

# Law, Policy, and the Convergence of Telecommunications and Computing Technologies

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## THE MATURING OF THE NEW ECONOMY

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**DEAN JEFFREY S. LEHMAN:** Maturing of the New Economy and the leader of the discussion is Jim Davidson. Jim is a graduate of the University of Nebraska and the University of Michigan Law School. He began his career as a corporate and securities lawyer for Pillsbury, Madison and Sutrow and then became managing director at Hembeck and Quist where he first headed up the mergers and acquisitions business and then technology investment banking. In 1999 he cofounded Silver Lake Partners, which is an investment firm that specializes in large-scale leveraged acquisitions of technology and related growth companies such as Seagate.

The commentators in order of their comments will be Jeff Mackie-Mason and Ronald Mann. Professor Mackie-Mason is a professor of information and computer science at the School of Information, a professor of public policy and a professor of economics at the University of Michigan. He is published widely about the economics of the Internet, the economics of other information technologies and competition in high-technology markets. Ronald Mann is a professor at the University of Michigan Law School where he teaches various courses related to real estate transactions, commercial transactions and intellectual property. His current research focuses on software development, letters of credit and payment systems used in electronic commerce. So we'll begin with Jim Davidson.

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**JIM DAVIDSON:** Great. Thanks a lot, Jeff, for the introduction and what I'm going to try to do is pick up a little bit of the themes that Rick talked about at lunch today. After attending law school I ended up basically spending most of my career after a few years practicing, being an investor. So the new fund we have really focuses on opportunities that this tech environment creates for putting capital to work and so my comments will probably describe what's happening in the market, is this normal and rational. Actually my conclusions will say this is actually a healthy thing that's going on in technology. We'll go through and hopefully be reasonably concise.

First of all put some of the background and ground rules together. The new economy from my perspective is really electronics related mostly digital and all information based. So the computers, communications, the content that gets delivered that way through the enabling platforms. Let's take a little historical, I kind of like to walk through memory lane if you will: the happy days of technology investing. If you focus to the left of the crash, when technology in the course of the 90s really had a tremendous bull run. And it started to be so popular that the popular press picked up on it and the average American started thinking they were expert technology investors. And it used to be a joke in Silicon Valley that people would say, "Well how did you make so much money investing in technology?" And they said, "They invested." It was totally indiscriminate. You could buy any company that had any kind of tech-sounding name

and the stock would go up. Everybody would go home at night thinking that they were brilliant. Well, unfortunately, at some point near the end of the decade that all changed. So if you look at what's happening lately, the peak in '99 obviously, the best of times and the worst of times. '99 was the best single performance in history for a U.S. market index. NASDAQ as an index appreciated 86 percent. It peaked in March of 2000 and then people started wondering how is this happening. What's actually kind of funny about this, is that during the period of time that the market was going up and you saw the extraordinary multiples being paid for technology stocks, people would literally walk around saying, "These are the good old days." You didn't have to be nostalgic about it at all. You could wake up in the morning and feel great about yourself because your self-worth was reinforced by the fact that your stocks were going up consistently. I'll talk about why that happened a little later. But then, and there were critics all along the way. The press could not understand how stocks were trading at 100 times revenues. And the press wrote about it all the time, and yet the stocks would go up. Why was that? Rational people would sit around and declare this is impossible. Laws of economics are not being followed here, what's going on? And yet the stocks would go up.

Well in 2000, you saw this happening, people were talking about the death of the dot.com, the death of Internet, the death of technology and actually what's happened is really healthy. Historically, 70 percent of venture companies fail. They don't do poorly, they don't struggle, they fail. In the last couple of years, a lot of those companies as Rick said, they just got public. The unfortunate thing is that by going public they will fail. They might have had a chance as a private company, they might have been able to raise capital and yet, today, in the glare of the public spotlight with the extra cost and the associated risk, they are going to fail.

It's actually uglier than that last chart looked. If you really look at what's happened in technology and you go through some of the subsectors, it's frightening. The real economy, the new economy all these things they talked about that got the front page of Fortune and Forbes and The Wall Street Journal, read all those wonderful columns, six articles about, and the B-section. The Wall Street Journal changed into a red herring surrogate. Everyone wanted to be a tech-centric financial publication. CNBC spends most of its time talking about tech companies. These things didn't exist 10 years ago and yet the bull market created this market. But if you look at this, the best performing major segment of technology is electronic manufacturing services, which really isn't a tech company at all. It's a contract manufacturer that builds things for tech companies and it was down 2 percent.

So what did we learn? Was there a mania? You bet! And it brings to mind that one of my partners, Roger McNamee, has a third law of investing which I have to warn the faint of heart about before I start in. Which is in a raging bull market, beware. Cream is not the only bovine byproduct that rises to the top. I think that's fair. But was there any substance to this? Was this rational? Because every time you go to and listen to an economics professor they say the markets are always rational. So what happened?

What really happened is I could have taken this chart back to the 60s or 70s. But what's happened is the technology economy really has transformed the overall economy. If you look at this chart, this is really just products, this is capital this does not include services. If you include services in here there's some estimates, services are always hard to measure, but there's some estimates that it's 14 percent of the total GDP (Gross Domestic Product). If it's 14 percent, it's the

single largest segment of the economy and it's the fastest-growing sector of the economy and it's the fastest-growing sector of the economy at this scale in the history of the United States. And if you look at, this is real GDP growth, this is not nominal. If you look at nominal the CAGR (compound annual growth rate) here is actually closer to 18 to 20 percent.

That's a phenomenal growth rate. And that understates it. If you look at what's really happening in corporate spending, how are people investing capital? And if you look at the transition from a mainframe-based economy to PC where productivity improvements came into being, you look at the Internet and what's currently going on, 50 cents out of every dollar of capital spending is being spent on IT (Information Technology) solutions. Again, that understates it. If you actually look at, this is capital equipment and software license fees. If you go buy an Oracle ERP (Enterprise Resource Planning) system or an I2 system or a PeopleSoft system you typically spend 15 to 25 percent of the total installation is the license fee. The rest of it is services to deploy the solution and get it up and running. If you look at the dollars being spent and where corporate America is spending money, non-government corporate America, 50 cents on every dollar and look at the trend line. Why? How do you get an economy with high productivity gains, low inflation, low unemployment? You don't get it without productivity gains primarily enabled by technology.

