Addendum

Dataquest Predicts

1996 and Beyond

February 20, 1996
Santa Clara Convention Center
Santa Clara, California

58

Dataquest
A Gartner Group Company

Published by Dataquest, a Gartner Group Company

Table of Contents - Supplement

DATAQUEST PREDICTS — February, 1996

Chapter 1: THE STATE OF THE WORLD ECONOMY

Joseph W. Duncan — 1-1
Vice President, Chief Economist
The Dun & Bradstreet Corporation

Chapter 2: THE EVOLVING PC MARKETPLACE

Andrew S. Grove — 2-1
President and CEO
Intel Corporation

INDEX TABLE — x-i

Note: The contents of this document are based on a verbatim transcription of tapes from the conference proceedings, including speeches, audience participation and panel discussions. A "best effort" was made to ensure the accuracy of names, acronyms, slang words, company and product names prior to the printing of the document.

This page is intentionally left blank

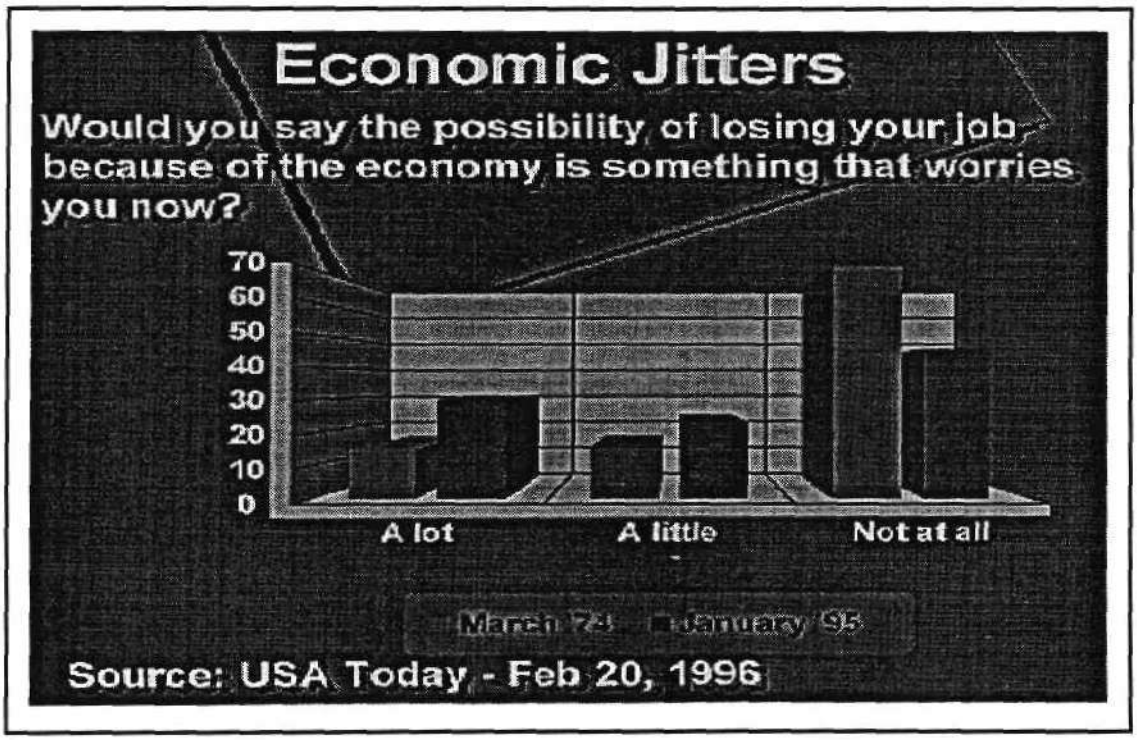
Chapter 1: THE STATE OF THE WORLD ECONOMY

Joseph W. Duncan
Vice President, Chief Economist
The Dun & Bradstreet Corporation

Moderator: Dr. Duncan has published over 100 technical articles and has co-authored the book, *Statistics for the 21st Century*. This book addresses the needs for improving the statistical information base for public and private companies. Joe is also a member of many associations and received the highest award from the International Statistical Institute for outstanding leadership. Joe has a BS ME from Case, an MBA from Harvard and a Ph.D. from Ohio State.

After Joe's speech on the outlook for the global economy, he has agreed to take several questions. We'll try to keep within the timeframe of what Joe has been allotted. Please now welcome Joseph Duncan.

Joseph Duncan: My topic is a very broad one, the state of the world economy. I'm going to continue the globalization theme that I've used before at Dataquest conferences but I have a couple of other things that I'd like to do today as well.



THE STATE OF THE WORLD ECONOMY

First, though, I'd like to pick up on this morning's issue of *USA Today*. They had a survey which asked people, "Would you say the possibility of losing your job because of the economy is something that worries you now?" Now, I know you're all in a dynamic environment and job changes are around you. In 1974, 70% of respondents to a similar survey were not worried about the impact of the economy on their job. Look at today's numbers. The number that are worried a lot has more than doubled in percentage. Even those that are worried a little has increased. Those that feel pretty good about things has dropped to about 45% from 70%.

I'm not going to answer any questions for you today about your particular job jitters. But I would like to give you a perspective on the economy that may help you understand the economic environment, not only for your personal career planning but for your business strategy as well.

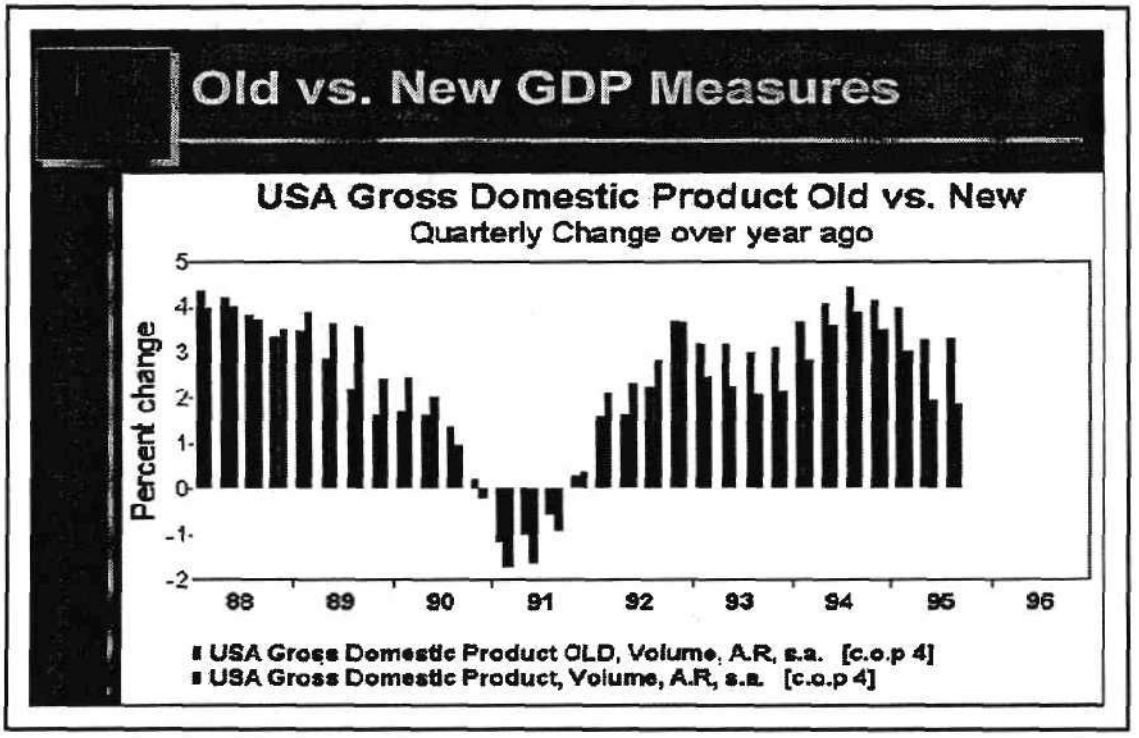
The topics that I'm going to cover today include one that's rather new for my presentations here and that's a review of recent changes in the economic data. The government is revising the way that national output is measured and it's going to have an impact on you, as I will explain in the first part of my presentation.

With that background, I'd like to do a quick tour of the world, talk about the global economic outlook over the next couple of years and give you a perspective on what the total environment is. As I've said many times before, you can't do a forecast for the national economy any more. You have to link it to the global outlook. That's likewise true for your businesses. You're really marketing to the world at large today, as well as receiving inputs from the world at large.

Then I'd like to conclude by giving you some pointers on why I think our global issues will affect the economic outlook. The reason people make forecasts of the economy is to alert policy makers to concerns and hopefully they'll repair those concerns and they will be even better than projected. So you have to keep track of what the basic issues are.

I'm going to spend a little time at the end on issues for the U.S., since I can't resist the fact that we are in the middle of a political year as noted by today's first step in the primary process.

First, let me talk about the changes in the way the government measures national growth. These changes really have two parts to them. First, every 5 years the government has traditionally moved the base period that's used to calculate a real economic growth. This time, however, they're also adding a concept called a chain-weighted index. That's a weight of the components in GDP. That's a very fundamental methodological change that I will show you is going to have a big impact on the numbers, particularly in this industry.



If we look at the old versus the new GDP numbers, as this chart does, the blue is the new number. You'll notice as you move into 1993, '94' and '95 that national economic growth under the new measure is substantially lower than it was previously reported. This is an environment in which everybody is concerned about economic growth. So now the government statisticians have figured out a way to tell us we're really worse off than we thought we were.

There is a big issue as to what that will mean, in terms of public confidence among consumers and business confidence among business leaders. I want to get into some of the dynamics behind this change in numbers.

As I mentioned, the types of changes include a change in the base period. The first part of that is to move from 1987 prices, which we've been using for the last 5 years or more, to the 1992 prices. The base period for the prices changes the relative weight of various activities. With the computer industry, for example and rapid price declines, the weight of the computer industry changes dramatically when you adjust the price period.

The problem that has emerged because the computer industry in particular and telecommunications as well, have been changing so rapidly is that the role of those industries was dominating the economy more than it really should have because they were using out-of-date relationships between the computer industry and the GDP.

For example, computers and telecommunications have been accounting for about 50% of fixed investment in the country. That's partly because the deflators used to measure those products have been in error. The chain weight is an attempt to get away from that substitution bias of the lower-classed products of being over-weighted in the economic numbers. The chain weight, in effect, is a moving weighting, as opposed to a fixed weighting for a fixed period of time.

Economists have noted for a long time that production growth tends to be strongest for goods which are relatively competitive. Lower prices. Of course, computers have been a key component of that.

When real GDP is recalculated with more recent weights, the contribution of those diminishing price components is reduced and the effect on economic growth is to have the reported growth lower. That's part of what you saw in those numbers that I just showed you before in that bar chart.

As a statistician, I would be the first to say that the methodology being used is a good move in the right direction. Because that substitution bias is a distortion. But as an economist, I have very mixed feelings. Because with the chain weighting process, on a quarterly basis you can no longer add together the real components because you don't have fixed weights as we did in the past.

The weighting scheme under this moving chain weighting changes through time. The quarters don't average to the annuals. It makes it very hard to figure out where we are in terms of what the numbers mean. If you're a regression enthusiast and you're running models of the economy, you have to re-estimate

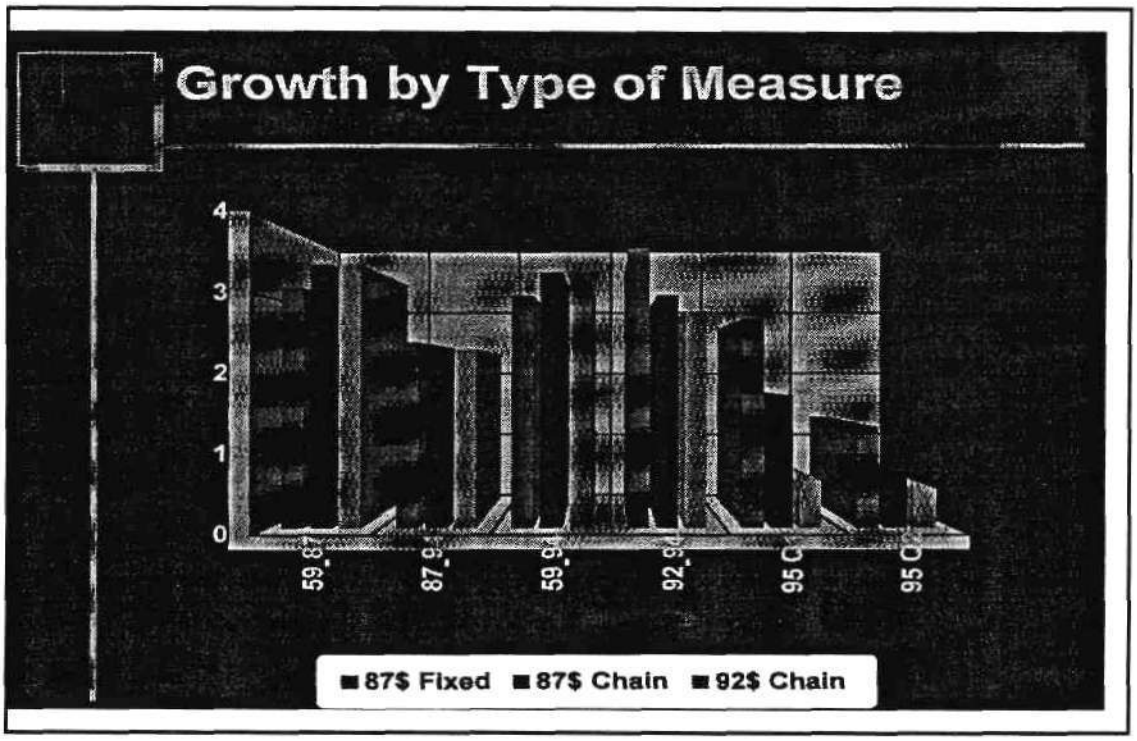
your regression equations every time new data becomes available. There are some serious technical issues with how you do that.

What it all boils down to is that economists and statisticians in particular, must readjust their thinking about how the economy is put together. And you, as a user of the statistics and an evaluator of the economic environment, have to readjust your thinking about what the growth really is.

Just to give you a rule of thumb: The adjustments that have been made will in effect reduce the rate of growth in the U.S. economy by 1 percentage point. So when somebody says "We have a two-and-a-half percent growth rate today," that would have been yesterday's three-and-a-half percent.

Furthermore, I wrote a book about how bad our statistics are. This change actually is only a half step in the right direction. The change is incomplete. They have in fact adjusted for the technological change in our economic structure from the standpoint of the weights. But the benefits of technological change are not considered.

Most areas where high technologies such as your business are used, the way the government measures productivity, the devices have no impact on productivity. Productivity is typically measured tons of steel per personnel. They are not pieces of paper produced by a clerk, which of course gets greatly enhanced with a computer. Computers, as you know, don't lead to a paperless society, they generate more paper.



Let me walk through some time periods for you, just to give you a flavor of this change. If you look at the period 1959 through 1987, 1987 through 1994 and so forth across the bottom -- I'm going to really focus on the first two quarters of last year, which are the only quarters we have data for under all three of the systems.

