



Fred Hager's Investment Guide & Outlook

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Retire Early And Wealthy

Take Advantage Of The Opportunities
Presented By The Current Bear Market

A 10-Year Plan To
Financial Independence

July, 2002



Fred Hager's Investment Guide and Outlook

Table Of Contents 2

Use The Bookmark Headings On Your Left To Read Each Section.
Click Here for Subscription Info

Foreword & Projections 4

My track record proves that long-term investors benefit the most from a good technology investing strategy. Despite the bear market, my portfolios have grown from \$10,000 to over \$540,000. Technology is not dead, it's just beginning again, but finding the right companies is tougher than ever.

Unbelievably Accurate Forecasts 8

If you take a look at what I was saying in 1989 about the tech industry, and in 1991 and 1995 about Microsoft and Intel, you'll see that not only did I foresee the coming changes in the dynamics of the hardware and software sectors, I pegged those companies as the leaders. These reports not only give you an idea of the detailed research involved in selecting companies, it shows how we accurately anticipate the changes happening in technology.

- **Assumptions In 1989** 9

- **Microsoft In 1991** 11

- **Intel In 1994** 14

The Hager Technology Investing Strategy 19

Learn the Keys and Rules to my investing strategy, and how I've managed to outperform the average mutual fund by more than 300% a year for more than 15 years. I believe this information will be worth thousands of dollars to you if you consider these points seriously and act on them. The strategy is very important, but what is more important are the kinds of stocks you choose to buy.

- **My Rules For Technology Investing** 21

- **Enhance Your Investment Performance** 23

- **What To Do When Markets Crash** 24

- **The Great Investment Illusions** 26

1. **Price-to-Earnings Illusion** 27

Fred Hager's Investment Guide and Outlook

2. Book Value Illusion	28
3. Dividend Illusion	29
4. Market Timing Illusion	30
5. Buy Low, Sell High Illusion	32
6. Investment Guru Illusion	34
Why The Technology Sector Is Still The Best Place To Invest	35
<p>For most technology investors, the past two years are full of pain and frustration. Now ridiculing high-tech companies becomes a popular sport. But accept it or not, the technology sector has become a significant part and the most active part of the economy. The technology sector still provides enormous growth and investment opportunities in the next few years.</p>	
Which Technologies For The Long-Term Investor?	40
<p>The technology sector is rapidly evolving and increasingly volatile. What are the industry dynamics, technological trends and competitive landscape in the Mobile Communications, Optical Communications, Power Management, Enterprise IT, Personal Computer, and Consumer Electronics areas that we follow? And where are the opportunities to prosper? Read the following sections to learn more.</p>	
• Mobile Communications	41
• Optical Communications	43
• Power Management	46
• Enterprise IT	49
• Tomorrow's PC	53
• Consumer Electronic	56
Conclusion	60
<p>Today, most companies are on the defensive, and virtually all of them have taken their beatings. Fundamentally though, the same precept that good companies can excel in a bad market holds true. The big difference now is we are at the bottom looking up. So be ready!</p>	

Fred Hager's Investment Guide and Outlook

Foreword by Fred Hager

If you had invested 10,000 in my long-term portfolios at their inception in 1986 you would have had \$749,180 fifteen years later in spite of a 73% drop during the last 18-month period.

The performance is the result of buying and holding the right stocks for the long term. Such a strategy has produced the most significant gains over the long-term. Warren Buffett, probably the most successful investor of our time, believes the same thing, and many of the most sophisticated investors agree with him.

Not having to pay taxes until you sell becomes a compelling reason to hold once you are up a few thousand percent.

Since 1986, my long-term portfolios have earned an average of 28% compounded per year, to this very day. The current market represents a greater opportunity than I had in 1986 when I started.

This does not mean the market cannot go lower or that a full recovery will happen right away. However if you like to take advantage of this great future potential, you have to be in the market and be willing to live with its inherent volatility. The right stocks will substantially outperform the market over the next decade.

My strategy has proven to be very profitable in spite of three bear markets and the biggest drop in the NASDAQ since its inception. Before you study my investment report, be sure to examine my record carefully.

Table 1 is my fifteen year growth projection published August 1, 1986

Table 2 represents the actual results during those fifteen years

Table 3 represents the growth projection of our portfolios for the next ten years

For the purpose of measuring our long term performance I took all transactions into consideration that were made in portfolio A and B, which are our long-term flagship portfolios. It includes the last full year, which was down 73%.