So if you think about it, how do you get those numbers? Those numbers don't get to be that big because everybody's buying PCs. You can only own so many beautiful Dells and Gateways and Compaqs and how many cell phones can you have? Probably I should except myself from that question. But you can't buy that much electronic gear. So what happens is you go through this, I'll take automotive as an example. In 1998 Business Week wrote an article that talked about the growth of technology. They were only eight years late but it was Business Week. They claimed that, it was an interesting fact, in the automotive industry for the first time the bill of materials, the cost of goods of the average automobile purchased by the average consumer in the United States, semiconductor content exceeded the steel content in a car. Now that's a big deal coming in this part of the country because steel believes that the automotive industry is a large end market. The steel industry tries to court the auto industry. And obviously the steel content has gone down but the number of memory chips, microcontrollers and microprocessors in a car has gone up dramatically. If you think about your car today there's almost no physical linkage anymore in your system. The brakes are automatic, your airbag has an accelerometer. In 1998, I don't know what the current number is, but more than 80 microcontrollers and microprocessors were included in the average automobile. I don't even know where autos rank in terms of end markets for the semiconductor industry. It's not in the top 10. So this is a big deal. You look at hotels, or when you walk into a hotel and someone says, "Welcome, Mr. Davidson. We have your king non-smoking room ready for you." There's a software program that tells them how often I stay, what I order from room service and they're happy to see me.

What's going on in the market right now is kind of interesting. Because we're going to find out really the courage that people have in the economy. A lot of economists are debating are we in a recession, are we about to go into a recession, are we just barely, miraculously, with the grace of God going to avoid a recession. And that debate actually is frightening some people in delaying IT spending. There's been a big inventory buildup that's caused a lot of the crash but uncertainty about IT spending is causing a lot of the uncertainty in the market and crashing the stock prices. But you look at somebody like Jack Welch he says, "God bless my competitors who slow down

because if they slow down it will make it easier for me to crush them." And that's actually something, you look at some of the gains that people are really getting here, this is Oracle. Oracle actually understands technology; they're deploying their own product so one would suspect they know something about it. But look at those gains. Forty-two percent revenue growth rate and their operating margin's almost doubled. And you might say to me, "Well, that's obvious, Jim, because that's a software company. You get incredible leverage from a company that sells software licenses." But that's not the Oracle business model. The license revenue from Oracle is slower growing than their services component. They're doing this because they're putting standard processes across their entire company. They used to negotiate price customer by customer by customer. Guess what? Ellison put a stop to that. There's one pricing formula that's available online in an Intranet and they manage it the entire way. You look at inventory or vacation, HR (Human Resources) benefits, they're doing every single thing internally. Look at those numbers in the productivity gain. Taking something from 17 percent operating margin to 30 percent, in excess of 30 percent operating margin, for a company of that size growing that fast is impossible without an IT solution.

So what is the Internet economy? I think we're going to talk about that because I've talked to a couple of press people before I got here about the conference and they basically said they'd like to write stories about the death of the dot.coms. Again it's kind of like Business Week. The dot.coms died last year, but there is something about the Internet that's real. The fundamental change that the Internet enables is real-time information and that's really very simple. For the first time in history you can connect an almost infinite number of participants to a system and share information in real time. In the old days for people who have been around, you know the batch-processing mode, the IBM mainframe, you'd stack up your cards, your punch cards, and you'd run them through, you'd run a program, and wait patiently while your timesharing solution let you enter your program. It would calculate when you would get your report. If you were lucky you'd get to run one once a night or something like that. The Internet's real different. It's real time. And what that means is you know immediately what your customer wants. And it enables something if you can incorporate the whole supply chain to get whole new business processes and eliminate a ton of waste in a supply chain where time has been your enemy. So with apologies to Admiral Stockdale from the famous debate where are we, how'd we get here and is it different this time. I'm going to talk about valuations a little bit. I really don't think they're that irrational although from the third-party observer they're frighteningly and irrational.

First, what's the old economy? The old economy is just what you've grown up with. You get a great idea, you build a prototype, you have to go get money at some point to help expand your idea and actually grow. You have to build a pilot line because you have to build something. Again you got more money or time. If you build a pilot line and grow your business internally it takes longer. You build yourself regionally you get some more money, you add physical infrastructure and you expand. A lot of companies did this.

In the new economy, people actually have outsourced a lot of their "non-core competencies" to other people and you've created a virtual corporation where you were able to share information through an integrated IT system. It's what Oracle's done very well, it's the foundation of Microsoft.net's strategy and actually some people brute force it right now just by eliminating firewalls between companies. For example, Cisco today has one of their contract manufacturers, Flextronics, does a lot of the high-end manufacturing gear for Cisco. There is literally no firewall

between their ERP systems for the gear they manufacture. It's not necessarily the ideal solution for people worried about privacy and confidence but those companies are such great partners that they've been able to make it work and has given Cisco an unbelievable competitive advantage as they've gone against Lucent and Cabletron and others.

When you create virtual corporations targeting huge markets, what's interesting is they grow faster. This isn't really any different than other transformational disruptive technologies in the economy from railroads to radio to TV, it just happens faster because the economy has structurally changed to be able to be deployed and reach more people in a shorter period of time. And it's not slowing down. This is one of the more amazing slides as you look at technology. Because most people think of Moore's Law, which is price performance doubles every 18 months. You get twice as many transistors on a piece of silicon for the same price or you get the same number for half price, however you want to do it. But storage, which everybody talks about, if you get streaming video you get voice, you're going to need a lot more storage. You look at companies like EMC who are selling network storage everywhere and growing like crazy. That's growing, that's doubling every 12 months. Then you come to optical. Communications industry is being transformed because you just look at the numbers. In a six-year period semiconductors, which most people think is a frighteningly aggressive evolutionary or revolutionary progression, their technology, it'll go up 16 fold. But optical will go up 256 fold. I shouldn't have had to look; I was a math person at one point in my life.