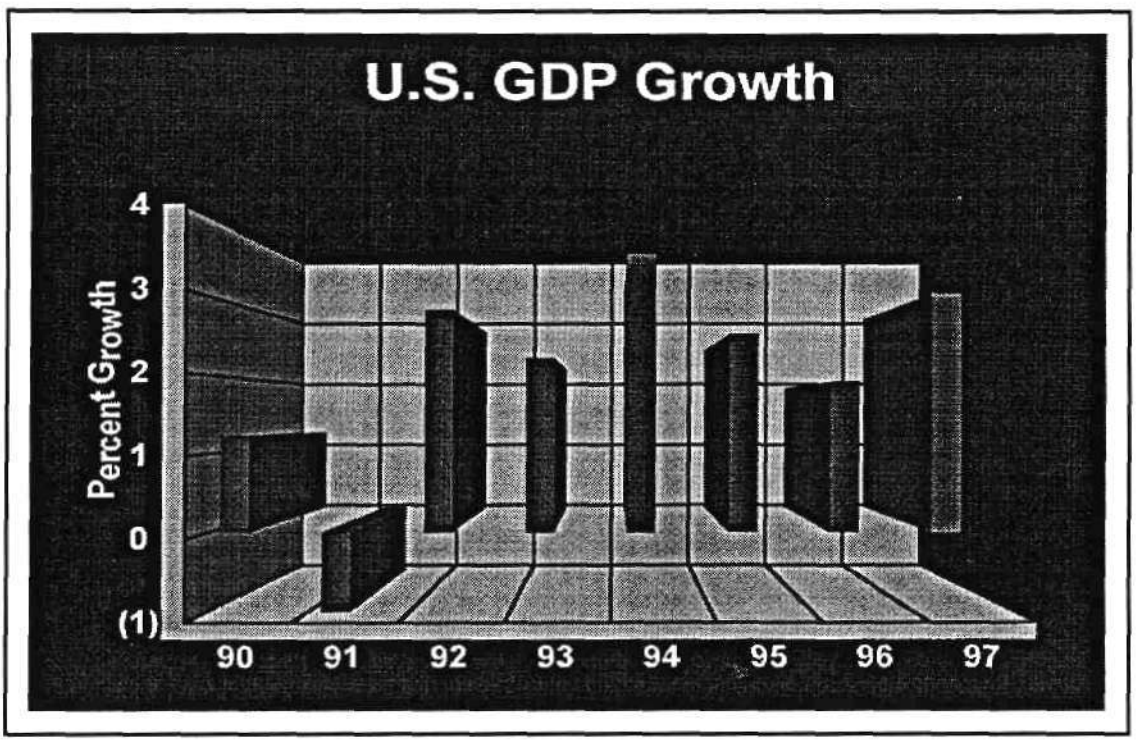
The first change is to introduce the 1987 prices. What that does on the pre-1987 growth rates is actually increase the average growth rate for the economy. After 1987 through 1984, it actually decreases the growth rate; partly because of the substitution effect that I talked about. For the entire period, there's actually a net overall gain; that is the entire period '59 through '94, which is the only period that's been adjusted to date.

However, when we get to more recent time periods, you'll see that for 1992 to 1994, GDP growth is substantially lower. For the first quarter of last year and the second quarter of last year, growth is almost in half. Now when you move to the 1992 price structure as well as the chain weighting, there's no impact prior to 1987; you get a slight impact on the '87-'94 overall growth rate. But you see that

for the more recent time periods, growth is lowered even more. It's very dramatic when you add those changes together for recent time periods.

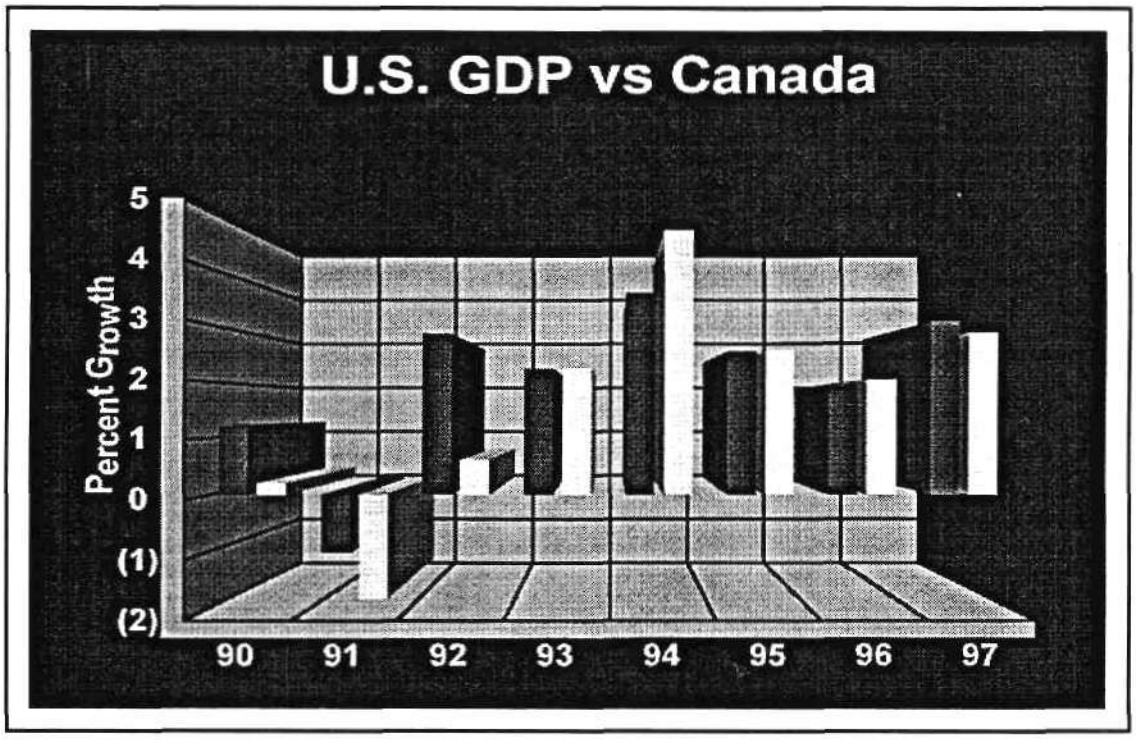
So in this political year, we're suddenly going to see the government issuing statistics that say the economy is not growing; when in fact all we have is a statistical adjustment. It's a statistical adjustment that's in your industry. So you need to be aware of the statistics and be careful as to how they're interpreted as you look at the environment that's involved in your industry.

Having castigated GDP, I just got back from a trip to Eurostat in Europe. All of the statisticians in Europe are lamenting the fact that the U.S. has adjusted its GDP so it is no longer comparable to other countries. For my presentation, I'm going to use the U.S. as a reference point, so just take into account that we have a different measure. Of course, my numbers are basically the old system because we don't have the numbers for the new system yet.

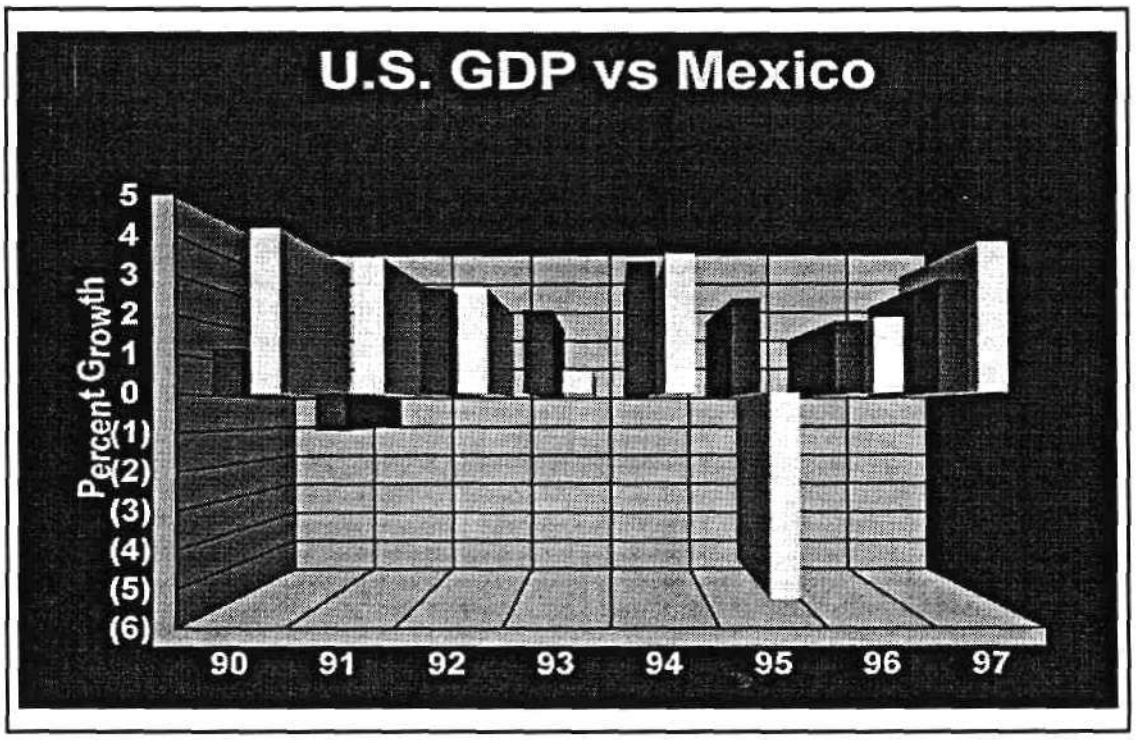


If we look at U.S. GDP growth over the last several years, you all know that we had a recession in 1991. Compared to 1994, 1995 was not a great growth year.

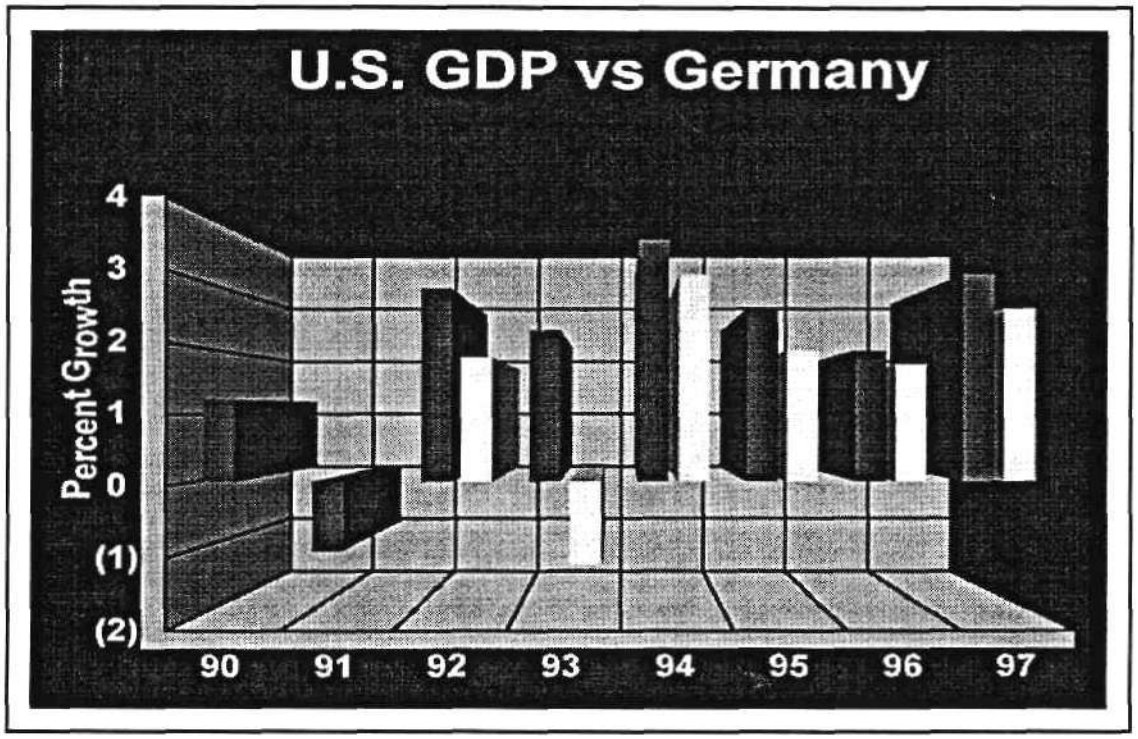
Actually, we're going to see lower reported growth now for '96 and '97. Now here I have to kind of adjust the numbers into the new system. We will probably have a percentage point higher on the number. It wouldn't affect the relatives here because I've adjusted it all the way through.



Let's use the U.S. as a benchmark and look at some other countries. Our neighbor to the north, Canada, our partner in NAFTA, actually had a deeper recession in 1991 than the U.S. did and was slower to recover. But that was followed by very good growth in 1994 and reasonably good growth last year. It looks like, for the next couple of years, Canada will do its traditional thing of mirroring growth in the U.S. They've gone through a very difficult readjustment of their economy. They have a new government that's much more conservative. But overall, it looks like they've adjusted their problems. So Canada, our neighbor to the north, our largest trading partner, will be a reasonably strong economy, growing about the same rate as the U.S.



Our other NAFTA partner, Mexico, as you know, does have some problems. The peso devaluation at the end of the election in 1994 led to negative growth for 1995 -- the numbers aren't out yet; this is my estimate -- of about 5.5%. What's interesting is there's already evidence that their economy is turning around because they're a low-cost center of production; they are exporting like crazy, so they're benefiting from strong external demand. So they're actually going to probably grow in 1996 about the same rate as the U.S. They'll grow more rapidly in 1997 as they fully recover and they get the double benefit of NAFTA plus recovery from that sharp decline.

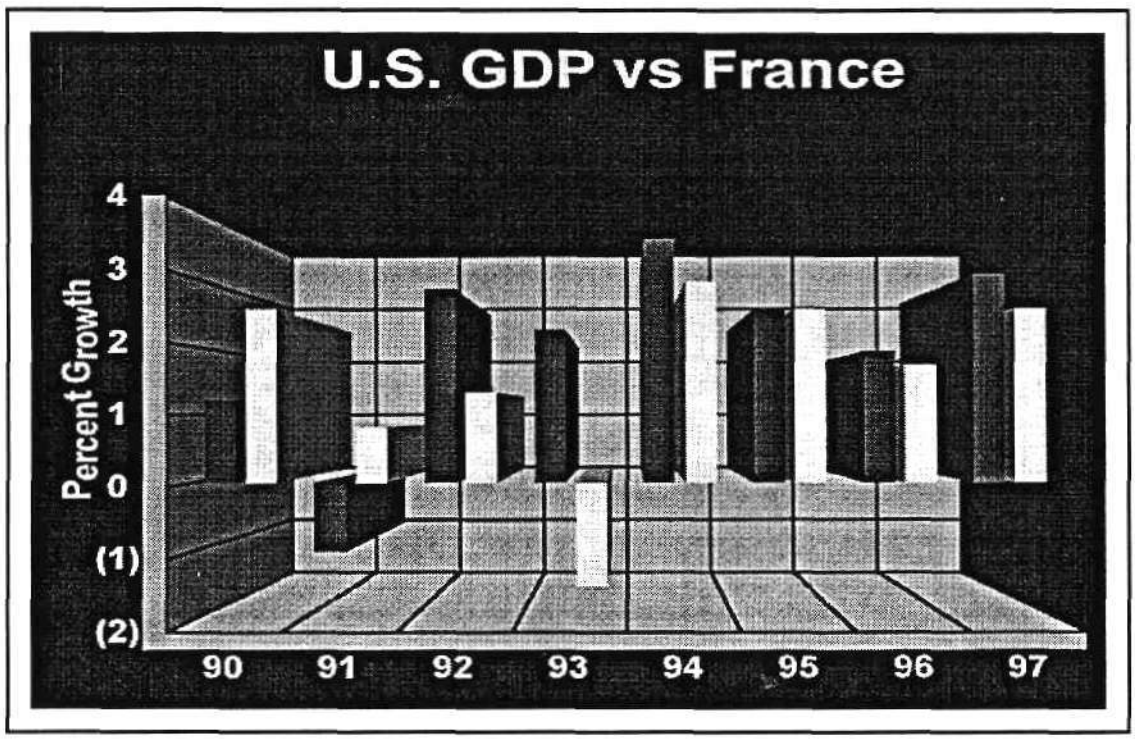


Moving to Europe, once again using the U.S. as a reference, Germany -- I do not have data for 1990 and 1991 because there's no data for the unified Germany that now exists for that time period. But starting in 1992, they actually had a very serious problem, as the unification began to cost the federal budget in Germany a lot of money and the subsidies required to bail out Eastern Germany pulled down GDP in 1993.