For the record, we have three portfolios that were started in 2000 and 2001. These were started to satisfy subscriber requests for more aggressive investing, and more analysis of companies. Those portfolios are down an average of 80%. In my opinion though, measuring short-term performance is meaningless with a volatile portfolio. It becomes meaningful only after a full bull and bear market cycle.

My 35% Target projections are based only on the proven strategy used in the A and B Portfolios.

The Table 1 below was sent to Mark Hulbert's Financial Service on August 1, 1986 for the record and distributed to our subscribers at the same time.

I am sure you find it surprising that 15 years ago I calculated that a bear market could drop prices by 65% from a bull market level and that at the same time a bull market would pull prices up 300% from a bear market level. Since nobody can time the market it makes more sense to ignore the volatility and concentrate on your long-term objective.

Fred Hager's Investment Guide and Outlook

Table 1 - The 15 Year Growth projection as published August 1, 1986

The table's second column reflects the average anticipated valuation of the portfolio at an average growth rate of 35% compounded annually and represents the performance target. The fourth column is an estimate of the average bull market over valuation assuming that a bull market would drive prices to an average of 75% above the first column target. The sixth column implies a bear market scenario with valuations depressed about 65% and thus retaining only about 35% of their bull market highs.

Target Date	Est. Average Mkt.	Est. Growth Rate	Est. Avg. Bull Mkt (+75%)	Bull Mkt. Compound Rate	Est. Avg. Bear Mkt (-40%)	Bear Mkt Compound Rate
1986	\$10,000	35%	\$10,000	0%	\$10,000	0%
1987	\$13,500	35%	\$23,625	136%	\$8,100	-19%
1988	\$18,225	35%	\$31,894	78%	\$10,935	5%
1989	\$24,604	35%	\$43,057	63%	\$14,762	14%
1990	\$33,215	35%	\$58,126	55%	\$19,929	19%
1991	\$44,840	35%	\$78,471	51%	\$26,904	22%
1992	\$60,534	35%	\$105,935	48%	\$36,321	24%
1993	\$81,722	35%	\$143,013	46%	\$49,033	26%
1994	\$110,324	35%	\$193,067	44%	\$66,194	28%
1995	\$148,937	35%	\$260,641	43%	\$89,362	28%
1996	\$201,066	35%	\$351,865	42%	\$120,639	29%
1997	\$271,439	35%	\$475,017	41%	\$162,863	29%
1998	\$366,442	35%	\$641,273	41%	\$219,865	30%
1999	\$494,697	35%	\$865,719	41%	\$296,818	30%
2000	\$667,841	35%	\$1,168,721	40%	\$400,704	30%
2001	\$901,585	35%	\$1,577,773	40%	\$540,951	31%

For the record, the table above was sent to Mark Hulbert's Financial Service on August 1, 1986.

The Hager Strategy is based on the assumption that some technology stocks will substantially outperform the market over the long-term. Hager is only selecting computer technology stocks and derivatives thereof. They can be in the hardware, software or services sector and must pass an intrinsic value screen designed for growth stock selection by HCTR. Fred Hager has more than 20 years years experience as chief executive in a small computer company dealing in hardware, software and computer support services. The strategy is to use this experience in the selection and evaluation of the Hager portfolio stocks.

Fred Hager's Investment Guide and Outlook

Table 2 - Actual growth from 1986 to 2001

This is the most interesting table because it shows the actual performance year by year. Since we started on August 1st performance is always calculated on August 1st.

The first year we were lucky. August 1st 1987 was a new bull market high which helped us to make 148% in the first year. The market had just topped out and the Dow and NASDAQ dropped about 35% in October. After that the performance is fairly predictable. After an unspectacular performance comes an excellent performance. The three loss periods before 2001 were each followed by an outstanding performance.

By August 1 2000 the peak of the market our \$10,000 had grown to a unbelievable \$2,740,880. A -73% drop in 2001 took us back to \$749,180 and to \$ 593,197 on June 4th 2002 the time of the writing of this report. If you agree that we are currently in a bear market you have to conclude that I am totally on target with my 15 year projection which shows a bear market value \$540,951.