So what's that mean? Look what happens to these companies. Think about this, first product off the assembly line to a billion dollars in revenues. They used to say a billion here, a billion there pretty soon it adds up to real money. These are amazing things. A company, Serent, I don't know if you guys remember Serent. It got a lot of publicity about a year-and-a-half ago, maybe two years ago, because Cisco bought the company. They paid \$7 billion for a company with \$8 million of trailing revenue. And everybody said, "How can that be? How can a company with \$8 million of trailing revenue be valued at \$7 billion?" These multiples have gone crazy and it was the poster child for technology gone amuck. At the time, Cisco traded for 23 times revenue. Maybe the market had gone amuck. But you look at a company that traded at 23 times revenue, giving stock to a little company, and three quarters later they were at a billion dollar run rate. In three quarters that acquisition was wildly accretive to Cisco. Could you have done that in the old economy? You'd have to build manufacturing, you'd have to build geographic distribution, you'd have to expand your capital base. What happened is the virtualization of the technology industry allowed them to outsource manufacturing to Flextronics and they were able to scale from zero to a billion in three quarters.

Now, with respect to policy questions I'll throw in some bones for us. One of the things in the markets, the markets are really volatile and everybody seems to be getting hurt lately. And if you look back at the regulatory environment, the legal environment that governs the stock markets it's all about the efficient market theory. You have full and fair disclosure of all material information among competing rational buyers and sellers. The questions I'd ask people to consider would be have the markets changed since that theory was codified? And secondly has the definition of an investor changed? Are people looking at different things than they used to? And I think again the answer is they're crazy different.

In the old days, think about 1933. If you wanted to buy a share of stock in Ma Bell you'd call a broker, there are only a couple brokers licensed for the exchange, they charged you whatever they wanted to because it was all regulated, I guess they charged you whatever the regulated price was but it was grossly exorbitant, they'd go find a price and then they'd call you back or send you a confirm and they'd look at their ticker or they'd call somebody up on the phone, which was new technology to them, and you wouldn't know about the trade or the price necessarily right away. Today we invest in a company called Datech, which owns Island ECN and the average time it takes for them to receive your order, make the trade and send you a confirm back is 0.8 seconds. So the time it takes to execute a trade and you think about the information. If you want to know what information was going on at Microsoft in the trial, or actually pick another, RCA, you want to know what RCA was doing in 1936, you'd have to find, it would take you a lot of time and effort to find probably bad information. Today the Internet enables you or CNBC or CNNFN they let you look at this information in real time and it's more information than you could ever digest and you're making trades immediately. About a hundred years ago Keynes interestingly predicted that if you had a very liquid market where the cost of trading was very low, people would change their mind a lot. And that people would stop investing as long-term investors and they would start trading as speculators. What's interesting is Keynes, you know I guess he deserves his reputation, because I think that's exactly what's happened.

Second comment is what's an investor today? And there's really three dominant styles of investing for this century. The first, Graham and Dodd, which Buffet, Warren Buffet is the leading protagonist today, of value investing. Then you have the growth investors who are, Peter Lynch went around as Magellan Fund and he tried to find companies who every year their earnings would grow with solid management and the stocks would go up. Really in '90s you started getting the dominance of momentum players. Momentum players, if you look at William O'Neill, Investor's Business Daily, he's basically the chart people who have the view that if you accelerate at revenue growth, your margins are expanding, there was better news today than there was yesterday, analysts expectations were going up, whisper numbers were ahead of published estimate numbers, that the stock was worth more tomorrow than it was today. And so they started this momentum game and it turned out to be the single most successful investment strategy in the '90s. I used to do speeches with people two years ago or for eight years ending two years ago, where I'd ask people what do you look at when you buy and sell a stock? Does value and multiple even enter into your consideration? Is it part of the matrix? And they looked at me as if I'd just landed from Mars and said, "No. Why would it?" That wasn't a data point that people cared about. And so today what you have is an environment where . . . , Rick made a comment at lunch today that's very, when I take away from the economics courses I took when I was here, it's supposed to be about an efficient market but at the end of day it's really about buyers and sellers. If there's more buyers than sellers, stocks go up. If there's more sellers than buyers, stocks go down. That's a great strategy when you're in an up market because that means there's always more buyers and stocks go up. But what it says in a down market is there are no buyers. The market could be at 1800 tomorrow; it could be at 2600 tomorrow. It is now a random market. You look at volatility, the amazing thing is, you look at this chart, 11 percent of the days NASDAQ moves more than 5 percent. Think about that. Five- percent movement in a day happens once every two weeks.

So why are they more volatile? They should be, they're changing the world. I mean you look at the cost savings that Oracle's getting and that their customers are going to get from Oracle 11I or what Dot Net's going to do for their customers. You look at what Siebel did for front-end automation. It's crazy. Supply and demand, people think they want to be part of this tech environment so they buy the stocks. And when they're hot they'll buy a lot of them. Pockets of lunacy will always exist. The things that were mentioned earlier. You get the Serents of the world. If a company can go from eight million to a billion dollars, it ought to trade at a big multiple. You look at the optical environment. There's still a lot of innovation there today. JDS Uniface continues to ship product today at 60, 70 percent gross margin where their yield is only 8 or 10 percent. Someone can figure out how to make an optical component with a better yield, it's worth a lot of money.