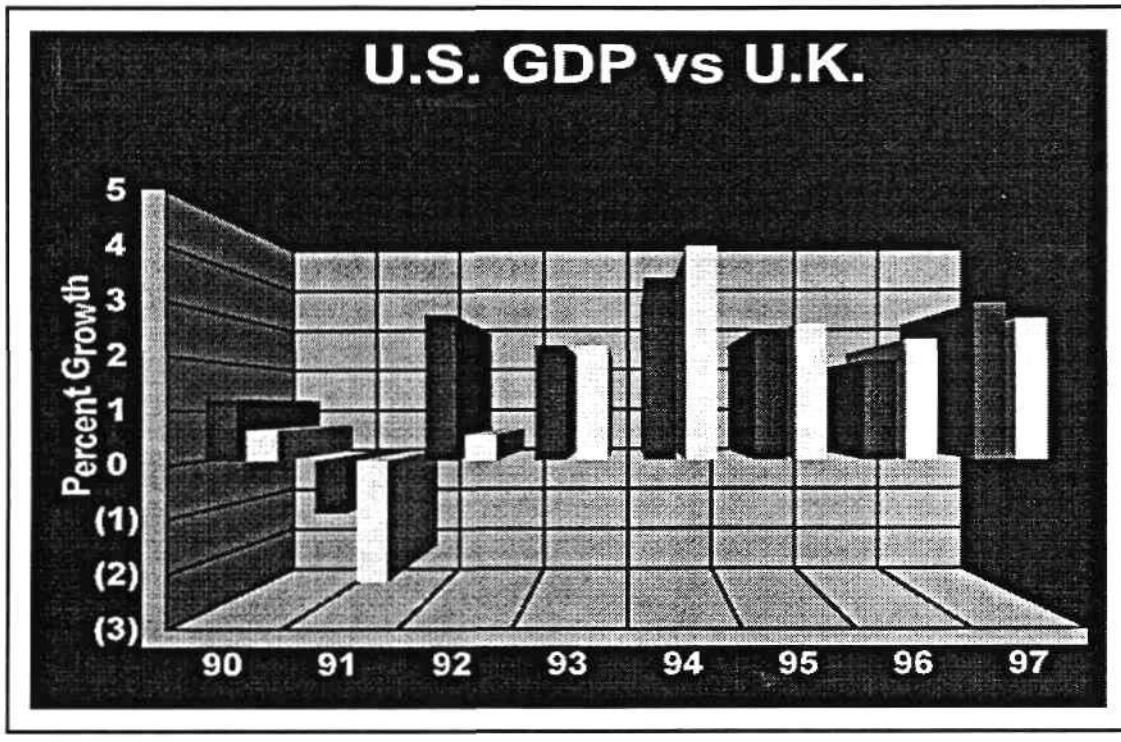
For 1995, the economy proved to be weaker than many people thought for Germany. Maybe we were looking for strong growth as they recovered. In fact, the most recent data suggest almost no growth in the 4th quarter. My number here for '95 may even overstate the growth in Germany.

Germany is facing serious economic distress because its unit labor costs are now the highest in the world and they have just made a labor agreement which makes it as kind of commitment that companies will not lay workers off. You cannot, in today's economy, restructure, become more competitive and not lay workers off. So Germany is facing an enormous amount of economic stress, even though

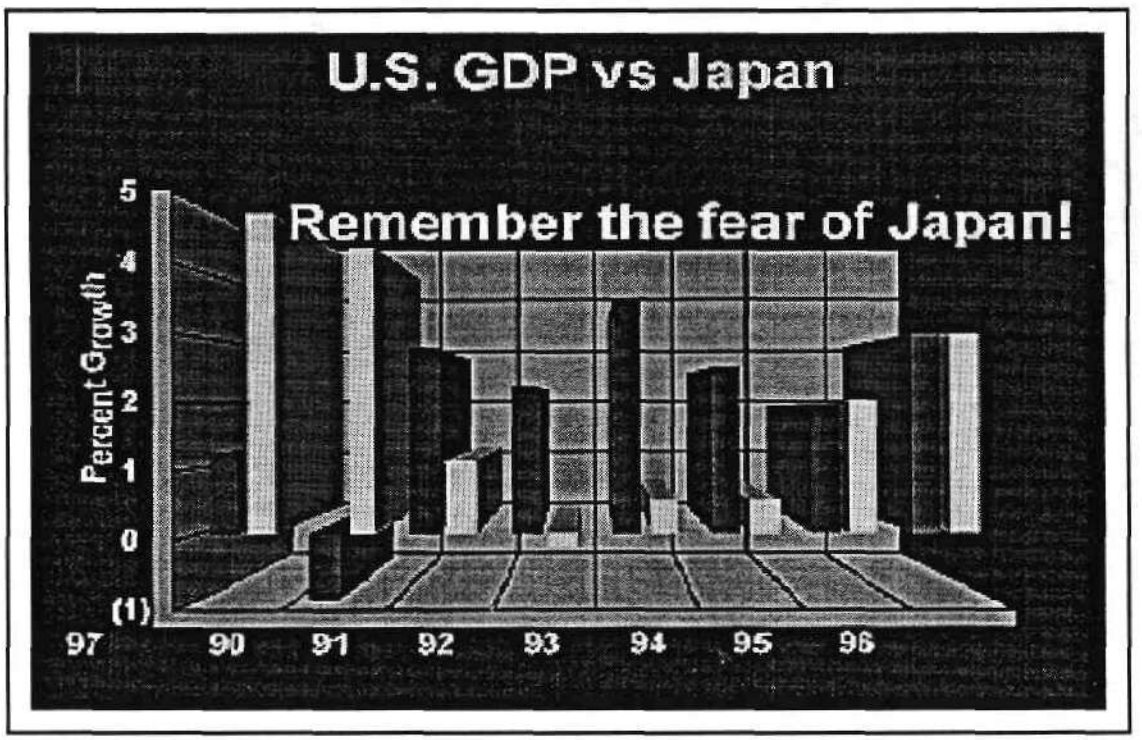
the fundamentals of the German economy would suggest that it should be the powerhouse in Europe.



France was growing when the U.S. was in recession and their recession was a little later, in 1993. They've grown reasonably well the last couple of years but as you know, they just had an election. There's a lack of leadership in France in terms of economic policy; every week there's a new proposal about how to fix the economy. There was a big strike recently that really slowed down the French economy. So the outlook is fairly questionable in the near term for France. I personally think they're going to work their way through and so I've got what would be called an optimistic forecast for France. But France will be growing less than the U.S., which will have very modest growth in 1996.



The UK also had a deeper recession than the U.S. They actually started slowing down before the U.S. did. In fact, back in the early '90s, I used to talk about the Anglo recession. The first company to go into recession was Australia; the second was the UK; third was Canada and then the U.S. So all English-speaking countries had a recession in 1991. The UK got very pessimistic at that point in time. But they led the rest of Europe out of the European recession and the UK has had very strong growth. There is obviously uncertainty about the election that's ahead. But the economic fundamentals in the UK are fairly strong and so I have a relatively optimistic forecast for the UK over the next couple of years. I don't see them getting into any grave economic difficulties.

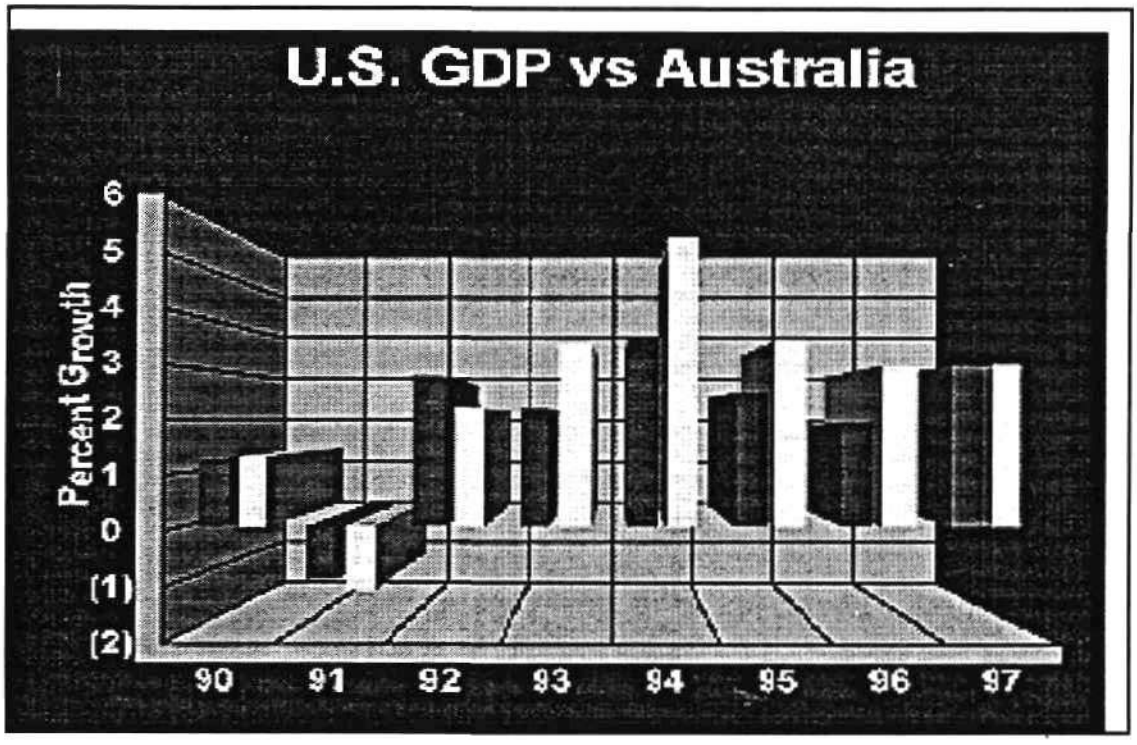


Let's turn our head the other direction toward Japan. I know many of you follow Japan more closely maybe even than you follow the U.S. We used to say as economists that when growth got below 4% in Japan, it was a recession. Of course in the U.S., if growth got to 4% it was a boom. But the Japanese economy had a remarkable entire post-war period. History, strong growth leading into the early part of the '90s. But as you can see from this chart, the last 4 years have been virtually zero growth in Japan. I'll come back to some of the issues there a little later.

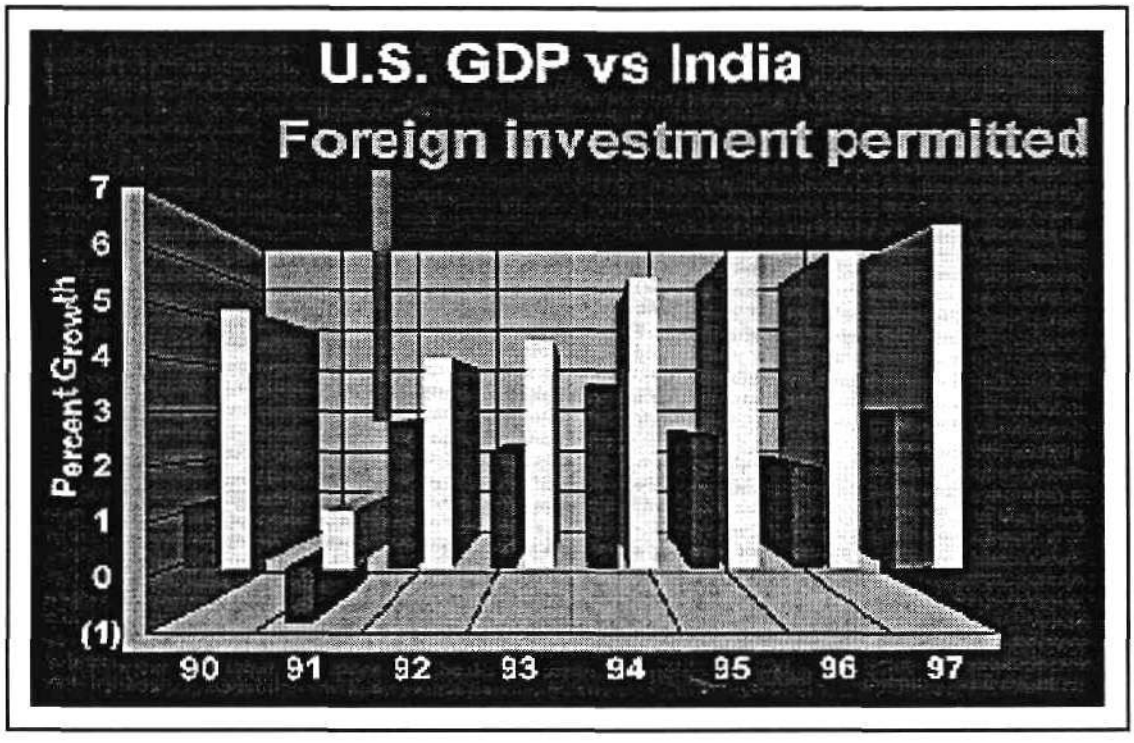
I actually have Japan growing at 2% in 1996. I was in Japan three weeks ago. A number of my Japanese friends are skeptical. I'm actually even more optimistic than the economic planning administration, which is always a cheerleader for the Japanese economy. Their problem is that they have been forecasting recovery for each of the last 4 years and they've been wrong. Now that a recovery is beginning to build, they're afraid to say so.

I think my 2% is probably a conservative estimate. But once again, even in 1997, a 3% growth rate for Japan is not very great, given its long economic history. It's

just on the mend but it is going to turn around. So don't believe all those stories that it's collapsing.



Let's look at Australia, which as I said was the first economy to go into recession. They came roaring back in 1994 and are doing reasonably well right at the moment. There is some debate about economic policy in Australia; in fact, every time I go there, there's debate about economic policy. But I think their fundamentals remain strong and so I have reasonable growth for both 1996 and 1997 in Australia.

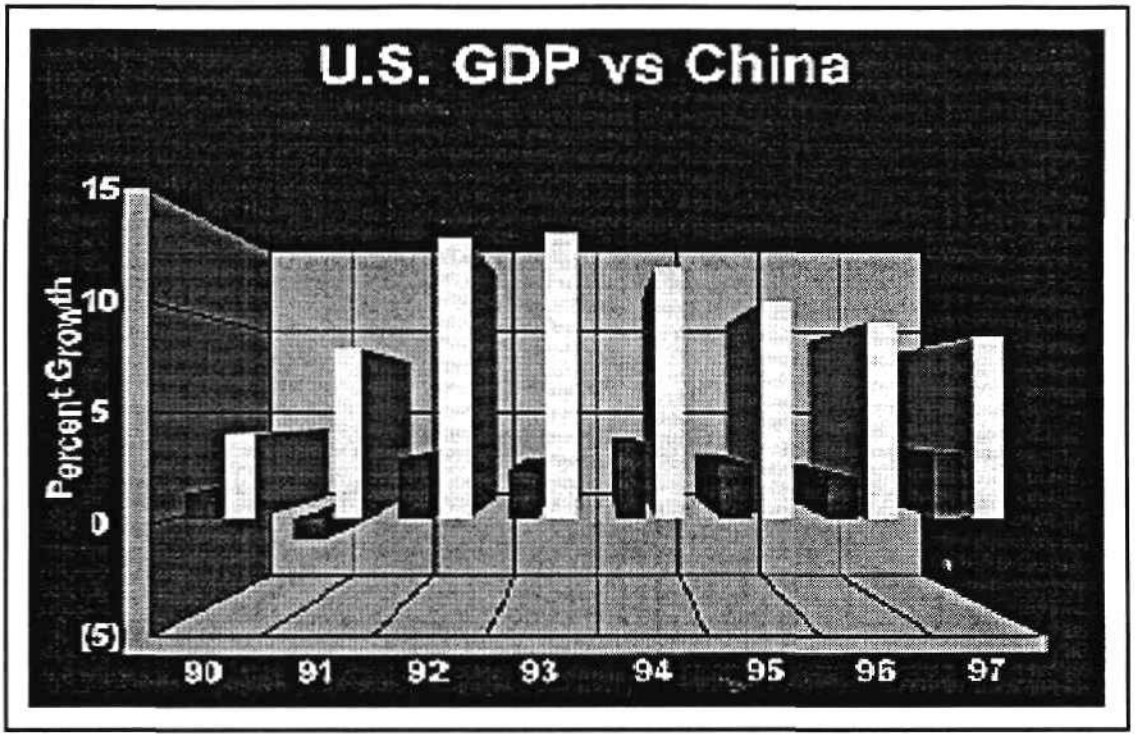


One country we don't talk too much about is India and I think that's a mistake. If you're not looking at India, you might want to take a second look. You'll notice that India's growth is fairly strong, compared to the U.S. What happened in India was about four years ago, they permitted for the first time since they've become an independent country to have direct foreign investment, where people would actually own companies in their economy. You can see the growth has begun to become strong after that.

