements small form factor computing promise are staggering. Consider some of these statistics: laptop computers typically cost greater than 600 percent of the cost of a Pocket PC

device to buy and provision. Well-managed companies require one support and maintenance technician per 23 personal computers while a single support technician can maintain more than 300 Pocket PC devices. The cost of ownership of a small form factor device versus an equivalent function laptop is greater than 80 percent cheaper to buy and run per year.

All of these technologies should follow the path of True Innovation: making the greatest possible technology available to the largest number of people. Along the way, they are challenging some of the IT industry's most cherished business models. To many, this is a threat. But True Innovation is not about preserving business models; it is about preserving a consumer's right to the greatest technology available at the lowest price. It is about putting the demands of the customer ahead of the industry's needs.

Closer to home for the information technology industry is the imminent migration inside the enterprise to 64-bit computing, a migration driven by ever-larger databases and the need to access them. I believe the 64-bit choices being introduced to the enterprise best represent the stark difference in philosophies that exist regarding how our industry will best grow over the next 10 years.

The philosophy behind Intel's Itanium processor is straightforward: they apparently believe that 64-bit computing will only be needed in selected applications. They believe the enterprise is willing to spend whatever it takes to get 64-bit technology wherever it is absolutely required. As a result, their Itanium 64-bit processors are not only expensive to buy with a substantial cost premium to 32-bit solutions, but also expensive to adopt, requiring Itanium users to rewrite all of their applications to conform to a

totally new instruction set. There is no migration path to the volume markets of desktop or mobile devices. This is not True Innovation.

Advanced Micro Devices is launching a 64-bit technology that will let the customer, not the supplier, decide just which machines and how many users need 64-bit power.

AMD's 64-bit solution marks the industry's first unified 64-bit architecture based on the industry-standard x86 platform that spans across enterprise servers, workstations, desktops, and mobile devices. For customers, AMD's 64-bit solution will make 64-bit computing accessible by providing a seamless, simplified migration path to 64-bit computing that is backward compatible without compromise to 32-bit for no additional cost. For the industry, AMD's family of 64-bit processors will spark further innovation by providing software developers a new landscape for development. This is True Innovation.

True Innovation is a choice: we can leverage innovation to best serve our customers or we can leverage innovation to best serve ourselves. Come April, when AMD launches Opteron, the first of its 64-bit family of solutions, I'm confident customers will choose, as they have time and time again, the path of True Innovation.

Chapter Four

Preserving the Foundation of True Innovation: Free and Open Competition

The great challenge our industry faces in maintaining the 10-12 percent CAGR I predict – a rate of growth that is 3-4 times that of healthy GDP increases, by the way - is not discovering a new phenomenon that will ignite our growth, but instead preserving the very foundation of True Innovation: free and open competition.

Anybody who has heard me speak over the last thirty years will know this is one topic that I am passionate about above all else. To those who question the effect free and open competition can have on our industry, look back to when IBM decided to standardize the personal computer on Intel's architecture and Microsoft's operating system while allowing each company to sell its products to other manufacturers.

This foundation of free and open competition created a level playing field that allowed for a pace and style of innovation the world had never before seen. When IBM introduced its personal computer, they forecasted to sell 250,000 units over the life of the product. Today, World Wide PC unit sales are approaching 150 million units annually, generating more than \$150 billion in annual revenues.

The foundation of free and open competition that IBM helped create in the personal computing space wasn't just good for the industry, it was also good for the consumer. That foundation, and the True Innovation that followed, has influenced the fastest adoption of new products and services our economy has ever seen.

I would like to end my conversation with you today by offering up three guidelines that I believe are critical to carrying forward a healthy competitive environment in our future.

As we have recently seen by the action of some companies and governments, free and open competition can easily slip away if not actively nourished, protected and encouraged.

My first guideline for preserving free and open competition is with respect to the role of standards. Some camps within the IT sector believe that as soon as a standard is established, an environment is created that tilts the playing field and brings forth abuses. This view, though potentially true, is shortsighted. In the high-tech arena, where we face extremely high development costs, standards can actually level the playing field by driving down barriers to entry. Standardization promotes volume markets by attracting additional participants, all of which drives a critical learning curve and promotes continuous cost reductions. As we saw with Microsoft Windows – one of the most industry-wide leveraged standards in history – it played a key role in creating a \$150 billion industry.