(See the estimated bear market average in Table 1)

Years Lapsed	Date	Total Growth	% of Target	% of Index	% Up from Prior Year	Compound Growth	Target
1	8/1/87	148%	184%	\$24,878	148%	148%	\$13,500
2	8/1/88	171%	149%	\$27,145	9%	65%	\$18,225
3	8/1/89	201%	122%	\$30,107	11%	44%	\$24,604
4	8/1/90	527%	202%	\$62,699	108%	58%	\$33,215
5	8/1/91	592%	166%	\$69,234	10%	47%	\$44,840
6	8/1/92	897%	176%	\$99,686	44%	47%	\$60,534
7	8/1/93	1246%	189%	\$134,553	35%	45%	\$81,722
8	8/1/94	855%	114%	\$95,511	-27%	33%	\$110,324
9	8/1/95	2471%	173%	\$257,140	169%	43%	\$148,937
10	8/1/96	2279%	118%	\$237,877	-7%	37%	\$201,066
11	8/1/97	7265%	271%	\$736,525	210%	48%	\$271,439
12	8/1/98	7136%	197%	\$723,631	-2%	43%	\$366,442
13	8/1/99	11858%	242%	\$1,195,751	65%	44%	\$494,697
14	8/1/00	27309%	410%	\$2,740,880	129%	49%	\$667,841
15	8/1/01	7392%	83%	\$749,180	-73%	31%	\$901,585

Fred Hager's Investment Guide and Outlook

Table 3 - The Next 10 Year Growth projection starting August 1, 2002

When I made up this 10 year projection table I used the same calculations I used for my 15 year table in 1986. I absolutely believe that it will be easier to achieve the targets of this table than my 1986 table. The main reason for this is that the current drop in value of some of our stocks is so extreme that their bounce back will be significant.

If you look at table 3 year 2003 you will notice that a normal 35% improvement will turn into a 136% in a bull market.

While I personally believe that the market can go down more, I am convinced that this is an unusually excellent entry point for an equity investment.

The table shows with a little luck \$30,000 invested now could turn into \$1,000,000 within 10 years in an average bull market.

The table's first column reflects the average anticipated valuation of the portfolio at an average growth rate of 35% compounded annually and represents the performance target. The second column is an estimate of the average bull market over valuation assuming that a bull market would drive prices to an average of 75% above the first column target. The third column implies a bear market scenario with valuations depressed about 65% and 40% from an average market target.

Target Date	Est. Average Mkt.	Est. Growth Rate	Est. Avg. Bull Mkt (+75%)	Bull Mkt. Compound Rate	Est. Avg. Bear Mkt (-40%)	Bear Mkt Compound Rate
2002	\$30,000	35%	\$30,000	0%	\$30,000	0%
2003	\$40,500	35%	\$70,875	136%	\$24,300	-19%
2004	\$54,675	35%	\$95,681	78%	\$32,805	5%
2005	\$73,811	35%	\$129,170	63%	\$44,287	14%
2006	\$99,645	35%	\$174,379	55%	\$59,787	19%
2007	\$134,521	35%	\$235,412	51%	\$80,713	22%
2008	\$181,603	35%	\$317,806	48%	\$108,962	24%
2009	\$245,165	35%	\$429,038	46%	\$147,099	26%
2010	\$330,972	35%	\$579,201	44%	\$198,583	28%
2011	\$446,812	35%	\$781,922	43%	\$268,087	28%
2012	\$603,197	35%	\$1,055,594	42%	\$361,918	29%

It is important to realize that bull markets generally last 4 to 5 times as long as bear markets. My experience has proven, as the following tables illustrate, that there is a 300% difference in the stock price swing among the types of companies I follow between Bull and Bear markets. Therefore, I believe it is pointless to take money out of the market until our stock average is up 300% from its Bear market low.

If you plan to invest for retirement stick to the portfolio A & B strategy. Only use money you do not need in the next few years.

Fred Hager's Investment Guide and Outlook

Unbelievably Accurate Forecasts

In 1989 I stated that we were in the beginning of what would be a very prosperous time for technology investors with the right companies in their portfolios. I believed the rate in which computers were increasing in speed, functionality, and penetration, would make for incredible opportunities for investors who knew what was really happening.

In 1991, I believed Microsoft's Excel and Word products would become the de facto standard and Bill Gates would ultimately be the richest man in the world. And in 1994 I announced to subscribers that if there was one company I would own, it would be Intel because of their impending dominance in the processor space.

Today I see many more similar opportunities, despite the tech crash. It's not a Wintel world anymore, just like it wasn't IBM's anymore back then. Once investors embrace that fact, instead of running from it, we'll be one step closer to the next true bull market.

Please Read The Following Articles From Years Ago To See What I Thought About The Future.

Fred Hager's Investment Guide and Outlook

High Tech Assumptions for the Next Ten Years - 1989

In 1989 I wrote an article about the assumptions on which I based my investment strategy. To date, the events have certainly shown that I was right on target. From my experience and perspective as chairman of a software company, I was able to make an informed forecast of the technology environment. Judge for yourself how accurate my predictions were.