There are some problems. They just canceled a contract for a major refinery, and they are now renegotiating that. But they make people worried a little bit that a formerly simply-planned economy can't quite trust the marketplace. A lot of debate by the opposition party about throwing out the economic freedom has been started. But let me suggest to you that once the genie's out of the bottle, most of the Indian population wants to see a free-market economy. It's not clear who's going to win the election but whoever wins, I don't think they're going to reverse the policies.

So India, a country of nearly a billion people, will begin to see some economic growth. There's enormous opportunity because they have a strong legal structure; they have the equivalent of British Common Law, unlike China which has no legal structure for business deals. India is a roughly safe place to invest from that point of view.

Our company, Dun & Bradstreet, actually has a facility now in India, where we do a lot of software programming. They are very good in the programming business. We export about half our product in India to other parts of the world. They're becoming the outsourcer for much computer programming activity.



Of course we can't ignore China. You'll notice I have little bars here for the U.S. because the growth in China is even more dramatic in comparison to the U.S., growing at 13% to 14% in 1992 and 1993. They had serious problems with inflation as a result of that overly-excited economy. But they have successfully, in 1994 and 1995, brought down the rate of inflation while maintaining growth in excess of 10%. Another billion-person society, absolutely enormous opportunities.

Let me just give you one dramatic statistic. If you think about middle-income families in income distribution, in the last 4 years in China, the free trade zones and the economic revolution have created approximately 100 million people in the middle class in China. A hundred million people who want toothpaste and Coca Cola and television sets and toasters and other things that we all take for granted. That's only 8% of the population. But 100 million people is a third the size of the European common market. Fantastic opportunities in China.

But great risks because of the leadership transformation that lies ahead. I'll come back to that in a moment. But it is impressive, the extent to which China has demonstrated sustained economic growth, really at a good pace since they began to free up the economy in 1979, when they permitted agriculture to become market-oriented.

I can't go through all the countries in the world but let me summarize the regions. I'll do this for 1995, 1996 and 1997. NAFTA and developed Europe, which is basically the common market, actually during 1995 grew at about the same pace when you added all the countries up.

Emerging Europe -- which is Central Europe, Russia/Eastern Europe, that is Hungary, Poland, Czechoslovakia, etc. -- had actually about 2% growth this year after declining in the previous 3 years.

Asia and the Pacific, when you add everybody together -- not just the newly-industrialized countries but all countries -- is out-paced by the developed world a little bit. If you look at the newly-industrialized countries, their growth rates doubled the growth of the developed countries.

Of course, Mexico pulled down Central and South America. The peso crisis rippled all the way through South America. So in 1995, the world picture showed South America as the weak spot.

As we look to my forecast for 1996 because of continuing problems in Mexico but more particularly the lower growth in the U.S., NAFTA will be a little less than it was last year. Developing Europe will be about the same and emerging Europe will begin to show positive economic growth. Asia and the Pacific will grow just about the same as they did last year. And South America will turn around.

If we look out to 1997, I look for stronger growth, as you saw in those charts in all 3: U.S., Canada and Mexico. Developing Europe should grow, be on an upbeat path. Emerging Europe even more so. Asia and the Pacific, which has had a very strong growth base, still growing strongly but not a dramatic change. Then, Central and South America becoming an opportunity.

When you add those patterns together and reach out for the 1990s as a decade, it's very easy to see. The 1990s, by the time we get to the end of the decade -- because of the strong growth base that this pattern shows -- we'll actually have more growth than we experienced in the 1980s. We think of the 1980s as the boom period. In just a few years we're going to look at the 1990s as the boom period.

As we actually sum up everybody -- including the Russian republics and China -- in terms of global growth, these charts show the total growth in the globe. Some of the countries are hard to measure. They're formerly centrally-planned economies; we don't have the statistics.

The World Bank has a series of production-oriented measures and I'll just give you their numbers for comparison. They're a little stronger than my forecasts. But I would just remind you that the World Bank has a great history of revision downward its forecasts as the time actually happens. They are eternal optimists, in terms of global growth.

But either picture you take is a picture that says the global environment is strong today and will strengthen over the next couple of years. That's good for the U.S. because the U.S. is one of the most competitive economies in the world. In fact, a center in Geneva that studies national competitiveness, for the last two years has rated the U.S. as the most competitive global economy, despite the way we bash ourselves in our press in the U.S.

Let me conclude, then, from this positive note by suggesting that if everything goes right, my forecast may actually turn out to be modestly conservative. Things could be better. They also could be worse, if some things go wrong.

What are some of the issues that you might want to keep your eye on as you look for your business in the next couple of years?

Let me start with Europe. My greatest worry in Europe, actually, is the forthcoming elections in Russia. I think it's very difficult to predict today what's

going to happen there. I think it is clear, as I mentioned about India, that they're not going to go back to the repressive society that they had before. But they certainly could take a sharp, different direction. There is a strong nationalistic theme in the election, which means that the Russian republic -- while it's been shown not to be strong militarily, is still worrisome militarily.

Japan is beginning to question whether its role in foreign policy is proper. They want to have a bigger role in some areas and they would like to get the U.S. out. So there are some issues around foreign policy in Japan that I think you need to keep your eye on as we look to the world economy. Frankly, I think that Japan views the U.S. as its partner and they will be a strong force in global growth in the future. But there is some nervousness now around the current leadership and particularly the coming elections.

What Japan really needs is a program of stimulation of the domestic level. The consumers are very pessimistic in Japan. Auto sales have recovered a little bit but they're still 30% below their peak. And many other areas. In fact, it's very interesting, when I was there, the newspapers had stories about people flocking to the U.S. discount stores that have been introduced in Japan against the retailers' desire. The consumer in Japan is taking a very cautious look at spending, just as the consumer is in the U.S.

I mentioned in passing before that there is a problem in China with the transition of leadership, the leadership after Deng. It's not clear where that's going but a current bad noise is coming out about Hong Kong and Taiwan that's worrisome. It may be that the new leadership wants to demonstrate its ability to be strong and not be pushed around by the rest of the world. But there's a great risk that if they go too far in either tearing apart the Hong Kong economy or taking over Taiwan, that it could create a major global crisis. I hope that will not be the case. I would not predict that but it certainly is a worrisome thing.

There's also, as I said before, a need to establish stronger business law and contract concepts so you're not just dealing with a ministry or you're dealing with an illegal framework. Once a contract law gets established in China, I think you'll see the pace of economic development pick up even more dramatically.

I think there's a question about stability in India. I mentioned that before. There is a forthcoming election. I just think, as I said before, that it's unlikely to overturn the economic progress that's been achieved. India wants to be part of

the global economy. They're already showing that they can compete. I think they look to be a major player in the second half of the 1990s.

Let me stop with a brief look at the U.S. You all know these from the daily news; I don't need to spend much time on it. But the budget debate in Congress has kind of fallen off the front page. Yet from a standpoint of the future economic growth of the U.S. economy, it's still the key issue. The correct policy for the U.S. government is to reduce the federal deficit. Virtually everyone agrees to that, both parties. The question is, of course, a political set of choices as to what the components of that balancing act are.

It's going to be, I think, an issue in the election. There may be some kind of a partial deal before the election but it's going to be the debate in the election. You'll be part of that debate. We all have to keep our eye on it and hope that the end result of that debate is a pro-growth, strengthen-the-economy process. Because, while there's a lot of uncertainty about tax laws -- we've seen capital investment fall off -- what we need is a government policy that promotes investment, that takes advantage of new technology and gets the real growth that that should lead us to.

Do you want to look at the outcome of the elections? Very simple question: Will smaller government prevail? If it doesn't prevail, we're in for some strangulation. You know, it's very interesting, Europe is shedding its social programs at the same time that many in the U.S. are proposing additional programs and social costs. Very interesting contrast.

Of course the other part of the election is will we have divided leadership again? Will we continue to have gridlock in Washington because of the different parties? There's a little bit of good in checks and balances but we've certainly seen a lot of stalemate in the last several years.

The outcome of the election is critical for business and consumer confidence. I think that all the global restructuring, the fact that the Fortune 500 companies have eliminated in excess of 5.5 million jobs in the last 15 years, has changed our economic structure dramatically. It's created a sense of unease, as that chart that I showed you at the beginning reflects.

In order to be productive and aggressive in the global competitive economy, we need to have a good, productive labor force. We need to rebuild a business spirit.

Your industry has the best spirit because you're in a boom era. But a lot of other people are having troubles and we need to find a way that the government can get out of the way and let business move aggressively forward. Hopefully the statisticians will even measure those gains correctly.

There is clear evidence of productivity gains from computers and there's clear evidence from wage gains when you look at not only wage and salary income, which is what's always measured but include the fringe benefits. The standard of living today is better than it was a decade ago and certainly better than it was two decades ago. But people try to tell us that we've been a stagnant society.

How many of your friends would trade their lifestyle today for the lifestyle of 20 years ago? Other than they would like to be younger and perhaps healthier and maybe weigh a little less than they do today. But in terms of the social style that flows from the productivity of our economy, we are a strong economy. Yet our numbers are going to say we're weaker and our rhetoric is saying we're weaker. We're ready to start looking at the glass as more than half full and look to the promise of tomorrow.

On that note, a little sermonette, let me say thank you very much for this opportunity to be here again. I will answer a couple of questions.

Questions and Answers:

Question: Could you expand upon the economy in Canada and the possibility of political change in Quebec and the effect that might have on a recession. You gave a somewhat rosy outlook for Canada.

Answer: You're probably from Canada and you've been living through it? No? Okay. There's been a big political battle which was reflected in the last election and the new government came in with a more austere policy. Those programs have basically straightened out their banking system and their economic base. As I say now, their economy is poised to grow about the same pace as the U.S.

Traditionally, in round numbers, whatever's in the U.S., one-tenth of that is in Canada. There's been a parallel kind of economy. Particularly the auto industry in the U.S. is closely tied to the auto industry in Canada. But there are many natural resource trading points and volume of trade. Canada's our largest trading

partner. They've been suffering from a weak -- the Canadian dollar is beginning to strengthen a little bit.

When you look at all the factors in Canada, they seem to have corrected their economic policy ship and there's no reason to expect that they would not grow as well as the U.S. is this year and next year. But there's not a dramatic advance. It's really just realigning their economy with ours after they got quite a bit out of alignment. In part, after we created a first free-trade zone, there were a lot of battles that grew around that, which were really unnecessary battles. Those have been basically worked out.

Question: What's the implication to the U.S. if it's not?

Answer: I talked to several chief statisticians of different countries when I was in Eurostat. They all agree that the methodology that the U.S. has adopted is a better methodology than they were using. They were all afraid to report lower growth. The change in the U.S. really had about five years of planning and research behind it. It's not something that you can do quickly because you have to go into the core of the accounts and create the indices to move the re-weighting forward on the chain index. There's a mechanical set of equations for doing that but you have to collect the base data out of the national accounts to do that. I am doubtful that other countries will follow the U.S. on this account for three or four years. But eventually I think they'll all be in this same system.

Incidentally, there is a thing called the System of National Accounts (SNA), which is a system designed under the leadership of the United Nations but includes people from OECD, Eurostat, IMF and the World Bank. Five major international organizations worked together to redesign the system of national accounts. The methodology of the system of national accounts will drive the national income measurement around the world over the next decade. All countries are revising their systems to line up with the SNA. This change in price measurement is just one component of that process. The U.S. actually in the past always resisted the SNA. Now they're leading the rest of the world into the new SNA.

Thank you all very much.

Chapter 2: THE EVOLVING PC MARKETPLACE

Andrew S. Grove
President and CEO
Intel Corporation

Moderator: Our next speaker is Andy Grove. Andy was born in Hungary several x86 generations ago. He proved to have quite a bit of vision early in his life, having left Hungary in 1956 during the Soviets' take-over. Andy earned his Ph.D. in chemistry from U.C. Berkeley during the most tumultuous times in the 1960s, kind of setting the stage for the tumultuous business life that Andy leads. After graduating, he went to Fairchild, the mother of Silicon Valley's semiconductor industry, as we all know.

In 1968, Gordon Moore and Bob Noyce left Fairchild to start Intel and Andy left shortly thereafter. Andy rose quickly and he hasn't stopped rising yet. Today, he leads Intel, the world's largest semiconductor company, with revenues in excess of $15 billion, with 26% net margins and a market capitalization of $46 billion. I think that Andy is the best manager in all of technology and we are very pleased to have him here today to give us his outlook on the future of the personal computer, arguably one of the most important inventions of the 20th century.

Andy will take a few questions after his presentation and we're very interested to hear your thoughts and your questions. Please now give Andy a very warm welcome.

Andy Grove: Good morning. Let me tell you a little bit about the travails of a speaker. I came here with a perfectly-polished presentation and then since everything was running a little behind I had some time to look at the binder that you had in front of you. As I was idly flipping the pages around, I noticed my entire presentation under a tab to be given by Martin Reynolds. Anything you ever wanted to know about Intel, including things I never knew, are in that presentation. So all of a sudden, I've got to figure out what to talk about. I can't talk about Intel, since it's already preempted. I will try to give you a little bit of a perspective for Martin Reynolds' speech. That's my mission today.

The categories I want to talk about are: I want to give you a little bit of a perspective, first of all, of microprocessors. Microprocessors turned 25 this year, the Generation X product of our time. I'm going to give you a little bit of a

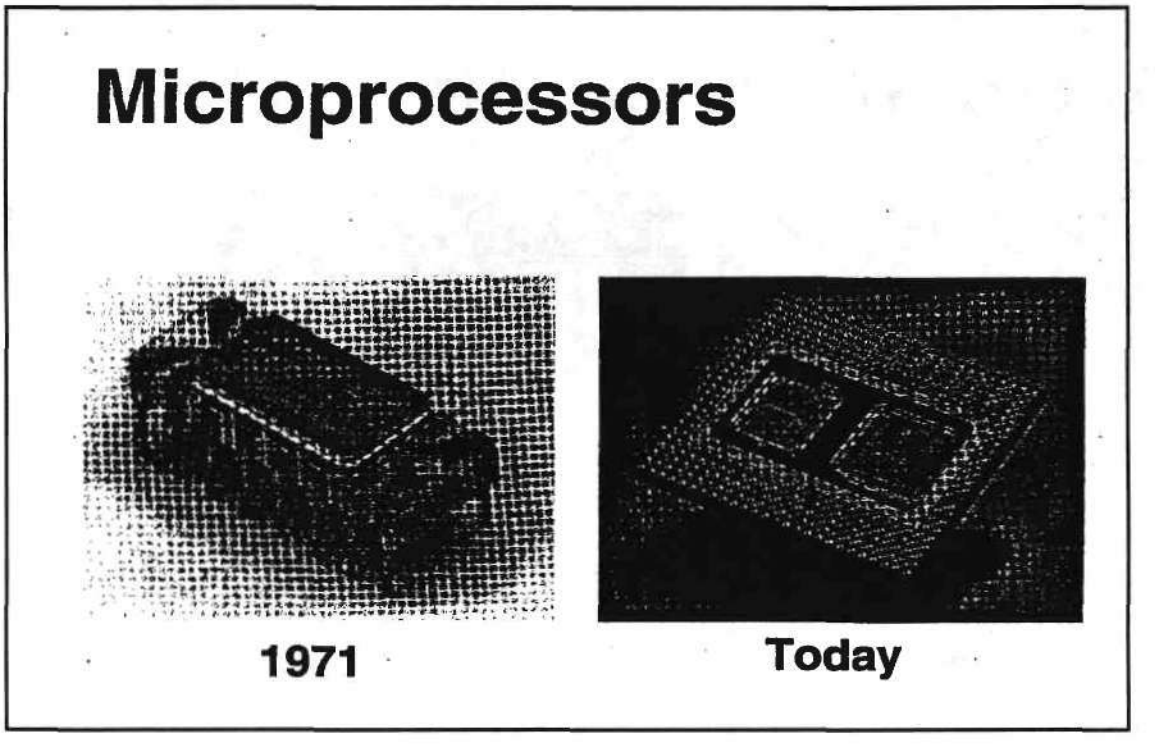
perspective in terms of what it was like when it started and what it is like today. Then I will try to fulfill Gene's introduction and give you a few views, a few comments on the evolution of the personal computer. Talk about the evolution of the industry that the personal computer sees as its environment.