Brings me to my corollary. When there's pockets of lunacy, you need to be careful about investing because you cognitively may know that a stock is grossly overvalued, but my specific corollary is that the market can stay irrational longer than you can stay solvent. So if you dare to short stocks when you know they're overvalued be prepared to go bankrupt and then in the poor house go around telling all your friends how smart you were. It's still crazy out there. This is after the correction. Look at the multiples. The thing is, people want to own winners. So the distribution here is that some stocks have crazy, crazy multiples and they're the market leaders or the perceived market leaders. The new, emerging technologies that are going to dominate the next wave of expansion. But look at the bottom three-quarters of the chart. These stocks are fundamentally cheap. Why? No one wants to own them. Some are good companies, some deserve to die. The question is can you tell the difference? You would think that the growth companies, the ones that have a path to profitability where they're accelerating their earnings every year, would be the ones that people own. Having taken statistics once in my life, look at the r-squared and the correlation between growth and multiple that exists in today's tech universe. It is, for all intents and purposes, uncorrelated. It's irrational. And these are the large stocks that are followed by Morgan Stanley Dean Witter, Goldman Sachs, CS of First Boston, and Merrill Lynch. So these are not unfollowed, random stocks. These are the most followed stocks in all of technology.

So although it seems irrational, I'll actually argue it's healthy for the economy and it's really the way it should be. You need to blow out not only the bad companies, but you need to blow out the bad investors. The people who can't tell the difference need to get out of this thing. And maybe that's elitist with professional investors dominating it, but investing in technology is different than buying a food company or buying a financial services company. Some of these companies will fail. They go public earlier in their lives, there's a lot more risk and even the big guys have to completely redo their business model. You could argue Microsoft.net's vision is a complete reengineering of the strategic priorities of one of the most successful companies in history. So it brings me back to my reason for optimism is my partner's first law of investing, is that investing is always a battle between fear and greed. And the good news is that fear always passes but greed is forever.

So my conclusions are straightforward. I actually think it's working. We had a speculative blow off, it's overcorrecting to the down side and it will scare people out who don't have the conviction or courage to stay in and play this game. I think one thing that's important and Rick talked about a little bit, is you need to continue encouraging innovation in the venture

community in particular. The venture business is inherently a great business. Because you get a start with something with almost no value and you get to create, potentially, something that is of incredible value. And so if 70 percent of the ideas fail, and 20 percent of the ideas are mediocre, 10 percent of the ideas might be great. And if you do that, the returns financially from those kinds of risk-rewards profiles are incredible. The problem today is, the venture business for the last five years was really easy. And so a lot of people out there are carrying venture capital business cards that have no idea how to build a company.

One question from a policy we could talk about or not is that the markets are inherently volatile and what the popular press has referred to as the Schumpeter Economy, where the economy isn't a smooth progression but there's actually fits and starts as entrepreneurs and capital flock to periods of technologies with discontinuity in the economy. I actually think that's healthy. It's worked great and I don't really see any reasons to damper things. But there's some policy proposals pending that might change that.

And finally, since I talked to some of the press before who said, "Aren't you going to come and tell us technology's dead and you're going to go to something else, go back to being a lawyer." And with apologies to Mark Twain, I think the rumors that technology industries are dead or dying is grossly exaggerated. So with that my colleagues here are ready to tell me I'm nuts, I'm crazy.

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**JEFFREY MACKIE-MASON:** Okay. Thanks. One of my colleagues who edits a journal told me a few years ago that he'd like to send papers to me to review when he really wanted to get rid of the paper. And he said that in the editorial office my nickname was Mack the Knife. That usually makes it easy to discuss things because I'm pretty brutal and critical. But, actually today isn't the case. Before I met Jim and talked to him about what he was going to talk about I was trying to anticipate what the session was going to be about and think about what I might say. And I was really quite delighted to find out that we think very similarly about things, but that makes my commentary maybe not quite as aggressive or interesting. So what I'm mostly going to do is compliment his remarks and really just add a few comments. A lot of the things I'll say are essentially the same things he was saying. I'm going to add a few comments, draw more perhaps from the focus that an economist would have on the fundamentals and the long-term prospects, but it comes to the same conclusion.

So I also anticipated, and it's not hard to these days, that a lot of people would wonder, "Gee, isn't the dot.com economy dead?" and I wanted to sort of remind us to have a little bit of perspective on what dot.coms are and how horrible this crash of the dot.com sector is. As of the beginning of this week in industry trade magazine called Industry Standard, they've been keeping track, they've got a layoff tracker online, they keep track day by day of how many layoffs there have been in the industry. And they claim now that they've counted a little over 61,000. That was actually as of two days ago so it's up a bit now I'm sure, of layoffs in dot.coms. For a little bit of perspective, especially local perspective, Daimler Chrysler is in the process of laying off, announced in January they're laying off 26,000. That may mean we're in for really big trouble, there are layoffs all over the economy but unlike in two decades ago, there hasn't been a huge amount of panic that the economy is going south because 26,000 auto workers are being let go. I

don't mean to diminish the pain and dislocation and suffering that those workers in either industry will experience, although James Fallows made the point recently that the white-collar, highly educated workers in dot.com's may not suffer quite as much as the older, less trained auto workers and such that are being laid off. But the point is, that the numbers aren't really all that overwhelming. You hear about all the layoffs and given the size of the economy it's actually not that many people when one company alone, and Chrysler's only planning a 15 percent reduction in output. Fifteen percent is not trivial but it's not disappearing. Hasn't had a 90 percent collapse the way that some of the companies that Jim pointed to have.

The other thing is that between December of last year and January of this year, seasonally adjusted employment increased in the U.S. And, in fact, that's been steadily true. And as Jim said, it's not even clear we're in a recession much less any sort of free fall or collapse. In the economy as a whole, things are still looking awfully good and it's important, I think, to keep a little perspective and not get, just as wise investors probably get a little bit overhyped about the value of the dot.com sector in the first place, I think the press is helping to fuel a little bit of overenthusiasm about the collapse of the dot.com sector and how horrible a thing that is. Jim's point, I think, is well taken that it's actually a very healthy thing. You throw out a lot of ideas, if a lot of them don't fail then you're not trying enough new things. We happen to be seeing a period of time now when people are discovering which of those ideas are failing.