Originally published in 1989 by Fred Hager

While we are continually surprised at the fast pace of development in the computer industry, I am absolutely convinced that 10 years from now the current state-of-the-art will be looked at as the beginning of computer science. Following are some of my assumptions about where the computer business is heading. For the last ten years, both the speed of the computers and the density with which data can be packed have increased approximately 100% every two years.

I expect the rate of progress over the next ten years will be at least that high. That means an improvement of 41% per year. By the middle of 1995, desktop computers running on Intel's 686 chips are expected to deliver speeds of 100 million instructions per second (MIPS). During the same time, new chip architectures such as reduced instruction set computers (RISC) will compete with the currently prevailing comprehensive instruction set computer (CISC) chips.

Since Intel has at this time a monopoly on the CISC chips with its 486, the outcome of this battle of the chips is vital to Intel. I expect future progress in computer performance to be exponential. The reason is simple. Years ago, engineers designed computer chips. Today, computers design computer chips. The engineers use sophisticated Computer-Aided-Design (CAD) software. The number of man-hours required for the design of a new chip has decreased with each new generation of chips, even while these chips are getting more and more complex. Instead of testing real circuits and burning up chips in the process, the circuits are tested on computer screens where faulty designs are pointed out by neat little prompts describing the problem.

If you projected the 41% annual increase in performance from 50 MIPS over a ten year period you arrive at a mind-boggling 1,500 MIPS. This would actually exceed the speed of today's \$10 million mainframes.

In the same time-frame the 2.5 inch disk drive will be capable of storing more than a giga byte (1,000 Million bytes) of data, which will be accessible from a book sized computer weighing no more than three pounds and running at a speed of more than a hundred MIPS. Many analysts and professionals believe there is no market for so much power. They are dead wrong. Huge databases will become part of computer software and knowledge workers will have all the resources they need in their briefcases. Most software will be graphic-based with picture definition which will exceed today's television screens. These computers will cost no more than 1,500 present value dollars.

The software potential will be immense. As soon as more power and more memory are available for much less money, software houses will come up with more user-friendly software. To make software extremely simple for the user, you have to put the complexity into the code to the point where it becomes a memory hog, given current memory limitations. In the future, software writers will not have to worry about that anymore.

This explosion of computing power will change the way we live and the way we do business. It will create tremendous opportunities for many existing companies, and it will also produce many new companies. There will be a new crop of companies whose growth will substantially outpace companies like IBM, DEC, UNISYS and AT&T.

There is another myth going around in investment circles regarding what will happen when everybody owns a computer. They say the market will be saturated. Baloney! As long as the industry comes up with new and better products, people will buy them. At one point in time older technology will simply not cut it any more.

Fred Hager's Investment Guide and Outlook

For example, if you can have instant response time, you will not tolerate a ten second delay anymore. If a four pound note book computer replaces a ten pound laptop with identical or better performance, you will not keep your ten pound monster. And, once a reliable erasable laser drive is available for backing up data, slowly but surely all magnetic tape drives will disappear. Current Winchester disk drives have to be backed up with tape drives or floppies. Both methods are unreliable from a professional point of view.

The coming decade will ensure strong growth for some companies, the ones that have the vision to anticipate the direction of the evolving technology and the ability to keep pace with the rapid changes.

These assumptions regarding the future of the computer industry are the foundation on which the Hager Technology Research's strategic investing is based.

Fred Hager's Investment Guide and Outlook

Microsoft (MSFT) – 1991

I wrote the below article in 1991 when Microsoft was trading for \$250 (adjusted for successive splits) everyone said the company was a poor investment. The Justice Dept. was after them, and the word on the street was Lotus and Word Perfect were going to take over. I was one of the few who were bullish on Microsoft. This article documents a 10-year forecast that has proven to be incredibly accurate.

If his strategy succeeds, William H. Gates, Chairman of Microsoft, will be the richest man in the world.

Bill Gates owns about 60 million shares of Microsoft, which are presently worth about \$5 billion; not bad for a young fellow of 35 years. Microsoft's earnings have grown at an average rate of more than 50% per year. If Microsoft's earnings were to grow at 35% during the next 10 years, and if MSFT would keep its present multiple, Bill Gates' present holdings would be worth a cool \$100 billion. Of course, there are a lot of things that could happen in between. In this report I am going to list Microsoft's potential problems as pointed out by analysts and competitors, and then present my opinion on the company.