The way to look at, going back 25 years, is what we've said about ourselves. We didn't have things like missions; that was before the corporate mission industry was formed. The closest I can do is quote out of our annual report of 1971, which happens to be our first annual report. Clearly the phrases that this annual report and our own view of ourselves revolved around had to do with leadership in the semiconductor industry.

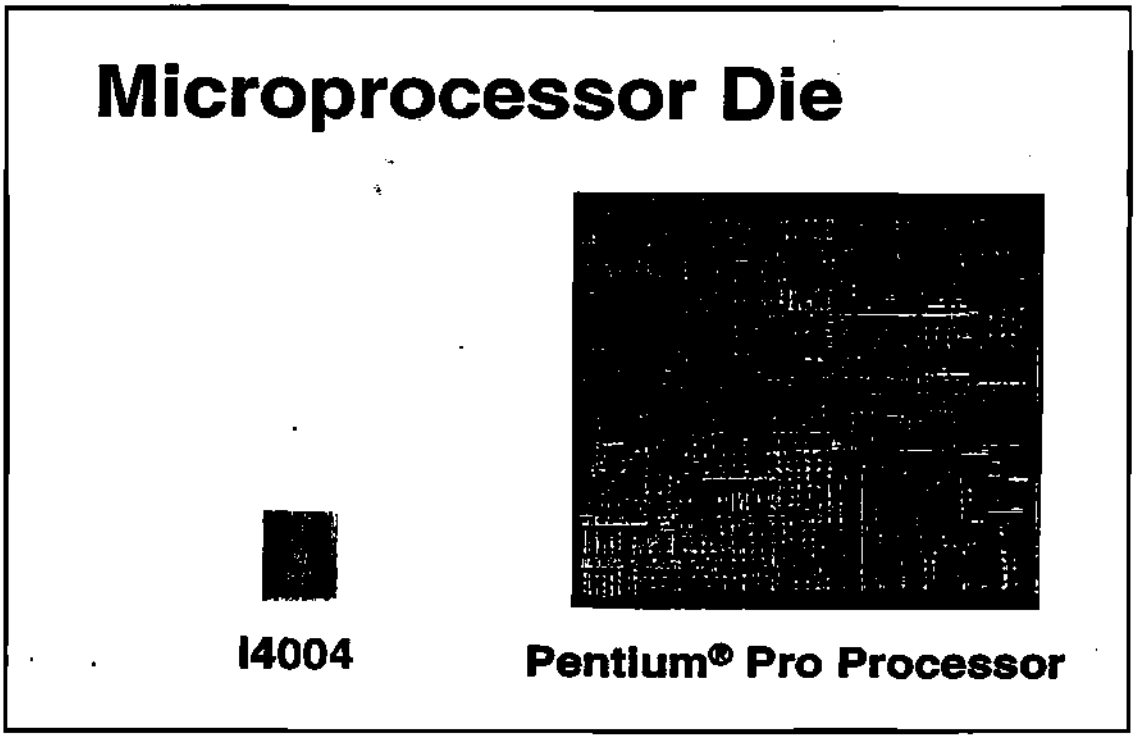
Intel was very proud to be a LSI company. LSI was a new phrase then, kind of the cause like the World Wide Web is today. It was the target for all of our activities. In that context, in 1971, we introduced the first microprocessor, the 4004. It was a 4-bit device, a little over 2,000 transistors running at 1 megahertz. Each of these parameters can be contrasted to the product of ours today.

But the most important characteristic of these devices is its history. It was meant to be a custom product for an electro-industrial calculator by a Japanese company that has since then gone out of business. How much we knew about its potential is characterized by the simple fact that we gave all rights to this microprocessor to the company that built that calculator. We clearly thought this was a custom device for that particular calculator, with an interesting concept, interesting architectural way of implementing 11 different custom services just by designing 3 of them but we had no further plan. We were busy building DRAMs.

We changed our minds a little while later and bought the rights back. Rights, that is, except for those calculators. Then we proceeded to immediately obsolete the stuff that we bought the rights back to. Subsequently we came out with the 8008, the 8080, 286 and on and on, until we came to the Pentium Pro processor, which is what you are seeing contrasted with the 4004. That's what 25 years meant.



The most interesting element as you look at this slide is the change in the packages. The microprocessor in those days fit into the simplest package that you could buy for a couple of dollars and that was by design. That was the only package that you could reliably buy by any kind of manufactured quantity, meaning the thousands. Today, those packages are as archaic as the chip, which you'll see in a moment.

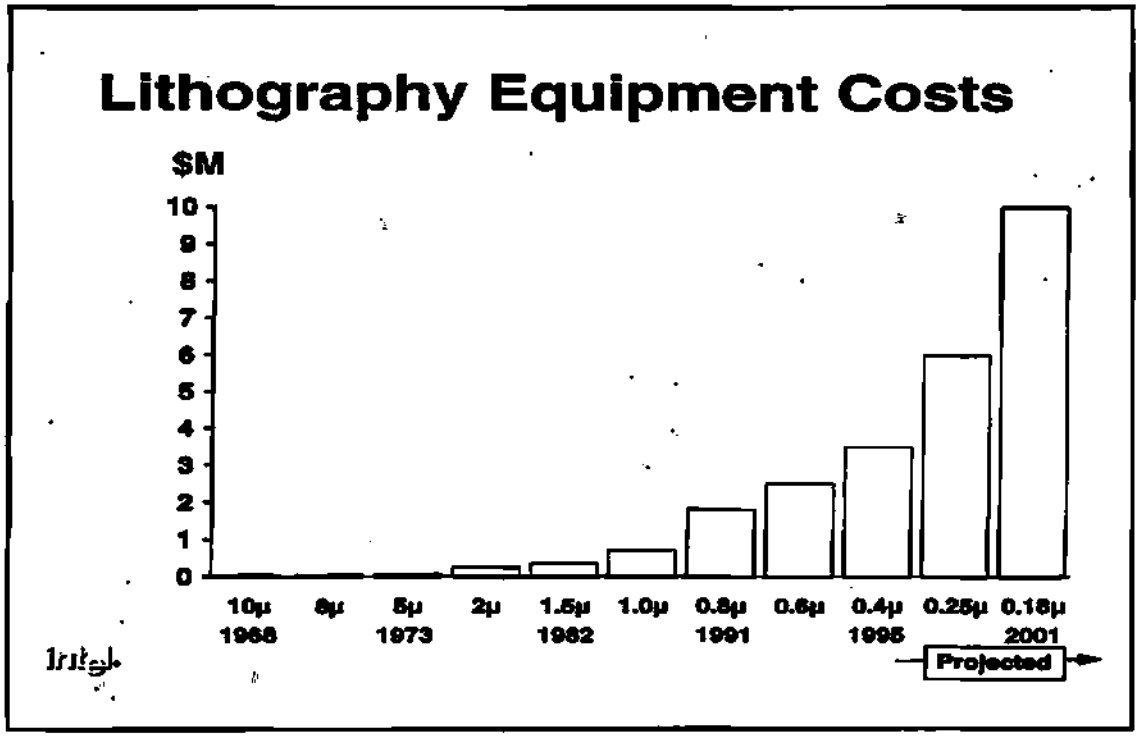


The microprocessor itself went from dual-bit to 32-bit; the frequency went from 1 megahertz to 200 megahertz; and the transistor count went from 2000 to 5.5 million. Yet, 25 years ago, that die which was the 4004 die was the most complex logic circuit anybody had ever done. Today the perspective with the Pentium Pro Processor is on the same scale, to give you an impression to scale of what one industry has done in that period of time.

We were also very proud then that we were one of the first companies to switch to producing the two-inch wafers. Those 2-inch wafers, by comparison to the 8-inch wafers that we manufacture today, on which products for our company are built, also represents an enormous amount of infrastructure change. Every single time we change the diameter of the silicon wafer that we do, we have to tear our factories apart and we have to repopulate them with completely new equipment. So this, from 2-inch to 8-inch, went through a number of steps and each of those steps are essentially the destruction and the rebuilding of our factory infrastructures.

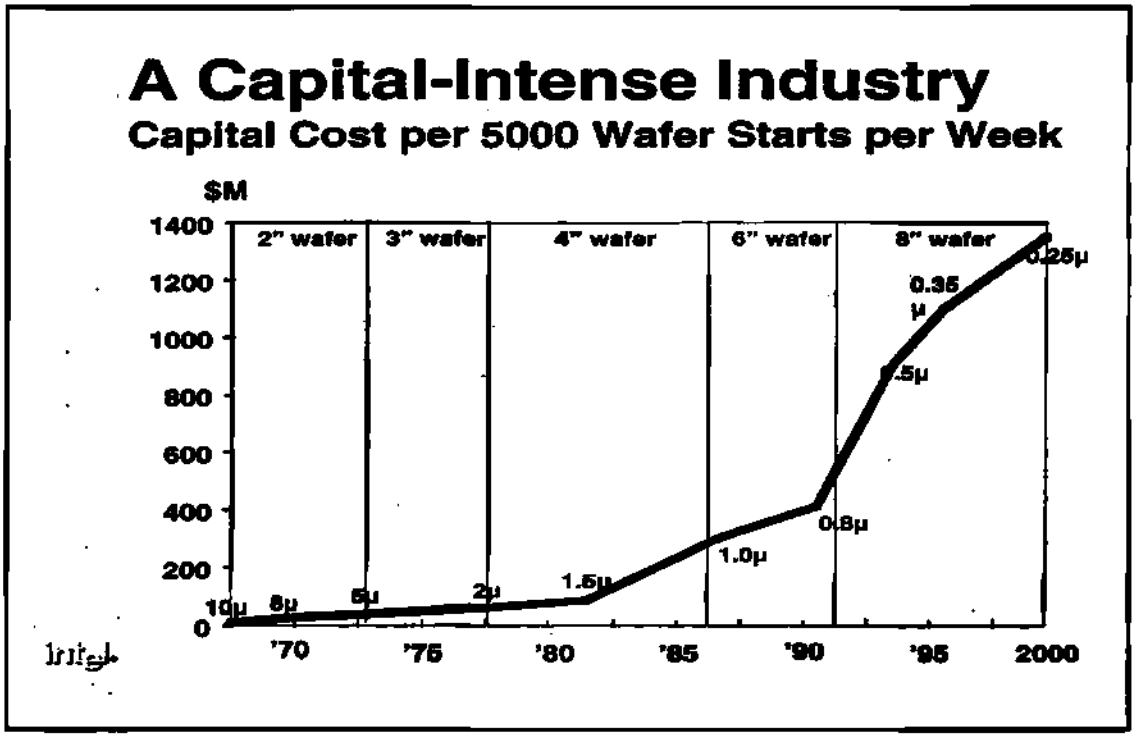
Speaking of factories, the first of them was built in Livermore, California. It was a 35,000 square foot building. About 10,000 of that was glue. It was a very large fab area by the standards of the day. Today, you'll see our current fab area that we are in the middle of starting up. Its clean room is 160,000 square feet. Everything kind of grows by order of magnitude change here. Unfortunately, the thing that grows by more than an order of magnitude is how much this factory is costing. This factory is $1.5 billion to build and equip. The original Livermore factory cost less than $3 million.

If you wonder what that money goes into, one glimpse of it you see when you take a look at the inside of the fab area 25 years ago and now and you can either notice the fashion of the day 25 years ago and what the picture doesn't tell is how hard we had to work to persuade the people to wear those mini-smocks. Maybe we had to keep the make-up from falling too far on the work tables. This has obviously changed.



The most important thing that has changed inside those factories is the equipment. The equipment cost is a pretty good representation of the equipment

complexity. We can't even do this to scale; I would have to do it on a semi-lot lot. But the first piece of lithography that we started, the factory was still producing the equipment for about $2,500 apiece. The equipment that we are putting into the new factory is in the $5-$10 million range per piece of equipment.



Consequently, when you aggregate those and look at the capital costs of the entire industry, it is skyrocketing. You'll notice incidentally in the '90s, broke the slope of that curve and represented more rapid increase in capital intensity. The fortunate part that goes with this is, interestingly, the economics of the industry have gotten better in the '90s than it's ever been. Not just Intel's but the entire industry. Because we've broken through a new period of high-yield, reliable, dependable production levels. Consequently, this environment, both in terms of manufacturing and in yields and production capabilities have permitted us to scale the industry to environ, while at the same time introducing more and more complex problems.

Perhaps the best way to sum this period of 25 years up by looking at microprocessors on the Moore's Law chart that predicts a doubling of density

every 18 months or so. You'll notice there is a straight line, constant rate of progression from the 4004 going through all the generations of microprocessors to the Pentium Pro Processor. As we look forward to the years ahead, there is every indication that this line will continue to remain the same straight line for as far as we can plan.

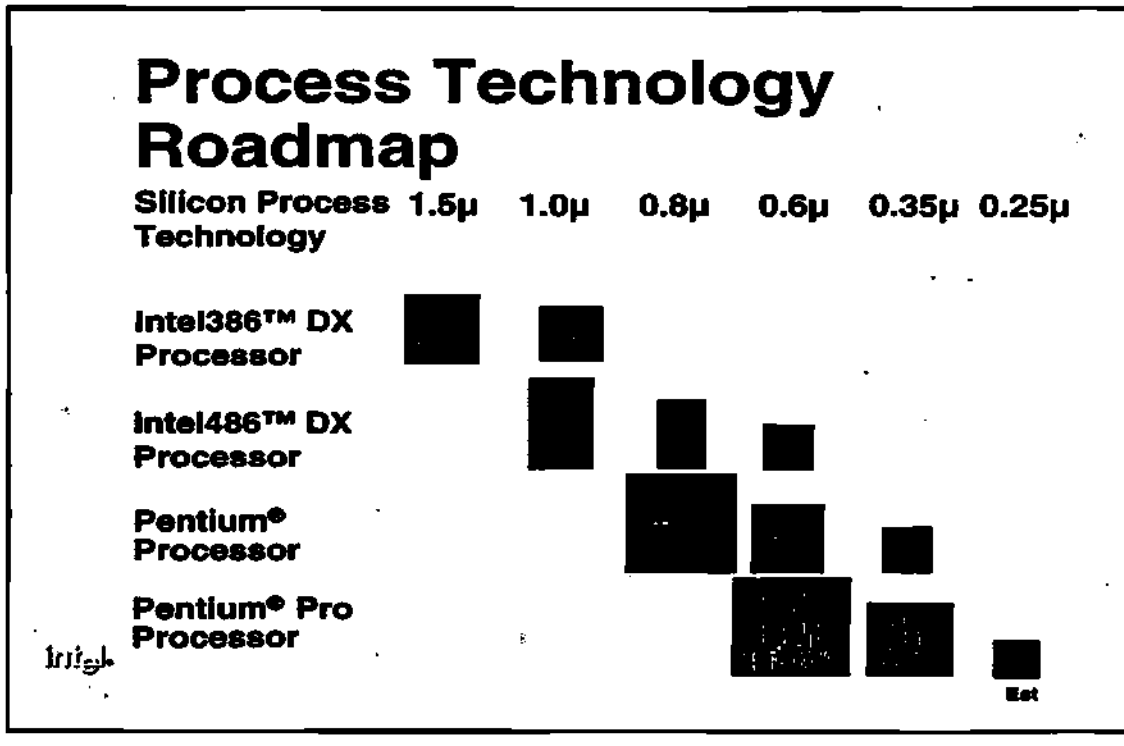
That's the retrospective of our industry. It was quite a dizzying ride and it continues to be more dizzying by the year.

The application and the appliance that made the semiconductor industry so vital in this last 10 years has been the personal computer. Consequently, I think it would be appropriate for us to think about the changes in the personal computer, both past, retrospectively and prospectively.