So how bad is it? Again, just for some perspective, this is the unemployment rate in the U.S. from 1989 to the year 2001. This is the horrible new recession we're in, this little blip here. The unemployment rate has gone up. Total employment has also gone up. More people are actually in the workforce. So we have both employment and unemployment going up. The point is that compared to the beginning of the tech decade, the '90s, unemployment is extraordinarily low in the U. S. In fact it's almost frighteningly low and it's probably because of IT that it can be that low. That our economy functions much more smoothly, transitions are much easier and we have much better communications, not only in the technical sense but in the business process sense so that we can keep a much more highly employed economy. We're really at a remarkably powerful and strong state. Of course, it could go up very rapidly and that's what people are worried about. But at the moment things don't look so bad at all. Here's the employment. Employment is a percentage of non-institutional population in the U.S. Again, over the past decade employment as a percent of population has gone up dramatically and you can't see any collapse in the last year.

So what is important? If I'm saying that the collapse of a few dot.coms and the loss of a few tens of billions of dollars really doesn't matter, what does matter? Well, the fundamentals are the same fundamentals that were true 20 years ago. I want to emphasize that unlike looking for the next best marketing idea, thinking of the next best retail Internet product to sell, the next best way to deliver dog food to the people that bought through their web browser, one thing that is absolutely true and hasn't changed for a long time and is crucially important is Moore's Law, which again Jim pointed out. This is Intel's version of it so there's a lot of little references to Intel products but after all it was Gordon Moore who first proposed Moore's Law. It's really an astonishing thing. Since the first Intel microprocessor, the 4004 in 1970 which had a couple thousand transistors, they've now released the Pentium 4 with almost 100 million transistors. That's a long time, after all that's 30 years. But if you look at the difference in the Pentium 3 and the Pentium 4 in just the last two years, or the Pentium 2 in '97, we've gone from 10 million transistors to 100 million transistors in less than five years. That inexorable technological rate of

change has continued without any serious deviation and it's going to continue for quite some time and that's drastically changing what the economy can do and what the nature of the infrastructure of our economy is and is going to be. And that's not going to change and that's not going to go away anytime in the foreseeable future at least.

Communications, too, as Jim pointed out it's not just semiconductors but other forms of technology as well. On the left chart I've got the mileage, basically the capacity of transoceanic fiber optic cable. That's just been explosive, the amount of communication capacity that's been laid under the ocean. And that's not cheap. The cable is cheap. It's just glass and less than pennies a yard now but you're laying it in trenches and under the ocean so it's still not cheap but the explosion has been there. Same in Internet backbone bandwidth. When you get down to the technological fundamentals it looks like this and is going to continue to look like this. The price of dot.coms of all of those experiments, a lot of those are going to come down, there's going to be a correction and we're going to see some pain for a while in market valuations. But the technology fundamentals haven't changed and that means that the economy built on these technologies isn't fundamentally going to change either.

The graph showing prices for communications lines and routers and switches. I like to explain this in terms of cost. Prices have been coming down about 30 percent per year for the underlying communication technology for the last four years. Think about the cost of anything going down 30 percent a year. Think if you will about the cost of tuition to a law school going down 30 percent per year. Law school would be pretty darn cheap just a few years from now. This is in an industry on which we build all other industries, communications, and the underlying cost of the core technology is going down 30 percent a year forever. It has been doing it since the 1950s and '60s.

So what are some of the implications? Well, just to do the exponential math just to remind you that these numbers are really big. Electronics functions will increase by factors of 10, 100, 1000 over a few years. Five, 10, 20 years. That means that what you could do before you can do a thousand times better 20 years from now, or a thousand times more of it just from semiconductor growth. For example, my laptop over there has approximately two times the computing power of the IBM 3090, which was their top of the line mainframe in 1986. Now 1986 that was a long time ago, it's 15 years. But then again that was a big machine on which a lot of industry was built and I've got twice the computing power on that laptop over there. What this means is that all business needs to design their operations around information technology. It is a key infrastructure input to all activities basically, all significant economic activities. And it's one which is now the transforming driver. Technology is now improving so rapidly and so persistently that any business that doesn't redesign its processes around information technology is going to be left behind. The quote from Jack Welch of GE is a good example of that. At least that somebody believes that at GE. Of course I did point out to Jim this morning he was saying that Jack is one of those great people who is willing to take big risks through recession. I pointed out that Jack is retiring this year so he can say whatever he wants but. . . .

If you're in a business where your core value is information technology, if you're in some sense an information technology business, and the argument is essentially that everything is going to become to some extent an information technology business, but if that's really what your value is coming from, where your product and your value to your customers is coming from, then you

have to be on the Moore's Law curve. Because if you're not, one of your competitors will be. You have to be bringing out new products, improving your products or reducing your costs at that same exponential rate as Moore's Law or if not you'll be left behind. So there has to be a transformation in the way we do business, the way the economy operates, the way firms interact with each other that is moving at this same pace in order to keep up with the technological transformation. That means that things are going to continue to change very rapidly in the economy.

So let me go back for a sec. It may sound like I'm just a foolish optimist who doesn't have very much invested in dot.coms, which is true, so it didn't hurt me too much that they all disappeared last year. But, nonetheless, what did happen having all these companies go away, how can I be so optimistic when in fact everybody says the sky is falling? Well, what I said is that the sky isn't falling in the sense if you look at the technological fundamentals they haven't changed. Moore's Law in computing and in communications has continued and that means we're going to continue to see that type of value.

Where do we see it then? In contrast to the horrible death-fall graphs if you look at the NASDAQ as a whole or the dot.coms, this is Microsoft. I know people feel sorry for Bill, he's had a bad year, he's lost a few tens of billions of dollars, but all things considered, if you look at the blue line from 1992 to today Microsoft hasn't actually done all that badly. You can see a few things going on last year that certainly weren't pleasant but the scale over there points out that the return on owning Microsoft for the past decade has been about 2000 percent compared to the S&P 500, which is down here in sort of the normal 200 percent over a decade, normal for the biggest bull market we've ever seen. So Microsoft, which is built on Moore's Law, has really followed that track and it's probably, maybe not Microsoft because they may be managed badly from now on or other problems, somebody with a lawsuit may affect it, but the point is if you build on Moore's Law and you stick to the technological fundamentals, that value is there and we're going to see that continuing to be there.