Let's start with the facts. Microsoft is at this time is the world's largest and most profitable software company. With a little luck, sales will reach \$2.8 billion this fiscal year. Earnings should be up about 50%.

What drives Microsoft's earnings is a mix of systems and application software. Microsoft owns MS-DOS, the operating system used by most personal computers. Worldwide there are about 60 million computers using MS-DOS. In the second quarter of 1991 Microsoft released a completely new version of its operating system, which it called MS-DOS 5. The rumor in the trade was that 900,000 copies of it were sold during the first week.

Microsoft also owns Microsoft Windows. A new version called Windows 3 was released in the beginning of 1990. About 4 million copies were sold in the first twelve months. It is estimated that about 8 million will be sold during the next twelve months. These operating systems give Microsoft a dominant roll in PC software. The huge customer base guarantees Microsoft buyers for any new or enhanced version of its operating systems. You can look forward to regular enhancements probably on the order of one each, every 12-18 months.

Microsoft's Excel is one of the finest spreadsheets on the market. Excel was the first graphical, wysiwyg (what you see is what you get) spreadsheet available. Microsoft has consistently gained market share from Lotus. It's latest version, Excel 3, is in my opinion the best spreadsheet product made. The spreadsheet is especially attractive to users of Microsoft Windows because most of the commands are identical and very intuitive to Windows users.

Microsoft had the first graphical, wysiwyg word processor. The word processor can be used in conjunction with Excel, it can import Excel spreadsheets and graphs, and it can even update data that is changed in Excel through its dynamic data exchange. Microsoft has many more application packages, as well as software tools. In addition, Microsoft has network software (LAN Manager) and is currently working on a relational database package.

With such a colossal customer base, it would seem there is nothing that could stop Microsoft from continuing to grow at a 35% rate into the next decade.

Here is what the detractors say.

The detractors are a diverse group consisting of bears, competitors, and the Federal Trade Commission. It appears everyone is ganging up on Microsoft. Competitors have been instrumental in getting the FTC involved by complaining to the FTC about Microsoft's unfair advantage in the software industry. As a result, the FTC is conducting an extensive investigation of Microsoft's business practices. Apple Computer has an ongoing lawsuit against Microsoft,

Fred Hager's Investment Guide and Outlook

alleging that Microsoft copied the overlaying features of Microsoft's Windows. IBM, which has had a close relationship with Microsoft, has made it clear that it is going its own way with Apple, an arch rival of Microsoft at this point. IBM has also formed other anti-Microsoft alliances, with companies such as Borland, Novell and Lotus. Lotus has said that Microsoft's honeymoon is over, because its new Lotus 123 for Windows will be out in the fall, giving Excel a run for the money. Word Perfect is also expected to release a Word Perfect for Windows shortly, which is expected to dent the market for Microsoft's Word for Windows.

My opinion:

This would seem enough to intimidate Microsoft's holders, but it isn't working. Microsoft is trading at an all time high. In my opinion, Microsoft will go a lot higher in the near term. As for the negative arguments: The anti-trust litigation has no merit in my opinion. The FTC never broke up Xerox or Polaroid for having a monopoly on a product.

The Apple lawsuit has no merit in my opinion either. However, you never know what one judge will rule. If that lawsuit were to go against Microsoft, it would have very serious consequences: (Quite possibly a permanent royalty on each Windows sale and maybe something like \$500 million in penalties.) Microsoft would certainly appeal the decision, and its attorneys would have another crack at it. I think this would be an unlikely outcome. My bet is nothing significant will develop out of the Apple litigation.

I see IBM's announcement of its arrangement with Apple as a big mistake. By announcing to the data processing industry that they are working with Apple on a future operating system, they indirectly let us know that OS-2 is dead. That is no surprise to me, but it probably is a big one to all the Fortune 500 companies that were planning to use OS-2. It is, of course, a sock in the face to all the software developers who are spending their research dollars on OS-2 products.

This is not the first time that IBM has shot itself in the foot. A few years back, when IBM had a 60% market share in PC's, IBM introduced the new Micro channel architecture and decided it would stop making the 286 AT in favor of only selling 386's. Two years later IBM's PC market share was down to 35% and Compaq's has doubled. Compaq was backordered on 286's for 12 months. Actually, for Apple, the arrangement with IBM is a smart move. It is getting IBM's RISC technology which is the best of the lot. The RS 6000 is blindingly fast and will finally give Apple the speed it needs. This will probably bury Motorola's 60040 chip. Apple is by far the largest user of the chip and. NCR is also abandoning that technology.