The personal computer was a major evolution from that original little desktop calculator. In the 10 years that transpired from the introduction of the microprocessor to the introduction of the first personal computer, very much has changed in our industry and very much has changed in our buying industry. Companies came and companies went and 1981 saw the entry of IBM into the personal computer industry.

Incidentally, remember I started you on our 1971 annual report. In 1981, we had clearly realized that our future was very closely tied to the progress of microprocessors and we didn't realize how true it was in 1981. We described ourselves as focusing on microprocessors in terms of our core competence and core capabilities.

By the middle '80s, we went out of our way to describe ourselves as a microcomputer company. It had become the exclusive centerpiece of all of our technical work and all of our marketing work.



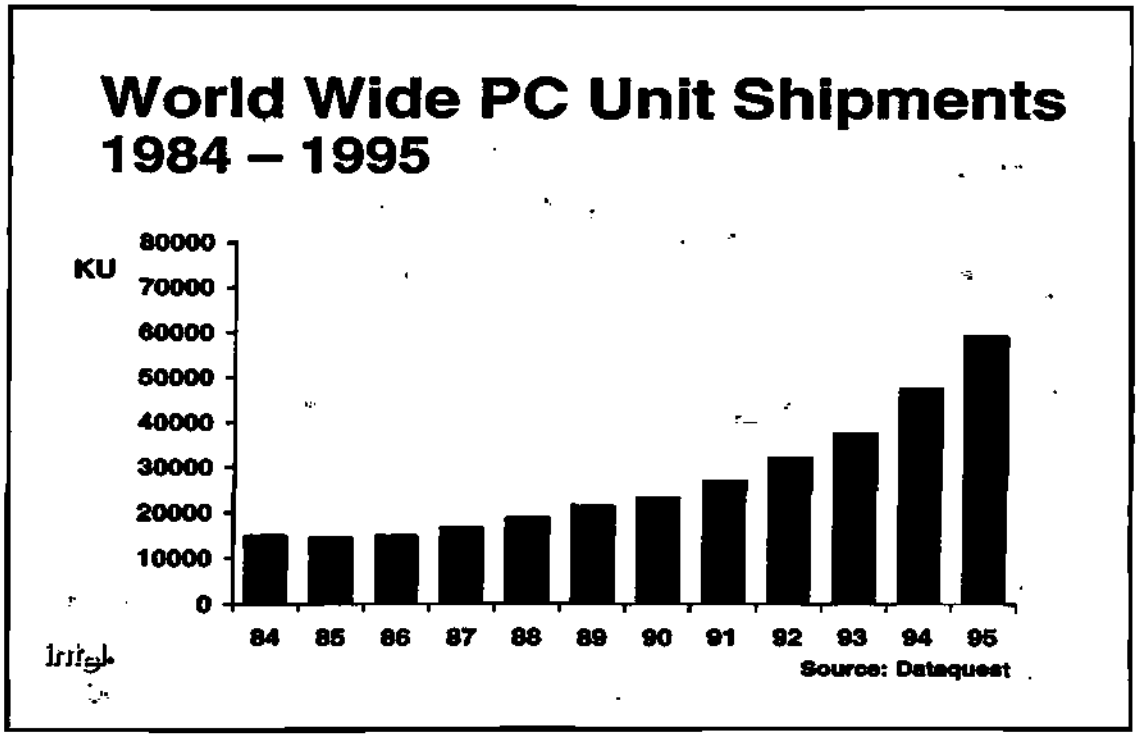
The story of the latter '80s is described by this microprocessor and technology roadmap. This is the soul of Intel, this slide, so I'm going to have to slow down a little bit and try to explain this. When you look horizontally, what you see is how we operate. We introduced the 386, originally in this case we introduced it with 1.5 micron technology. That dimension described the minimum feature size on the chips.

No sooner do we introduce that product, or even at the time when we introduced this product, we had another team working on the next generation of 386 on a tighter, higher-density technology, in this case the 1 micron technology.

The one that tends to go to peak production is the latter design, the latter density, the latter strength, the different ways that went into that second design. That design is also a basis for the introduction of the next generation of microprocessors, in this case the 486. The 486 gets introduced and the first generation gets ramped into production of the third generation and by this time we have decided that we are putting two more generations of 486 into production, each with a finer silicon geometry.

As that unfolds, we take the second one of those and using that technology, we introduce the next generation of microprocessor, the Pentium processor. Then the cycle repeats again. This is the engine of our industry, what you are seeing up here. The introduction of a new product, the ramping of a new product, simultaneously using the design and marketing the momentum of that new product to usher in a new technology, which in turn speeds up that product. Because the finer geometry's represent high performance and simultaneously reduces its cost because the finer geometry's represent more chips on a wafer and higher yield.

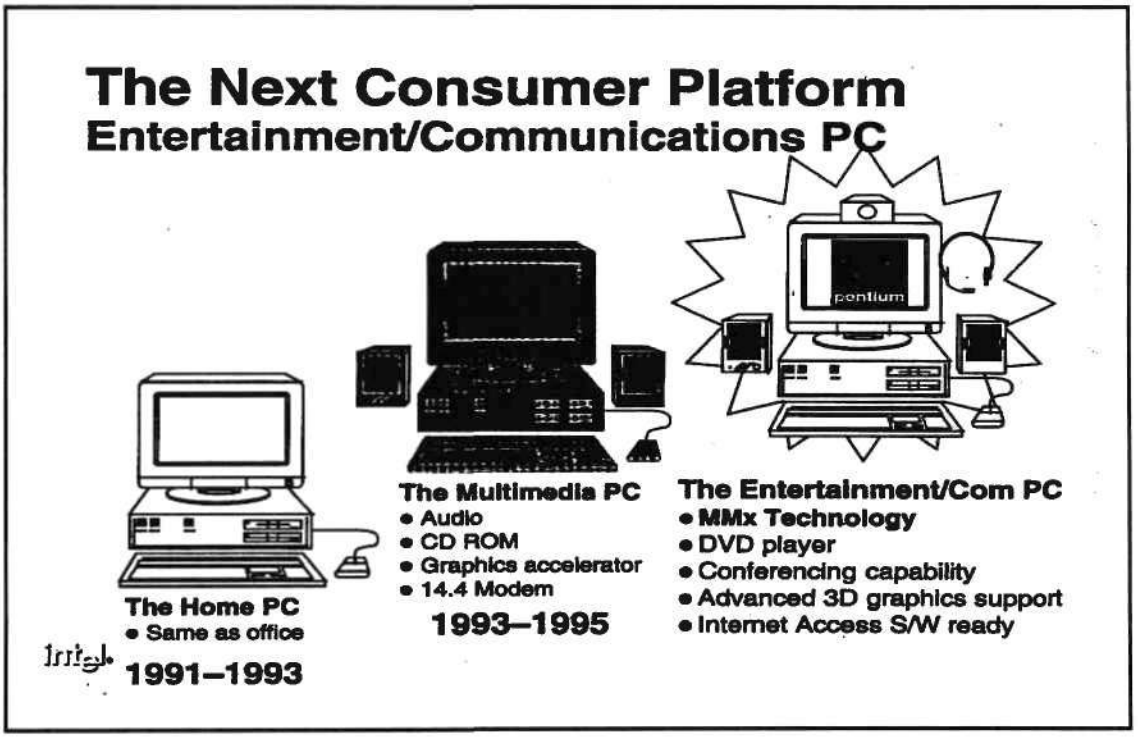
This process, relentlessly repeated over and over, is what has given us the economic basis for the mass-produced personal computer, in a very unusual in terms of industrial development, very unusual phenomenon, where cost reduction and high performance have gone hand in hand. This is the vitality that has created this industry that Gene referred to earlier as being one of the most vital industries in our lifetimes. That's the personal computer.



Here I'm going to switch to borrowing some slides out of Martin Reynolds' presentation. Unless he changes it since I've come and borrowed them. Consequently, we see an enormous growth industry. A growth industry that in a period of about 15 years has gone from nothing and caught up with a $40-something-a-year industry, the television industry. Sometime in the vicinity of '97, PC annual production rates are likely to cross over black-and-white and color television production rates.

The gross rate through its first 10 years exceeded that of practically any information appliance -- fax machines, cellular phones and the like. It continues to grow in the high teens, corresponds to something like 17% compounded annual growth rate. Projections continue for it to continue that way and we anticipate that we will cross the 100 million unit annual rate before we cross into the new decade.

That is the unit drawing of the personal computer. The personal computer is kind of like a river, it keeps flowing down. But at any given moment, it is different than the river that you had at that point before. The units that we shipped in '85 are different than the units that we shipped in '81. The units that we shipped in '90 are different than in '85 and so forth.



The rough classifications of the personal computers in the history of the personal computer in terms of capabilities are as follows:

The first generation of personal computer products were basically office replacement, terminal replacement products. The character of these largely optimized as smart terminal would require. The home personal computer was basically that personal computer taken home. There was no substantial difference between the home PC and the office PC.

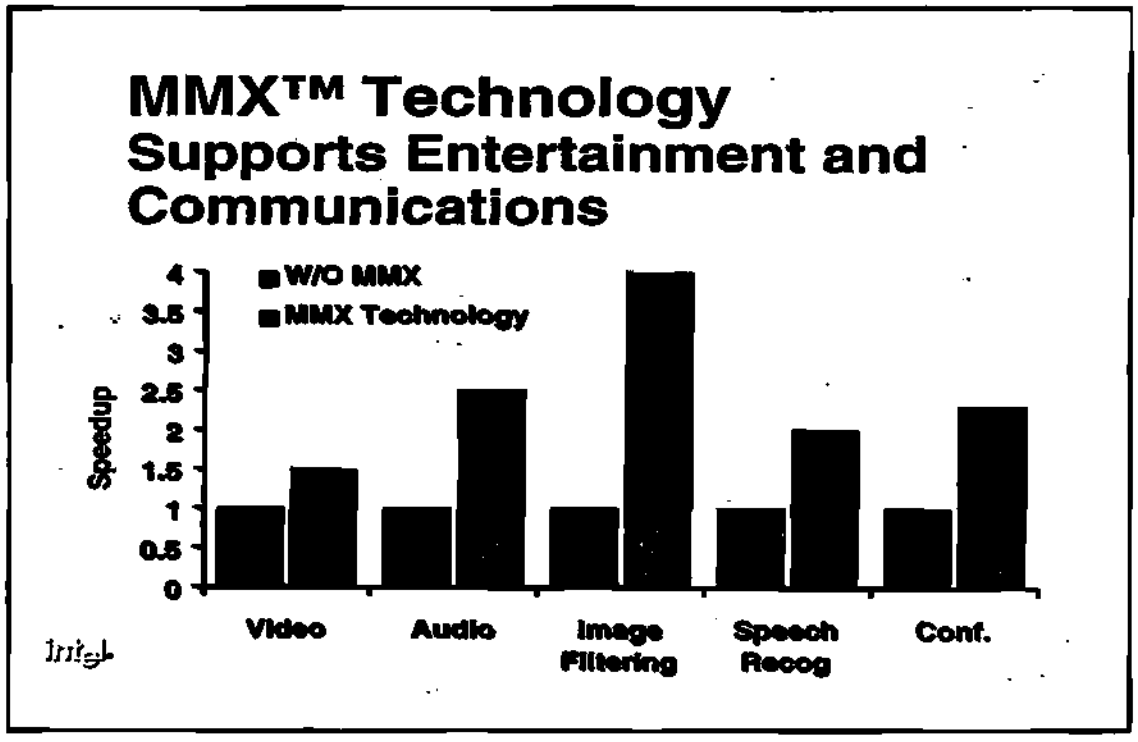
By the early '90s, the Multimedia PC came in. The PC was fundamentally re-engineered from the bottom up, via its architecture into the box structure into how the video and audio capabilities are handled. The kind of storage it can deal with --namely, CD-ROMs -- have all been re-engineered to provide an experience that contains color graphics, sound, video and the interactivity that goes from switching from one data file back to another without ever getting out of your applications or getting into any kind of command instructions.

What we are as an industry in the middle of unveiling or transitioning into is the third generation of the implementing of the next consumer platform, which in the absence of anything crisper I will call the Entertainment/Communications PC. This PC is going to clearly have high-performance microprocessors and consequently it will be able to deal with much more powerful storage media, like Digital Video Disc. It is going to have the ability to handle real-time multimedia communications, or RMC. I'm going to use that phrase probably a few more times in the course of this speech.

Video and data conferencing is probably the most obvious example of a real-time multimedia communications capability in this generation of personal computers that the industry will produce. We'll have these kinds of capability built in as a matter of routine, the same way as multimedia capabilities are built into these PCs.

Equally importantly, not only will these be graphically-capable PCs, they will be capable with 3D graphics and more about the 3D graphics and what that means in a minute.

Intel's key contribution to this entertainment/communications PC is modifying the microprocessor architecture to be more suited for the tasks that are implicit in this type of a personal computer.



In the latter part of this year, we will be unveiling this modification in the form of a multimedia extension to our microprocessors called MMX technology, "MMX" standing for multimedia extension.

What this does is two things simultaneously: First of all, it modifies the basic instruction set architecture of the basic Pentium microprocessor and later also the Pentium Pro microprocessor, in a fashion that's analogous to how the instruction set architecture was modified when we went from the 286 to the 386, or from the 486 to the Pentium Processor. This instruction set will be particularly optimized for multimedia applications, visualization applications and communications and Internet-related applications.

Just to give you an example of what this does, by looking at the variety of means of measuring the speed-up capabilities for different types of functions like filtering or video, you see that MMX technology gives anywhere from 20%, 30%, 40% or higher percentage improvement on those instructions, which by and large corresponds to a generational change in microprocessors. So it's quite a significant change.

All those factories that we are building in place, this is a larger chip. Not a whole lot larger chip but it's a larger chip. It does require extra manufacturing capacity. We are putting that manufacturing capacity in place and we are planning the fastest conversion across our microprocessor line that we have ever done. Our plans call for a transition to this MMX technology instruction set over the period of time '97-'98, basically completing it within an 18-months to 2-year period of time.

The implication of all of this is we are going to put across the board of this very large and growing industry the capabilities for these RMC class of applications. But it is only one of the several factors and forces arriving at the same place.

The other one that I think is going to be very important to tap the power of this microprocessor and really provide a user experience beyond anything that we have encountered today will be Digital Video Disc (DVD). That even as we have spent many years working on microprocessors and building factories for that, a number of companies have been spending enormous efforts, multi-hundred million dollars of development over the years, to bring out a technology that can bring practically an order of magnitude improvement in the storage capability over the higher, highest-density storage capability of today, which is CD-ROMs.

In addition to that, also 100% improvement in transfer rate where the data can come from the CD-ROM to the computer -- coupled with the high-performance microprocessor, high-performance particularly for these purposes -- will give us really a dynamite platform for these type of applications. The demand that we foresee that is going to come is the increasing drive for computing to be visually based.

Visualization, it's kind of almost like "globalization" -- it's about as specific and as meaningful. So let me try to give you a particular definition of what I mean when I talk about visualization. Visualization, to me, means a user interacting with a realistic graphical representation.

Realism in graphics comes in imbuing the visual image that you see on your two-dimensional screen with two characteristics: Rendering the physical object to appear to be three-dimensional and the word "rendering" is actually the operative word here. Secondly, giving them perspective that corresponds to a three-dimensional pace. Like I look at you today and I see a three-dimensional whole

and I can see perspectives, I can see distances because of the way these represent to me.

Capturing that and turning this onto the screen is bringing three-dimension to the point of view of the user. It means something different than rendering the objects three-dimensional.

What we are talking about is doing both movements toward 3D, both in terms of the objects that you see and also in terms of the spatial representation. Permitting the user to interact with this doubly three-dimensional world, basically by user control -- by a mouse or a joy stick or some kind of a pointing device.

What this requires in computing terms is re-computing very compute-intensive objects in a very compute-intensive space, at a rate that is as fast as the user makes the movements. This is a very compute-intensive shift. Of course, compute-intensive is what we do for a living and it is exactly the prevalence of the desire for users to bring this kind of experience to their home PCs that is going to soak up the capabilities that the industry brings, from DVD to MMX technology combined.