On the hardware side, Intel, the same thing. Intel over the past decade, 2000 percent return. Yeah, sure, there's been a collapse in the last year, it's not been a nice year for Intel shareholders but all they had to do is look back 13 or 14 months and they're still up 2000 percent over a decade.

What about communications? Well, Cisco's even better. And there's the one you really wish you'd invested in if you're investing in blue chip technologies. They're up a little over 10,000 percent over the decade, again compared to this is the rest of America down here, S&P 500, which has been a pretty darn good return if you've been investing in the S&P 500. It's been the best decade you could have done that. But it would be even better if you'd invested in Moore's Law.

So why did the bubble burst? What went wrong? Yeah, there was an irrational feeding frenzy. Jim said there's a lot of people out there who don't know what they're doing. That's been true on both the financing side and on the technology side. It seemed like anybody who named a company dot.com was going to make money and so a lot of people who didn't know how to do anything other than name their company dot.com went out there and there was the feeding frenzy. There was also a timing problem, and this is something that I think is worth keeping in

mind. In the '80s, particularly in the late '80s, there was a lot of talk about the so-called productivity paradox. The boom in IT investment started in the '70s and the early '80s. And by the late '80s people were starting to say, "You know, we've been spending all this money on computers, why don't we see productivity going up in the U.S.? Why are we still stuck in these rather not very exciting productivity numbers that aren't growing very fast? Where is the boom from all this IT?" Well, it turns out it was there and by the early '90s we could measure it, and in fact about half of productivity growth in the last 20 years in the U.S. has been due to information technology investments. But it took us a while to see it, because although the technology improves very rapidly and we can build bigger and better machines and fatter and faster communications pipes at extraordinary rates, we still have to learn how to use them. The human element hasn't changed, the process element hasn't changed, we haven't sped up figuring out how to adapt, figuring out how to structure new businesses, figuring out how to structure new partnerships, figuring out how to change our old product lines into new product lines. So there's going to be a lag. It's going to take time to see the benefits.

So in the '80s, we couldn't find anywhere in the data, the productivity benefits, but in the '90s it became very evident what they were and we saw it big time. I think we're going to see the same light from the technology boom of the '90s. The new economy has been driven by these infrastructure investments and as Jim pointed out you now have companies that go from zero dollars to a billion dollars in two to four years, sometimes even less than that. Very rapid growth in the physical infrastructure and the technology development, but the infrastructure companies themselves; they're relatively small part of the economy. They may be the biggest sector of the economy if you include services but we're still only talking about 10 to 15 percent at most of the U.S. economy. What really matters is that IT is being incorporated in the rest of the economy and becoming part of the rest of the economy. The benefits of the infrastructure development are going to require reengineering; new management processes, new social policies, new legislative policies and implementations of those policies. We need social transformation throughout the process to take advantage of that so the tremendous benefits of the '90s technological boom were not in the valuations of the dot.coms. We're going to see them in the next decade, in the developments of new ways of doing business and new sources of value.

I'm going to skip this slide because I'm talking too long and it's just sort of connecting some of the policy issues that are coming up in other talks. I'll let other people do that.

So do we have a new economy? The speculative bubble has burst, but the fundamentals have changed forever. I don't think economics has changed. I'm not one of the people who thinks there's a new economics, but there is, in some sense, a new economy in that the core infrastructure of the economy now is information technology. And that is a technology that increases at extraordinary rate in terms of its value and the economy is going to be driven by that for some time to come. That's true, that's here to stay, we're not going to see that change. So as long as the key infrastructures are improving at the rate of about doubling every year in terms of capabilities and value, we're going to see the economy changing at something similar. Thank you.

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**RONALD J. MANN:** So Jim gets up here and Jim actually goes out and makes money doing this and so he really knows what's going on. And Jeff's an economist and so he actually has data so he has something significant to say. But I'm a lawyer and so the only way I can know anything about any of this is by trying to talk to people who do it because it's just not what we do. So it's really true when I say that I don't have anything to disagree with what they said so I'm just going to try and compliment what Jim said, too. Mostly what I want to build on is just a couple of separate points. What does it mean--Internet time--that we're just going to move so much more rapidly, and I'm going to talk about just two things briefly looking at the four-minute-to-three clock.

The first thing I think Internet time is it really exaggerates these Schumpeterian waves of creative destruction that you see throughout the economy. The second thing is, I want to talk about a legal issue, surprisingly enough. It really rebalances, I think, ideas about what kinds of intellectual property protection we'd have in this economy.

The first one is fairly simple. You just want to know is this so bad that we had this crash? And as both of them suggested, no. We had this infrastructure that's going up so much more rapidly. What that means is that we have a much greater number of new companies every year. There are many more companies that started up in the Internet sector and in the venture capital sector in the last five years than in the five years before that. You have many more companies that we're testing out every year.

The second thing we know is that these companies have incredibly short life cycles. When you see this graph I think one of the two most important charts from Jim's presentation is this one where you see Microsoft. That's a very slow, stodgy old-style company. It takes them like 14 years to make a billion dollars. Then you see Serent that just goes straight up. What that means is, you've got a lot of companies that succeed really quickly but if you're going to fail we can find that out pretty quickly. You can go from nothing to three rounds of venture capital to going public to being wildly successful to failing and you might not have even needed to have an annual meeting yet. What that means is we needed to have a massive number of failures and, frankly, it's not really clear we've had as massive a number of failures of companies yet as we need to have. What we've had so far is a lot of stock prices falling and I really think this quarter you're just now starting to see the companies failing and you're going to see a lot more over the next year of people who are just trying to hang on still.

What I want to talk about a little bit is what's going to be left after this particular wave of a crash. And I'm just going to talk about business-to-consumer companies because that's just the thing that I study most and offer a couple of thoughts about that. One thing, the world moves really, really quickly in Internet time and it's just not really clear that getting yourself up and going public and getting your product out on the market as fast as you possibly can with as much advertising to build market share as quickly as possible is the best thing to do. Some of the companies that look like they're succeeding are companies that really went more slowly. Many of these are companies that either Jim's company or Jim's close partners have invested in. I can't remember which ones they are. I know that Kleiner and Integral Capital Partners have invested in almost every one of the companies I'm going to talk about, for what it's worth.