I see no impact from this development on MSFT. No software developer will write for a nonexistent operating system, and whether they like it or not, writing for Windows is the only game in town.

As for Lotus 123 for Windows, one thing becomes clear. Lotus finally figured that making a Microsoft Excel like spreadsheet is the only way to go. What must be painfully clear to Lotus is that its 123 for Windows will require its customers to purchase millions of copies of Microsoft's Windows, without which the new 123 cannot run. After they buy Windows and learn the window interface, they will then be faced with the problem of learning a new and different spreadsheet. I believe many will then opt for Excel. I am one of the few who believe that the new Lotus spreadsheet is a positive development for Microsoft.

How about the new Word Perfect for Windows? Here you have a similar story. There have been in excess of seven million Word Perfect applications sold. It is said that half of them will buy the new Word Perfect for Windows. For Microsoft, that means a few million more Windows. It also means that it will be easier for Microsoft Word to gain market share because the new Word Perfect will be much more like Microsoft Word than the present product. There is one more good reason for users to switch: it is easier to integrate Excel with Word for Windows than with Word Perfect.

It is quite possible that Microsoft could come out with a real killer application. MSFT does not have a good database program. At this point Borland seems to have that niche sewed up with

Fred Hager's Investment Guide and Outlook

Paradox and Dbase from its recent acquisition of Ashton Tate. Since early 1990, Microsoft has been working on a revolutionary database program which is supposed to eliminate the need for programming. This program is not expected to come out before 1993. If the program works as proposed, it would be a billion dollar program.

Microsoft is also working on a sophisticated new Windows program called Windows NT (NT stands for New Technology). This systems program is expected to be the Windows of choice for high performance work stations. It was designed to be Microsoft's answer to OS-2.

In summary, it is too late to stop Microsoft, even if all the competitors gang up on the company. The software business is driven by what the customers want, not by what the competition wants. Microsoft's mammoth customer base simply gives it a lock on the PC software business.

Investors are always looking for the next Polaroid or the next Xerox. The problem is they didn't recognize the opportunity when they could have bought these stocks before they went up a few thousand per cent. Ten years from now the same investors will be looking for the next Microsoft, not having recognized the opportunity when it presented itself.

I believe the chances are better than 75% that some time within the next 5 years, the capitalization of Microsoft will exceed that of IBM. What is surprising is that this statement evokes an expression of disbelief even with some of the most knowledgeable analysts. Microsoft's capitalization is at this time \$83 x 176 million shares, or \$14 billion, while IBM's capitalization is \$100 x 571 million shares or \$57 billion. The ratio is now 4.07 to 1 in favor of IBM.

Fred Hager's Investment Guide and Outlook

Investors who purchased Intel in January 1994 have received 16 shares for each original share purchased through a series of splits.

Intel – January 10, 1994

By Fred Hager

If I could only buy one stock for 1994, I would select Intel. For this reason I devoted the first part of this letter to INTC.

INTEL CORPORATION (INTC) \$62 P/E 12

What kind of P/E does a company deserve which has the following attributes:

- It is the clear technology leader in an Industry that has the most exciting potential for the next few years.
- It shipped over 70% of all PC/ workstation microprocessor chips shipped worldwide in 1993
- It is the absolute market leader in its niche
- During the last five years its earnings grew from \$1.25 to over \$5 dollars per share, which is 320% or 31.95% compounded annually.
- I expect earnings growth for 1994 to be consistent with its five year average.
- The company has more cash on hand per sales dollar than any other major computer manufacturer.
- It has an overwhelming array of new products that will hit the market during 1994.

At a time when the S&P 500 was trading on December 31, 1993 at a P/E of 22.95, Intel was trading at 11.81 times the expected minimum earnings for its 1993 calendar period. Minimum earnings of \$5.25 are expected to be reported for the 12 months period ending December 31, or about January 15, 1994. The stock closed at \$62 on the last trading day of the year.

By any standard Intel should sell at a P/E premium of 50% to the market. As it is, it actually sells at a discount of about 40% of the market. A 50% premium would put Intel at \$150, the market's multiple would put it around \$100. Pretty wild when you think about it. Of course I have always said that the market is not very efficient in pricing securities, and in some cases it is downright stupid. What's good about it is it opens up all kind of opportunities.

When I originally recommended Intel at \$52 on August 1, 1993, I superficially dealt with some of the so called negatives that seem to confuse the bears. At this point the negatives seem to center around the Power PC Chip and competition from Advanced Micro Devices as well as from Cyrix. I intend to cover this subject in some more detail, and therefore some of the points made five months ago may be repeated. Following are the major points made by the bears on Intel.