Then what we are going to do is make these applications communications-enabled and communications-rich, such that this experience can be shared between multiple users, either pairs or in multiples of users and this is where the real-time and the communications parts of the RMC -- the "R" and the "C" -- come in.

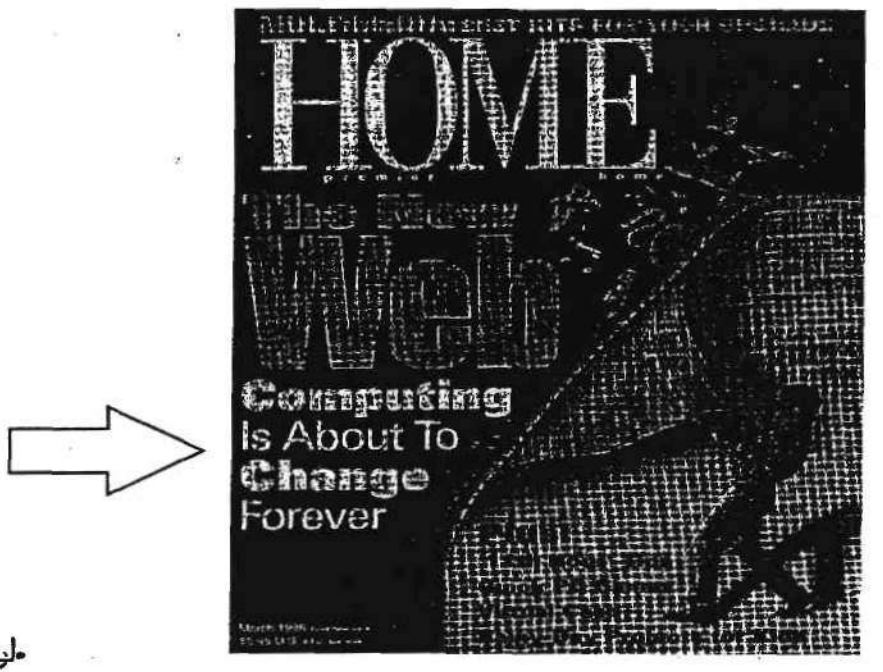
What you will see is MMX technology will be very helpful in that because not only does it improve the computation capability of what you see on the screen but it improves the capability of shipping those masses of data, compressing them and shipping them on the available bandwidth to another computer.

The first implementation that you are likely to see is low-cost and therefore completely ubiquitous digital simultaneous voice and data modem. That's what DSVD stands for. That's available today but it is basically a high-end item because it's very expensive. By bringing MMX technology into the processor, we can reduce the cost of what you need to implement this digital simultaneous voice and data function and deliver the communicating aspect broadly basically to all personal computers in relatively short order.

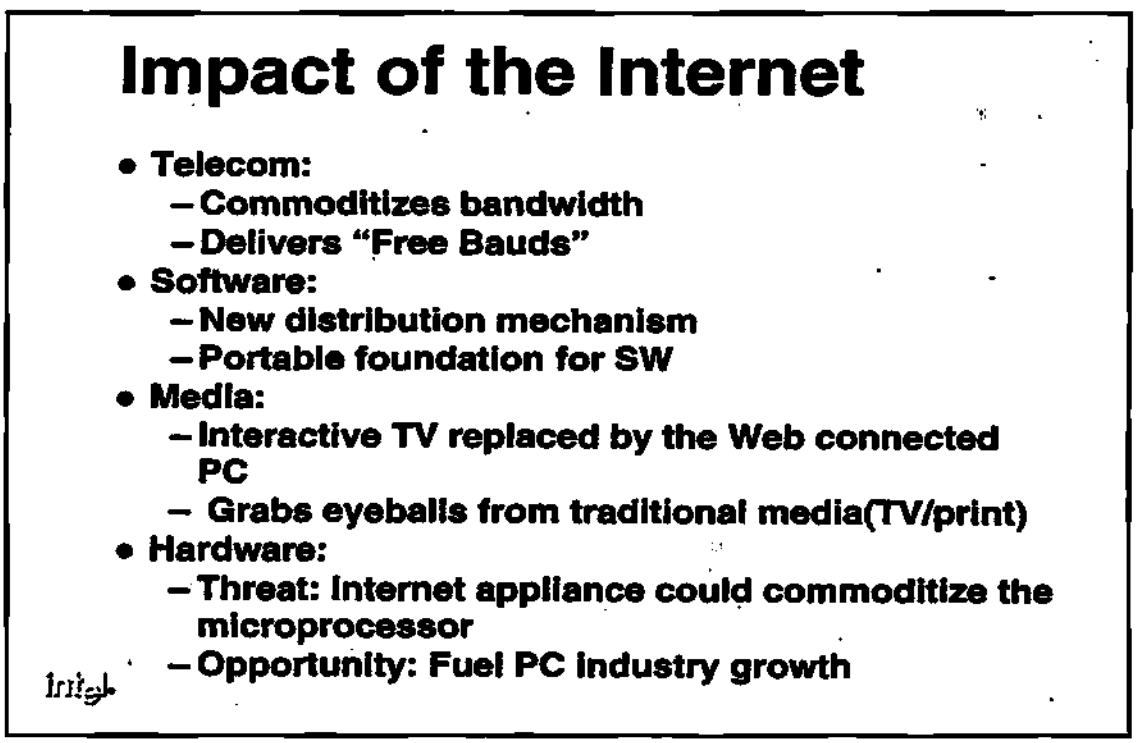
After that, a key driver will be to position all of these RMC capabilities to apply and operate over the Internet-style IP networks that are as ubiquitous as personal computers and promise to stay with the personal computers as their fundamental communications means.

What I'm trying to paint a picture of is, with visualization and communications becoming mandatory driving forces of the personal computing phenomenon, MMX technology that we bring to bear will be able to enhance the PCs, that they will provide the best platform both for "on the Net" and "off the Net" applications.

Because of this enhancement and because of the repositioning of that third class of personal computers I'm talking about, we are going to be able to serve a larger industry surrounding us. We, the personal computing industry, will be able to serve a larger set of industries surrounding us than before. That's the last thing that I want to touch on.



You're all aware of this and the way this comes in random articles. Forest after forest is being destroyed to extol the virtues of this new world. Covers like this stare at you from every airport and every in-basket. It's kind of hard to find a balance because there's a lot of hype; but there is enormous amount of reality, in my opinion, behind all this hype. So I would like to spend the last few minutes talking about what I see -- the impact of the Internet on a number of industries.



For starters, I want to talk about the telecommunications industry, where the Internet's impact is the most obvious. The Internet and the technology implicit in the Internet does two things: It stretches the capabilities of the existing infrastructures. The existing infrastructure is simply capable of handling more information for whatever infrastructure already exists or can be enhanced for any given sum of money than the older means of communications.

The consequence of this is it renders more and more of the communications service and infrastructure industry into a very indistinguishable commodity-like capability and renders them consequently into a price competition that they have never seen before. Whether this is good news for the telecommunications

industry or not remains to be seen but it is going to be a change for them because it also represents a lot more traffic, a lot more applications.

But from the standpoint of the personal computing industry, the low-cost ubiquitous bandwidth that I believe holds "free baud's" and prayed for the last several years, is really going to come to us, certainly in the form of packet-switched TCP/IP network; i.e., the Internet.

The Internet will also impact the software industry in a very substantial fashion. The impact comes in two ways: First of all, it represents a brand new platform to which people can write software in a way that's different than how software has been written in the past. Software has been written basically by the operating system representing the platform. The application software can now be generated directly onto the Internet infrastructure and the appliances on the Internet, bypassing to a fair extent the operating systems that are on there.

A more important characteristic is that software is a bunch of bits. The Internet is a medium for transporting a commodity in a very inexpensive fashion, bits from one place to the other. Therefore, the Internet will become an irresistibly attractive distribution mechanism for software, for big software, for little software, for data and for what is today called, archaically enough, packaged software. Because it will no longer need to be packaged.

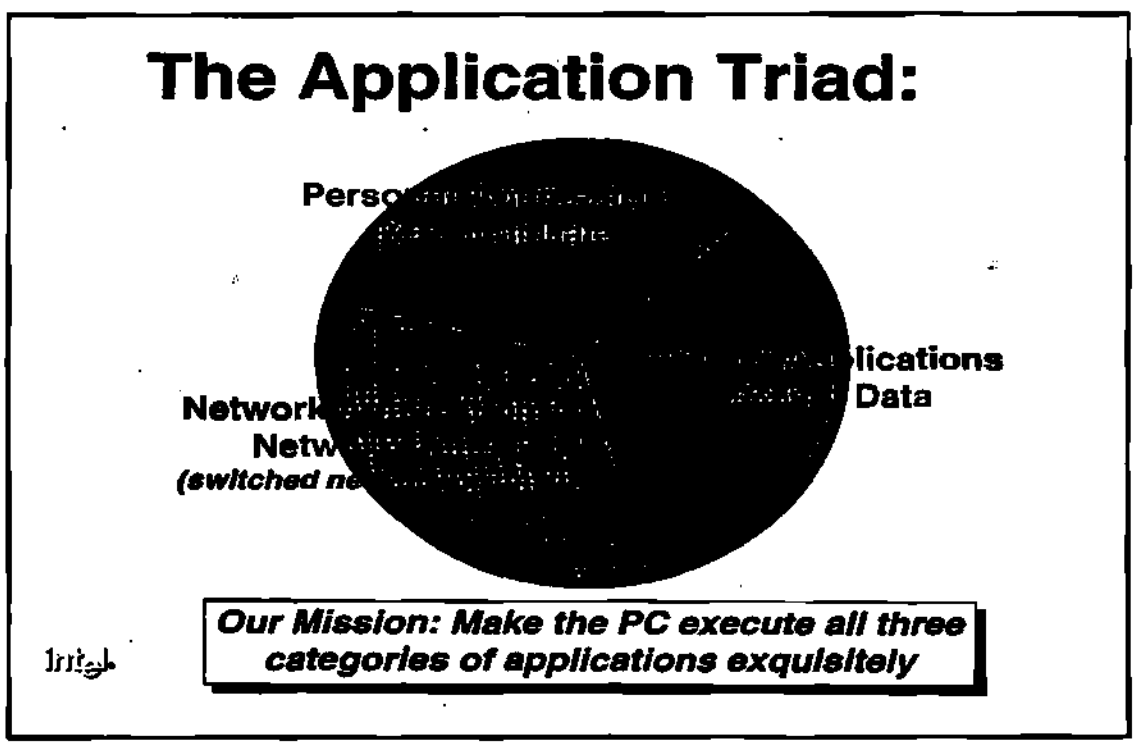
It was big news 10 years ago when software appeared on shelves as packages. It will be equally big news when software no longer will need to be put on shelves but can appear on your computer, almost by magic, through the wire. Clearly, this will have an impact on the software industry and even more clearly, it will have an impact on the industry that makes its living distributing software.

The media industry: I'm going to talk about a separate item in a minute. It is going to be, just by way of introduction, what people used to think of and fantasize about as the interactive TV industry. The industry of Web-connected personal computers will replace that space and consequently this industry will be capable of grabbing eyeballs, grabbing customers, from the traditional media industry. But let me hold that for a moment because I'll come back to it in a minute.

Lastly, in terms of the hardware industry, the Internet appliance clearly represents a potential substitute for personal computers, or a complement for personal

computers, depending on how this mixture will come out. It will either eat into the growth of the personal computer hardware industry or catalyze the growth of the personal computer industry. Of course that is all in the future.

Let me provide you with some arguments of what I think we need to contemplate as we ponder the impact of the Internet on several of these segments; all except the telecom part, all of the other three.



Personal computer applications will come in the form of what I call an application triad. Personal computers, as you remember, started out as personal computers. The only data and the only software they operated with was what comes on the top of the circle: Personal applications operating on personal data.

In the decade of the 1980s, particularly from the mid-1980s to the current date, a big driving force -- largely in corporate applications, office applications but also in the consumer place -- was the fact that computers could be connected to other computers. This largely came through proprietary networks, private networks, or local area networks, or corporate wide area networks. But an enormous portion

of today's corporate personal computer use comes on private network or switched-network-provided applications and data. That's the second portion of this triad.

What we are seeing now is the evolution and the development of a third portion of the application and data space, which is the applications and data provided by public Internet-based applications.

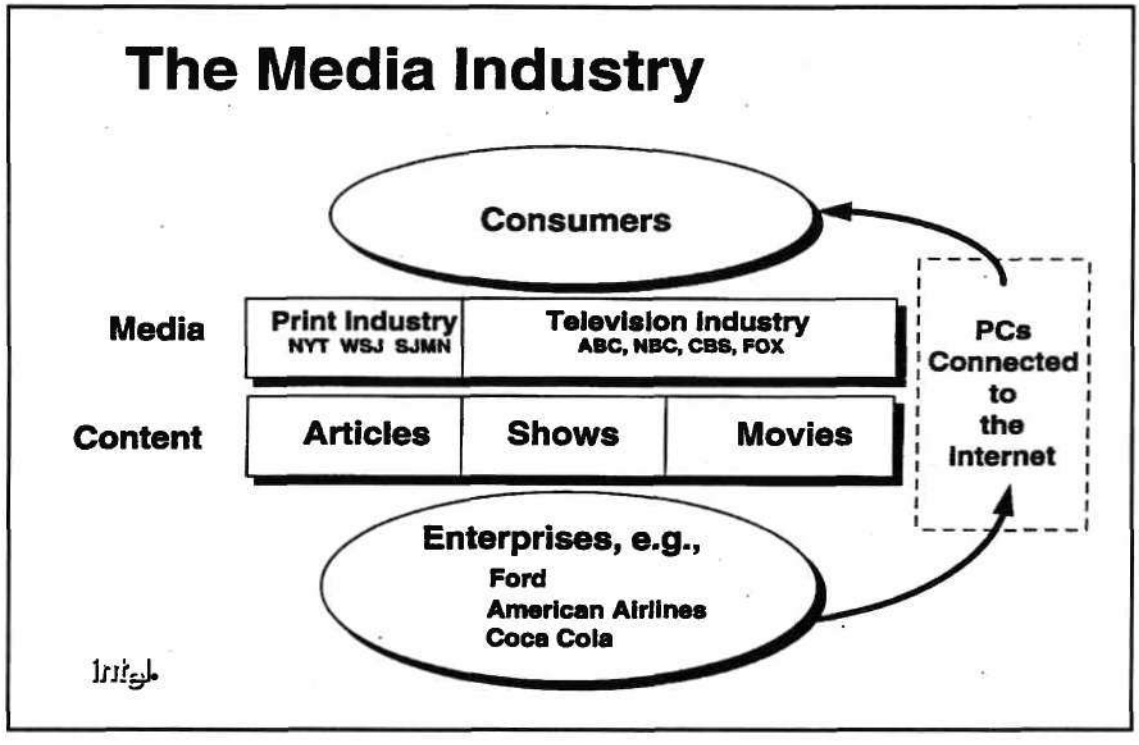
The consideration that I would like to leave you with is: A personal computer is what it is today because it has been able to evolve from the personal use to the personal plus private network use, from the personal and private network use of personal private networks and Internet-based use.

All these applications have to be available at the click of a mouse in front of your nose at any given time on demand; and furthermore, you have to be able to switch back and forth between those applications and move data back and forth between those applications, or else you render yourself into a very limited application existence.

Consequently, what I see happening, this triad nature of the industry is going to have the impact on the software industry that's based on this hybrid nature of these applications. Complex content, for instance, could be delivered in storage media like CDs, floppy discs or DVDs (digital video discs).

The interactive components could come in whichever network is more suitable or more readily available and these will be eclectic always because I don't believe that the world is going to be leaping to have a uniform network available over any period of time. Furthermore, the software can be delivered and updated readily through the connected piece, even if it was originally delivered on a storage-based inserted basis.

The applications themselves will take advantage of the fact that both switched-network and IP networks will be available at any given time. Some applications clearly operate better on a switched point-to-point network. Some applications operate better and more economically on the IP network. The ability to mix these out of the same connectivity device and the same physical network infrastructure is going to lead to very exciting applications that take advantage of exactly this hybrid characteristic that is possible.