What you also see is instead of focusing on selling something on the Internet that no one else has thought of selling on the Internet yet, which is an idea which seemed to work pretty well last year, now people have realized that to make money even on the Internet you have to have a very large gross profit margin. What Amazon.com really tells you is even if you conquer the entire world and can sell huge, massive quantities of something for which there is a positive profit margin, it's very hard to make money unless you have a substantial gross margin. The companies that are making money are the ones that identify products for which you can see some sort of margin. And really, I think the way you see these companies doing, that is, they try to figure out a business model that allows them to have lots more transactions off of which they can slice money rather than figure out something that requires them to pile up big mounds of inventory. And the companies that tried to grow lots of inventory or were forced to grow lots of inventory have had more problems making money.

Some of the companies I think are showing how this works--I'm just going to go very quickly here--are people who sell products which even in the regular brick-and-mortar area have very high margins. You have people who sell jewelry like Blue Nile, flowers is something for which some of these companies have been very successful and Reflect.com is a sort of personalized, cosmetic products thing that Proctor & Gamble's doing. Another thing to do is you just do transactions. If you do transactions you don't really need to have inventory because there's not really anything you're selling except information and of course it's not very expensive to store information. You see these companies like e-Trade and Travelocity and that's what they're doing.

Second thing I want to talk about is how is this pace of Internet time affecting the legal infrastructure. And the principle legal infrastructure for the new economy, for my purposes, is the intellectual-property protection that we provide for the things that people are creating. Basic rationale that the American system of intellectual property has, and this isn't necessarily the best rationale. It's certainly in a lot of respects not the rationale that other Western countries have for lots of the important products. Our system generally proceeds on the idea that we want to give people an incentive for innovation. And the way we're going to do that is if they come up with a product that falls within one of the pigeonholes that we protect, we're not going to let anybody else use that product or idea for a long period time so that they can reap profits from it. For that to make sense a couple things have to be true. One, it only makes sense if giving this incentive is necessary for people to make the product. It's not good for the economy to give a monopoly to somebody to create something that they would have created anyway because the monopoly is necessarily a cost to the economy. So you shouldn't be doing this unless you need to do it to give people the incentive to create it.

The other thing is, it assumes that the incentive is effective. It's possible that the incentive just doesn't have any affect on people. Now you look at Internet time. How long in Internet time does it take to go from zero to a billion dollars? Well you know maybe four or five weeks. How long do we protect intellectual property? Well patents we give people 20 years. Twenty years is a very long time on the Internet. You would have to wonder, I think, whether we really need to protect patents for infrastructure for Internet 20 years or whether some shorter period of time is long enough to reap a return on the investment. It's very difficult to figure out how to do these things because when you're trying to figure out the appropriate length of intellectual property protection, you want to look at broad categories that are easily understandable and figure out something about how innovation works in the area as a whole. But when you hear these people

talking about what happens under Moore's Law in 20 years, that's a long, long, long time. And it's much longer now than it was in 1800. I mean in 1800, 20 years was a small part of the life cycle of a product. Now, it's generations and generations and generations of life cycle.

What about copyright? Copyright's important. We protect software with copyright. Well, the copyright protection is life plus 75 years. And if it's a company, some companies write software, well they get 95 years. Ninety-five years is just an absurdly long period of time to have copyright protection for things that have product cycles so short. So you would wonder so does this really matter? Because you might think, well if the product's only going to be used because its life cycle is so short, we're not going to be using this software product for more than 18 months, why does it matter if we protect it for 95 years because after all it's unlikely anybody's going to be buying Microsoft Word in the year 2060. I'm not sure what they'll be buying. It might be something by Microsoft but it probably won't recognizably resemble anything that we buy now in any way even if there's some chance that the object that you use it on resembles what we use it on now, which I guess that's unlikely, too. But I think that's just not right. What happens is the patent protection, the copyright protection being to the extent that the products develop more rapidly it's still true that the products are built on things that are protected. And you tie up the infrastructure for decades. So if someone can get a patent or copyright protection for something, it lasts a much longer time than I think is plausibly necessary to get the amount of incentive for the innovation. If someone can bring a product to market and gets profits from a first mover advantage for a significant portion of the product cycle before someone can come in and compete with them, if you then protect them for another 85 years after that it's easy to think that's really longer than is necessary.

I'm several minutes past when I'm supposed to stop so I'll just stop.

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**DEAN JEFFREY S. LEHMAN:** Okay, let's collect questions from everyone and I'll pose them to the panel as they come in. The first one is simple and direct. I'll start with Jim's reaction on this. Please comment on the proposition that Microsoft and Intel and Cisco are not representative of the tech industry because of their monopoly positions.

**JIM DAVIDSON:** I guess they're clearly large players in the markets but it's actually kind of interesting that I guess Microsoft's on trial right now whether they're a monopoly or not. I think they're not representative of every tech company because there are thousands and thousands of tech companies and they are three of the most successful tech companies. It would be like saying Michael Jordan and Magic Johnson are representative of basketball players. They are among the best that have ever been and I would say that the benefit they've done for the economy has actually been extraordinary in that a lot of the effects that we talked about in terms of the economy growing as productivity improvements are a result of there existing some kind of industry standards that people can have some kind of standard platform for communicating in business and have a standard productivity pool. And I think Microsoft, one of the operating system, the Windows part of it, but actually the office tools have been incredibly important for productivity improvements. I think Intel with their microprocessor back in the days of August of 1981 in their hotel in New York City when they announced that they won the lottery. IBM picked them for the microprocessor for the 8086 microprocessor for the IBM PC. A lot of the

developer community that rallied around it, all these funny stories about how IBM tried to pick digital research as the operating system, the modified CPM and the guy wouldn't return Ken Avito's call so Gates got the deal and then had to write basically his dos version. Cisco I think is the most interesting of all. If you look at Cisco's success, Cisco's success is really the result of being the first company in the technology industry that outsourced a huge percentage of their R&D. They've done so many acquisitions and their secret is their marketing department, their sales department and their customer relationship business has been so far superior that they've actually been better than any other technology company that I'm aware of in integrating acquisitions and driving revenue and profitability. And by outsourcing that R&D I would argue, in fact, they are the almost opposite of a monopolist. There's a lot of new technologies, particularly in the optical and the metro area switch markets, where the best technology continues to be done outside of Cisco. I think one of the big issues for Cisco going forward is going to be with their stock price as depressed as it is, are they going to be able to continue to do business as usual and acquire the needed technologies as the communications industries change so rapidly and continue on that path. But I think that to say they're representative is a gross exaggeration because I think that they are among the best companies, not only in the tech industry, but in all of corporateness(sic) in the world.