Admittedly, standards must exist within a fine line: while they have done more for the cause of free and open competition than perhaps any other phenomena, they have also created a foundation that is easily abused. As a guideline moving forward, when you hear of a company promoting a standard, ask yourself this: is that standard exclusionary or inclusive? Does the standard invite other companies to participate, or is the standard confined to a company of one? The role of standards should be to serve as an open platform for broad participation.

My second guideline covers the role of intellectual property policy – a topic so important to our economic growth that our Founding Fathers included it in our constitution. Intellectual property policy has been one of the core issues of free and open competition long before the recent – and very unfortunate – bickering between my friends in the film

and music business and the high-tech industry. It is in the past that I believe we can find some very relevant solutions to the ills of today's intellectual property debate.

Two decades ago, with the emergence of industry standards for both hardware and software, there was a growing awareness throughout the industry of the value added by innovation and creativity, which led to strengthened legal protection of intellectual property. However, the vast majority of companies in our industry recognized that, while it is important to protect intellectual property and to realize a return on their investment, there were also benefits to be gained from broadly licensing technology on reasonable terms in order to ensure the proliferation of standards, the growth of markets and the promotion of True Innovation. By making good technology available to the entire industry, everybody won.

I am concerned, however, that in these challenging economic times, some companies are increasingly using their intellectual property portfolios as blunt instruments. They are misinterpreting their right to protecting intellectual property with protecting and defending a business model that is out-of-touch with the needs and wants of consumers. We are in danger today of using intellectual property law as a weapon to maintain an anti-competitive environment.

To understand the role of IP policy today, we should take a lesson from the early days of the personal computing industry: intellectual property policy should focus on protecting and rewarding ideas, not business models. Today's guidelines for the role of IP laws and regulations should be clear: guarantee the entrepreneur or artist their just rewards for creating an influential and profitable idea. Intellectual property law should not, however, be used as an excuse to protect preexisting franchises that are getting in the way of new ideas being brought to market. Protect the idea, not the business model.

My third guideline for preserving free and open competition concerns the role of anti-trust. Anti-trust issues are widely covered in the news, and at the center of most allegations, lawsuits or trials lay one fundamental question: in today's economy, does anti-trust law exist to protect the consumer or the competition?

I am outspoken on the role of anti-trust laws because they are either the most powerful enemy, or ally, of free and open competition. Take the Microsoft trial. The question was not whether there should be sanctions – Microsoft was adjudged to have used its market dominance in personal computer operating system software to stifle competition – but whether the remedy requested by the prosecution would punish Microsoft or consumers. I believe in the end, a majority of what the prosecution requested was denied because while the proposed sanctions might have helped Microsoft's competition, U.S. District Judge Colleen Kollar-Kotelly found they would not have helped consumers. I applaud the results.

We should never lose sight of the fact that the overriding goal of antitrust laws is to assure free and open competition – the only certain way to protect the interest of consumers. When this happens, consumers will benefit from more choices, more rapid adoption of innovative solutions and lower prices – in short, all the benefits of True Innovation.

The three areas of guidance I offered today – on the role of standards, intellectual property policy and anti-trust laws – by no means cover all that is vital to the preservation of free and open competition. In the high-tech industry, the battle over free trade is another area that is not just putting the industry at risk, but also society. If a government sets up barriers preventing the greatest possible technology from getting

to the widest audience possible – effectively nullifying the very definition of True Innovation – they are robbing their businesses and consumers of the tools to compete globally and are limiting the prosperity of their individual citizens. Similarly, excessive or misguided government regulation is yet another deterrent to free and open competition. It's very simple: without free trade and prudent government management of regulations, free and open competition does not exist and True Innovation suffers.

In closing, I would like to quote one of my few heroes, the early 20th century Austrian economist Joseph Schumpeter who said: "Growth will occur when the entrepreneur is given the opportunity to innovate and can participate in the fruits of his success."

As our industry is just now beginning to recover from the worst economic bubble in its history, we cannot forget that our growth relies on the ability of the creative individual to turn the underlying phenomenon that has driven us – the ability to provide ever-greater functionality at an ever-lower cost – into True Innovation. Joseph Schumpeter reminds us that growth will only occur when the entrepreneur can participate in the fruits of his success. That is why, for example, I am a champion of the continuation of stock options in their present form: by allowing the entrepreneur to participate in the rewards that come with taking risks, stock options will, as they have throughout the history of our industry, provide the right incentive to prevent our industry from maturing for years to come. There is simply no greater motivator for True Innovation than ensuring that those who take the risks to create something new and valuable are amply rewarded for their efforts.

Thank you for continuing to encourage our industry to work harder, to freely compete on behalf of our customers, and for having me here this morning to share my thoughts.