I said a minute ago that I want to talk about the media industry and the impact of it and I think this is very significant. What I've described -- which is Web-connected computers, very highly media-rich, enabled with the technology of MMX and high-density discs, connected through TCP/IP networks at variable costs, variable density, to any number of other computers -- will give rise to a potentially new branch, a very exciting branch of the media industry.

What is the media industry specifically before all of these phenomena hit it? I like to sketch this picture, kind of a model for the media industry as we know it today. The driving force of the media industry is the money coming from the basic enterprises, the clients of the media industry, people like Coca Cola or General Motors or Intel or Microsoft or IBM or whoever but people who spend lots of money advertising their products.

What we are after is the eyeballs of consumers that are on the top of this chart. Consumers like you and me and our friends and millions of people. We pay on account of how many eyeballs we can reach. In between us (enterprises) and us

(consumers) -- because we are both, as individuals -- we have two layers of the industry:

The media industry that are involved with grabbing the eyeballs and making them available for our messages. The way they do that in the media industry is engage the content-producing industry, whether the content is the latest and most attractive soap opera, or better news magazines that cater to a particular niche audience, or magazines that cater to a large broad-end audience. The media industry horizontally competes with each other. All of this to give us the largest number of consumers that are available for us to communicate with and bring them messages about products.

What this new phenomenon of Web-connected computers brings is a shunt, is a by-pass. It permits us enterprises to reach consumers through a brand new and completely independent capability that has content of its own, has a distribution mechanism that's clearly and uniquely different than what we had and it reaches the same consumers at the end of this process as the old media industry did.

Now to consider this, the blue (enterprise) universe spends approximately $350 billion a year. That is what the enterprises spend on everything that's above them. That is more than the total amount of money spent on communications and computing in the world combined. It's a very large sum of money. If we can even make a marginal penetration into that, a 10% penetration, it would bring an infusion of spending to our industry that would be the largest single infusion, measured as a fraction of the spending that goes into it in a very significant fashion, enough to lift us. By the way, enough to give pause to the purveyors of the old media industry in terms of lost opportunity and lost business.

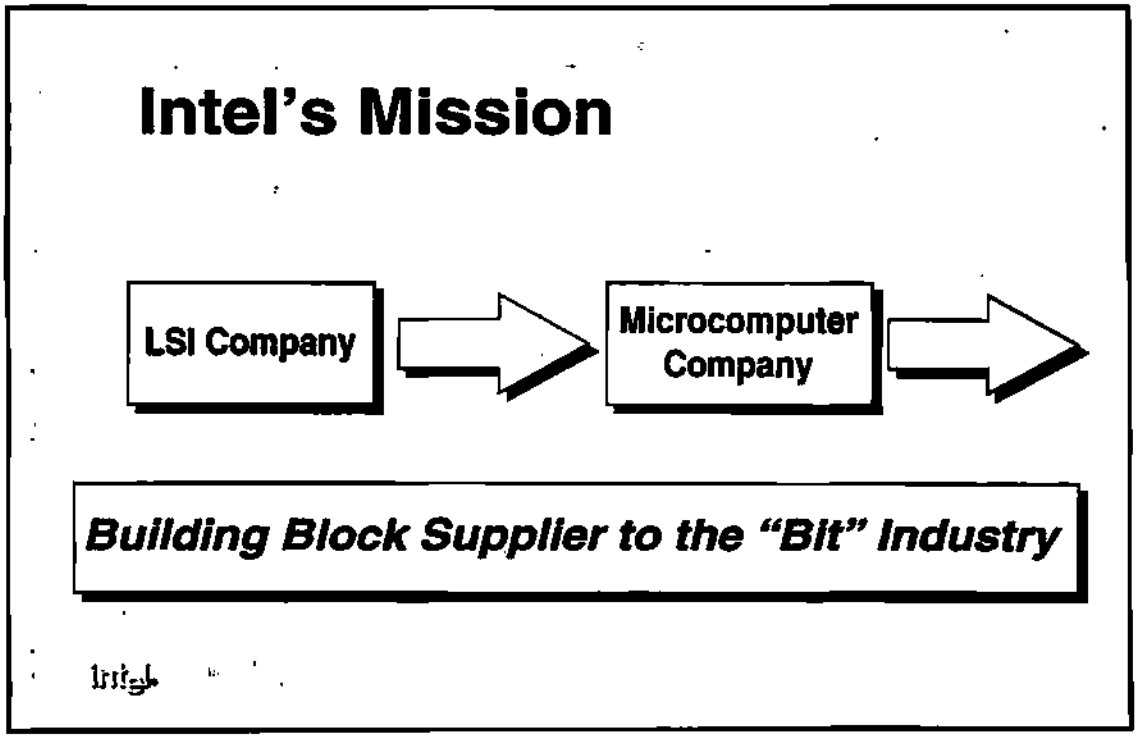
This is a very interesting phenomenon. This is the first time -- no, it's the second time we break out of our customary ways. Because the first time, all of our industry basically was formed and evolved to chase after office workers. Then in the late 1980s, early 1990s, we discovered the home user and the home segment. We are now in a similar and potentially even bigger development with a bigger reach, reaching after a population whose economics and whose service economically is a completely different industry. Nothing energizes our industry more than the potential of going after a very large market unserved by us.

The bottom line of all of this is I think we are seeing the possibility of our target market changing. Intel's target market used to be, in LSI days, the computer

industry. In microprocessor days, we've defined it to be the computing industry because we serve market segments that have nothing to do with computers. We were serving computer users.

Then we modified them to include computers and communications. This is in terms of stating our corporate mission. We find ourselves at the threshold of having to rethink who we are serving and expanding this from computing and communications to include the members and the audiences of this new media industry.

All of this industry is common in terms of the raw material that they work with, which are digital information, bits. They produce bits, they store bits, they ship bits and they use bits to deploy commercial messages with. In order to deploy commercial messages, they have to deploy other kind of attractive content with which to attract the audience for those commercial messages. It's all about bits. The digitalization that people have been talking about in our industry is in fact here and it is in fact about to create a revolution in the media industry. That revolution, like most revolutions, has winners and losers; and I think our industry, the industry that lives in the world of bits, is about to benefit from it.



Going back home, talking about Intel, we have two roles in this: Our role is to continue to provide higher and higher performance microprocessors at mass-production volumes, or mass-production cost effectiveness. And to provide RMC components. Thank you.

Questions and Answers:

Question: One of the advances that Intel has provided is an incredible supply of microprocessing power in the industry. There's also an incredible supply of storage capacity. But there is really a lack of communications bandwidth. You talked about free bauds in the future. How do you think that will come about?

Answer: It will come about basically through the evolution that we are seeing of the Internet infrastructure. People have no choice but to upgrade their part of the infrastructure in order to participate in the total Internet opportunity. The beauty of this is that not one company is charged with deploying the entire point-to-point infrastructure. Intel builds their own internal infrastructure, strengthens it, puts routers and switches and gateways and stuff like that in there. There's a big LAN there that's getting more and more robust. We want to reach out and talk to other LANs. We have done our part; the other company has done their part.

In between, the telecommunications providers have a lot of unused capability and they are adding more and more unused capabilities -- T1 lines, T3 lines and the like. All we need to do is connect to those. It is a little bit like -- I have kind of not-very-precise phrase -- it's a co-op, in which everybody does a certain part of the work and the total gets done that way. Everybody does their own work because they have to anyway.

It is very different than the concept involved in putting a broadband network in place that would bring fiber to the home, etc., where people would have to spend many tens, possibly hundreds of millions of dollars before they could reach a sufficiency of customer base to get the revenue base back.

We are doing the things that we described just as a matter of ordinary business. We are building our LANs; we are not waiting for any of these applications. We are doing them just to ship around all kinds of stuff inside a company; we are adding routers, we are adding switches, the telecommunications company is adding T1 lines and T3 capacity and microwave capacity and the like anyway.

The revenue and the traffic is taking place in real time. So it's incrementally improved by the combined investments of all the participants. It's a much more realistic thing than this brand-new infinite capacity somehow deployed over the next "x" years from house to house.

Question: Historically, Intel has maintained a "compatibility", a backward compatibility with the x86 processor. You talked about the MMX architecture. Is that going to maintain compatibility with that, or is it completely new architecture?

Answer: What we have done over this period of time -- not all of the 25 years but certainly since the early 1980s -- is very rigidly maintain compatibility from generation to generation, while at the same time introducing improvements in our instructions as architecturists. Quite clearly, the architecture of the Pentium Pro is not the same as the architecture of the 286 was; it is capable of doing far more things and capable of doing them far better. But software that was developed for the 286 will run in a comparably-improved fashion today on the Pentium Pro as it did through all the other generations in between.

This is the design philosophy that we are devoted to, to maintain inter-generational compatibility forever, while at the same time figure out ways of introducing the evolution's and discoveries of computer science to improve the architectural subject to that framework. We intend to stay with that.

Question: How does your MMX technology differ from the NSP, which is your Native Signal Processor?

Answer: Native Signal Processor is not a technology, it's a concept. It's a concept that every system has a microprocessor. Once you have that microprocessor, you can develop the system in such a way that the microprocessor, particularly if it's powerful enough, can do the signal processing functions that are increasingly necessary in multimedia and particularly real-time multimedia communications applications and the platform. That is the concept.

To implement the concept, you need higher performance microprocessors and you need decent pieces of software that bring those capabilities to the microprocessor. MMX technology is an improvement of the microprocessor along that vector, exactly along the multimedia communications vector, so it will

lend itself even more effectively to do the task of native microprocessor-based signal processing consistently.

Question: Can you expand upon your belief as to why the PC would be a better option than the network appliance that costs $500? Or do you think that Intel, to cover its bases, should actually get into the business of making processors for those network appliances?

Answer: If I understood your question, it has to do with the relationship between PCs and network appliances. The way I look at this is, the tasks that I described today -- if you buy into what I described, which is that applications that will come in that applications triad will require intermixing and hybrid delivery of rich experience, visual computing, communications and multimedia all combined. It does require a high-performance processor; it does require a high-performance personal computing platform with appropriate buses and graphics implementation and it does require high-performance and high-density storage medium. I've just described the personal computer of the future.

Now, that is not at all the only application that is possible on the horizon. It is quite possible that, given all the ubiquity of TCP/IP networks, there will be implements that are more the moral equivalents of a telephone that will develop, that will be very simple, very low-cost and capable of a simple set of applications that are based only on what data you can get on the future phone lines, which is going to be a TCP/IP connection and the application that comes down on that line.

If such an application can be done economically, I see this more as an upscaling of a telephone than the dumbing down of the personal computer. The more one can rely on the ubiquity and the reliability of TCP/IP networks, the more there is a case that can be made for a device like that. But quite frankly, the cost of that device has to be compared with the cost of a telephone, it cannot even be $500. I don't think you will replace the telephone with a $500 instrument. It is going to have to be substantially less expensive than that.

So there may be devices like this in the future and I hope there will be. If they are, we certainly intend to market capabilities to the makers of those devices.

Thank you very much.

This page is intentionally left blank

4

486,, 2-8, 2-12

A

Australia,, 1-12, 1-14

B

bandwidth,, 2-14, 2-17, 2-24
benchmark,, 1-8
broadband,, 2-24
bus,, 2-26
business strategy,, 1-2

C

Canada,, 1-8, 1-12, 1-18, 1-21, 1-22
CD-R,, 2-11, 2-13
China,, 1-16, 1-17, 1-18, 1-19
commodity,, 2-17, 2-18
core,, 1-22, 2-7
cost,, 1-9, 1-10, 2-5, 2-9, 2-14, 2-17, 2-24, 2-26

D

desktop,, 2-7
die,, 2-4
Digital Equipment Corporation,, 2-11, 2-13
Digital Video Disk,, 2-13, 2-14
digital,, 2-14, 2-20, 2-23
distribution,, 1-17, 2-18
Dun & Bradstreet,, 1-1, 1-16

E

Eastern Europe,, 1-17
economy,, 1-1, 1-2, 1-4, 1-5, 1-6, 1-7, 1-8, 1-9, 1-10, 1-11, 1-13, 1-15, 1-16, 1-17, 1-18, 1-19, 1-20, 1-21, 1-22
enterprise computing,, 2-22
Europe,, 1-7, 1-10, 1-11, 1-12, 1-17, 1-18, 1-20
evolution,, 2-2, 2-7, 2-19, 2-24, 2-25

F

fab,, 2-5
floppy,, 2-20
France,, 1-11

G

General Motors,, 2-21
Germany,, 1-10
growth,, 1-3, 1-4, 1-5, 1-6, 1-7, 1-8, 1-9, 1-11, 1-12, 1-13, 1-14, 1-15, 1-16, 1-17, 1-18, 1-19, 1-20, 1-22, 2-10, 2-18

H

hardware,, 2-18
Hong Kong,, 1-19
hybrid,, 2-20, 2-26

I

IBM Corporation,, 2-21
infrastructure,, 2-4, 2-17, 2-18, 2-20, 2-24

J

Japan,, 1-13, 1-19

L

labor,, 1-10, 1-20
Local Area Network (LAN),, 2-19, 2-24

M

measurement,, 1-22
methodology,, 1-4, 1-22
Mexico,, 1-9, 1-17, 1-18
microprocessor,, 2-2, 2-3, 2-4, 2-7, 2-8, 2-9, 2-12, 2-13, 2-23, 2-25, 2-26
Microsoft,, 2-21
modem,, 2-14
Mooreís Law,, 2-6
multimedia,, 2-11, 2-12, 2-25, 2-26

N

NAFTA,, 1-8, 1-9, 1-17
newspapers,, 1-19
niche,, 2-22

P

partner,, 1-8, 1-9, 1-19, 1-22
PC,, 2-1, 2-9, 2-10, 2-11, 2-12, 2-16, 2-26
Pentium,, 2-2, 2-4, 2-7, 2-9, 2-12, 2-25
personal computer,, 2-1, 2-2, 2-7, 2-9, 2-10, 2-11, 2-12, 2-15, 2-18, 2-19, 2-20, 2-26
platform,, 2-11, 2-13, 2-15, 2-18, 2-25, 2-26
productivity,, 1-5, 1-21
proprietary,, 2-19

R

recession,, 1-7, 1-8, 1-11, 1-12, 1-13, 1-21
restructure,, 1-10
revolution,, 1-17, 2-23

S

SNA,, 1-22

T

Taiwan,, 1-19
telecom,, 2-18

U

United Kingdom,, 1-12
United States,, 1-2, 1-5, 1-7, 1-8, 1-9, 1-10, 1-11, 1-12, 1-13, 1-14, 1-15, 1-16, 1-17, 1-18, 1-19, 1-20, 1-21, 1-22

W

wide area networks,, 2-19
wire,, 2-18

TO ORDER:

- ADDITIONAL COPIES
- BULK REPRINTS
- ELECTRONIC VERSIONS
- COMPANY INTERNAL NETWORK SITE LICENSES
- OR TRANSMITTAL BY OTHER FORMS OR MEANS

CALL:

(800) 457-8233 OR (805) 298-3262

Dataquest Transcript Services
26524 Golden Valley Road, Ste. 401
Santa Clarita, CA 91350

RECENT TRANSCRIPTS STILL AVAILABLE:

Channel Trends: Retailers
March 7, 1996
San Jose, CA

Dataquest Predicts 1996 and Beyond
January 30, 1996
Boston, MA
February 20, 1996
Santa Clara, CA

The Wireless Phenomenon
January 24, 1996
San Jose

Mobile PC Technology Forum
Technological Shifts in Mobile Pcs
December 7, 1995
San Jose, CA

Channel Trends: Corporate Resellers
October 25, 1995
San Jose, CA

Semiconductors '95
The Building Blocks of a New World Order
October 12, 14, 1995
Palm Desert, CA

UPCOMING TRANSCRIPTS:

The IT Services Summit — Global Gathering
April 1, 2, 1996
Orlando, FL

Copier Conference 1996
Document Management: The Battle Begins
May 13-14, 1996
Boston, MA

PC: The Race for PC Leadership
May 20, 21, 1996
Santa Clara, CA

Mining the Internet
June 5, 1996
Boston, MA

Storage Track
June 26, 27, 1996