Fred Hager's Investment Guide and Outlook

IBM's new Power PC chip the 601 is more powerful than Intel's Pentium.

1. IBM's new Power PC is much cheaper than the Pentium.
2. IBM's new Power PC chip will grab an ever increasing share of the micro processor market and therefore seriously impact Intel's sales volume and profit margins.
3. Windows NT will run on the Power PC.
4. The new Apple PC with the Power chip will run Windows.
5. In addition there are other manufacturers such as Advanced Micro Devices and Cyrix that are presently making and selling 486 type microprocessor chips. There are also a few additional manufacturers that have announced the manufacture of new processor chips.
6. There is uncertainty about the litigation between AMD, Cyril and Intel.
7. The semiconductor bill to order ratio is negative.
8. Intel has announced substantial price reductions which means that Intel's margins are eroding.

My answers to the negative points:

1. Few people realize that Intel cannot talk about the power of its soon to be introduced next generation Pentiums until they can actually ship them in volume. The reason is strictly good marketing. If Intel would announce today that in May 1994 it will have a new Pentium which will have a speed of about 100 Megahertz and consume about 50% less energy and be only half the size of the current Pentium, sales of the current Pentiums would instantly drop because many people would postpone their purchases and wait for the latest state of the art chip. Now, the fact is, Intel does have such a chip and will sell it in volume by April 1994. I am waiting for this chip myself. This new generation chip is already in the hands of most major manufacturers for evaluation at this writing. According to Intel, in the future you can expect the new product cycle to be shortened from about 18 months to about 12 months, with an increase of about 100% speed with each cycle. This means that in April 1995 you will see a 200 Megahertz chip. Of course it will not be officially announced until it is shipped. By the way a classic case of early product announcement happened about 10 years ago when Osborne Computer announced a superior model to be shipped in about 3 months. Osborne was at the time the fastest growing computer Company, having achieved about 100 million in sales in its 3rd year. The drop in sales was so abrupt that Osborne landed in Chapter 11 before the new product could be shipped. A few months later the company ceased to exist altogether. The lesson was not lost on any high tech company. It is: You never obsolete a product that is a big seller with an announcement of a product that you cannot ship in volume. Of course this does not apply to the pre announcement of the Power PC since IBM is not manufacturing any in volume for the next few years. IBM is actually at this time the biggest seller of Intel equipped PC's. What does this tell you?

2. IBM's new Power PC is much cheaper than the Pentium. This is absolutely not true. The Power chip is much cheaper, but people are not buying chips, people are buying computers. Paul Otellini senior vice president of Intel's microprocessor group stated on 12/11/93 in an interview with Dow Jones that making a PC with a Pentium will be about \$1000 cheaper than making a PC with a Power chip. The reason is that the components to make Intel PC's are mass-produced staple goods. Some of the components used to configure Power PC's are much more expensive. The Idea that the Power PC is cheaper is an illusion.

3. IBM's new Power PC chip will grab an ever increasing share of the micro processor market and therefore seriously impact Intel's sales volume and profit margins. Many people fail to realize that the key to moving hardware is software. The lack of software is the Achilles heel of

Fred Hager's Investment Guide and Outlook

the Power PC. Very few ordinary PC users will. I never buy a PC that is not 100% compatible with the software they have. Some MS-DOS software will be around for years and no Power PC will ever run any. As a matter of fact it will not run more than 5 % of the currently available PC software. There are many misconceptions about this. For instance it is claimed that the Power PC will run the current Windows in emulation mode. If Windows is run in emulation mode it will run 7 to 10 times slower. Any one who runs Windows now even on a 486 thinks it doesn't run fast enough. Running 7 times slower is unacceptable. Until the Power PC can run DOS and Windows applications in native modes (which I predict will never happen) Intel will eat everybody's lunch. Of course MS-DOS will be completely obsolete within 2 to 4 years when competitive processors will run at speeds of about a thousand MHz (relative to current technology clock speeds). Any marketer knows in order to take market share from the leader you not only have to be a little better and a little cheaper, you have to be a lot better and a lot cheaper. So I put my money on Intel.