**DEAN JEFFREY S. LEHMAN:** Any other reactions?

**JEFFREY MACKIE-MASON:** I'll just say a word because I put up those charts and I certainly didn't mean to suggest that they were representative companies. Of companies. I wasn't giving investment advice. For instance the easy thing for an economist trained in efficient markets theory to do is to say pick the winners. Jim showed me he has a book in his briefcase with him today that the title of which is How to Make Money in the Stock Market. It's a nice title. Everyone would like to write that book and in fact a lot of people have. No, the point I was making in picking those companies was to show that over a decade there's been a tremendous amount of value created by following this technology curve. Obviously, the companies that followed it best and were the best companies made the most. But the correction we're seeing at the moment is mostly the collapse of mania for retail-based Internet delivery businesses. And it turns out, the Internet delivery business for retail is just not probably the biggest advantage we get from all this technology. There are lots of other things we get and the technology over time is driving tremendous increases in value and will continue to do so. Which of the companies to invest in for the next decade, I'm not going to tell you. Jim would be happy to tell you and you should see him afterwards if that's what you want to know.

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**DEAN JEFFREY S. LEHMAN:** This, I guess, is about information here, which is what can regulators do to monitor chatrooms where an aggressive campaign of misinformation can cause serious harm to a company's stock in the short term?

**RONALD J. MANN:** Hard problem. I think that's a hard problem because it's difficult given the norms of our country and the technology of the Internet as I understand it to expect that you're going to have regulators who are going to keep people from posting messages on the Internet. It's very difficult, I think, technologically to keep anybody in the United States from writing anything that's mean about somebody and it's going to be

particularly difficult to do that before they've done it. I think the most that you're likely to see is reactions to the sites that are dedicated to a particular company and there's a lot of litigation right now about acquiring domain names that might be critical of companies so you might have such domain names as WalMartSucks.com. There's a whole series of litigation before ICANN in which Wal-Mart tries to acquire that name and people try to acquire these negative names. But that's just a fruitless battle to spin, paying lawyers to do that because as soon as you get the one name there'll just be a different one or there'll be a chatroom someplace. I don't think that anything can be done about it. I think the most that can be done is as time goes on I think the people who invest in these companies become more sophisticated at distinguishing between false information and true information and there's just much more information out there than there used to be and just because there's more information doesn't mean that it's all true.

**JIM DAVIDSON:** I would say that I think it's good and bad. It probably goes back to the type of investor we're talking about. The good news is there's a lot of information that goes in on chatrooms and 99.9 percent of it is just wrong. It's people who need to get a life. The interesting thing is, and it happens every quarter, there'll be someone who goes on for QLogic I think it was most recently, they're going to miss their quarter and the stock tanked. If you had just slept in that day and then woken up, because the information flow is so quick the SEC or the NASD or the New York Stock Exchange sees the stock market reaction, calls the company immediately and then there is corrective information that goes out very quickly. And so if you had just slept in that day, you would have had no impact on your life. The stock would have cratered down 70 percent and then recovered at the end of the day. And so, the question is you're going to obviously, speculators who trade on rumor, innuendo, whispers etc. are playing that game and it is market manipulation and I think right now the SEC has few tools to really combat it and there are some teenagers in southern California who think of it as sport. But, people have to deal with that but for most investors whether you invest in a mutual fund or you invest directly in the market, it really doesn't affect you as much as the press would lead you to believe because there really isn't that much volume and the volume that's generated is really around people trading it as it moves around. So it's people getting in and out of the market. If you really look statistically my guess is there are very few people hurt and the dollars hurt are not as great as the press lead you to believe.

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**DEAN JEFFREY S. LEHMAN:** Next question and the person who wrote it down is going to need to help me in case I'm having trouble reading one word on here. If I misread it shout out the correct word. Most IT software value is not, the questioner suggests, from speed but rather from finality, that's the word I think is here.

**JIM DAVIDSON:** Functionality.

**DEAN JEFFREY S. LEHMAN:** Functionality could be it. Maybe this is an abbreviation for functionality. Finality or functionality? Okay you can stay anonymous. Your competitor doesn't get, it must be functionality, for one-tenth of your cost by waiting for faster CPUs. Moore's Law makes it run faster, not better. That's an assertion. Reactions?

**JEFFREY MACKIE-MASON:** I certainly agree. That's one of the important points, is that Moore's Law makes the underlying technology run faster but it doesn't mean we know how to use it better. And that's why we saw such lags in the measurement of productivity improvements from technology investments in the 1980s and why in general I think we should expect to. If anything it's going to seem like that lag is increasing. Probably it's getting shorter because our processes for adopting new technologies are also improving but the new technologies are emerging so much faster the time it takes to incorporate those in our business and social processes is not getting that much faster and so it really will depend on how you use the technology and not just having it. You can't make money any more by just buying chips than you can make money just by starting a dotcom. You have to actually do something useful with those chips.

**DEAN JEFFREY S. LEHMAN:** I'm out of questions. Anybody else have any other questions for the panelists? If not I'll give the panelists a chance to add any final comments. Then let's thank them for a wonderful presentation.

That concludes today's sessions and we will begin again tomorrow morning bright and early at 9:00 a.m. Thanks a lot.