4. Windows NT will run on the Power PC. That is true, however, Microsoft sells about one Windows NT to every 15 of its Windows 3.1. Windows NT is not directed at the PC market. It is directed at the server and work station market. This has not been a market in which Intel participated. This market is dominated by RISC chips and is a huge 22 billion dollar business. The market leader is Hewlett Packard with a share of about \$7 billion in this business, Other heavy hitters in this sector are Sun Microsystems, DEC and to a lesser degree , but coming on strong IBM with about 1.5 billion dollars in sales of its R6000 workstation which now sports the new Power chip. It is expected that Windows NT will become a standard operating system for servers and workstations. If that happens, then Intel will for the first time be able to compete with its CISC (Pentium) processor in this RISC dominated sector.

5. The new Apple PC with the Power chip will run Windows. Apple's Mac has been running on Motorola's 68000 series chip from the beginning to now. AS the power of the 68000 evolved from the 68010, 68020, 68030 and 68040 the latest of that series, the race for speed was consistently won by Intel as Intel moved from the 286 to the 286XT, 286AT, 386, 486 and finally to the Pentium. As the Motorola chip fell behind in speed Apple, who was married through its software to the chip, suffered. The Power chip was really created for Apple. Motorola needed to take advantage of IBM's leading RISC technology to produce a faster chip and both Motorola and IBM needed Apple's huge volume to get into instant volume production. The fact that Apple uses the Power PC however does not affect Intel since Apple never used Intel chips before. I can't see why Apple selling a system with Windows would make sense, since the Apple computer would be more expensive.

6. In addition there are other manufacturers such as Advanced Micro Devices and Cyrix that are presently making and selling 486 type processor chips. There are also a few additional manufacturers that have announced the manufacture of new processor chips. That is true of course. But let us deal with AMD first. So far all AMD has done with respect to its processor chip development is copying Intel's microcode. Eventually when the legal issues are resolved AMD will either have to pay a royalty to Intel or try to keep pace with Intel with its own R&D. Since Intel's R&D budget, exceeds AMD's total sales volume it would take a miracle for A&D to succeed, especially when you look at AMD's shrinking cash position. AMD's cash balances shrank from \$153.9 million at the fiscal year ended 12/91, to \$52 million in 1992, to \$25.8 million as of 9/1/93. As for Cyrix, most of the above applies. Of course Cyrix is a relatively tiny company with sales expected to be about \$140 million for 1993. To its credit its cash balance as of 9/1/93 of \$43.4 million actually exceeded that of its ten times larger rival AMD. Moving into high volume micro processor production is an extremely cash intensive business with \$500 million about par for the course for a manufacturing facility. In this high stakes business Intel's \$2 billion plus cash flow makes it an awesome competitor.

7. There is uncertainty about litigation between AMD, Cyrix and Intel. That is true. But what does it mean? In the unlikely event that Intel loses all cases, Intel's position would be the same as it is now. AMD is already making all the chips it is capable of making without regard to the potential liability to Intel. The same applies to Cyrix. However, if AMD lost, Intel might be awarded a billion dollars. There is a better than fifty percent chance that Cyrix will prevail and there is a better than fifty percent chance that AMD will lose. On 12/27/93 Intel won a key court

Fred Hager's Investment Guide and Outlook

decision allowing it to speed up its array of copyright cases against AMD. A federal court lifted a stay in court proceedings that held up Intel's efforts to extract some \$600 million from AMD for allegedly copying the 386 chip. At the state level an arbitrator earlier awarded AMD the right to clone the 386 chip. Later a California court gutted the award saying the arbitrator overstepped his bounds. Intel can now proceed directly with federal cases on both the 386 and the 486 chips. The situation looks pretty bad for AMD this fact is reflected in AMD's low P/E of 6.

8. The semiconductor bill to order ratio is negative. A lot has been made lately of the negative book to bill ration in the semiconductor industry. Intel's book to bill ratio is positive.

9. Intel has announced substantial price reductions. This means Intel's margins are eroding. Intel has reduced prices consistently over the years. Most times, these price cuts coincided or preceded the introduction of more powerful processors. The net effect usually was that the previous generation of processors is heavily discounted to prevent the competition from getting more market share. At the same time the new generation of chips is promoted to keep the margins constant. It will be no different this time with the new 100 mhz chips. The most recent advances made in chip design by Intel will result in substantial cost reduction in manufacturing. The key to these savings is Intel's move from 0.08 micron fabrication to 0.06 micron fabrication. Intel has also succeeded in increasing the silicon waver size to a point where one waver yields twice the number of chips. According to an Intel spokesman these two design advances will increase waver yield by about 400%. There are rumors from reliable sources that Intel will ship new 486 chips with a clock speed of 75 and 100 MHz respectively before the first quarter is over. The higher speeds are achieved through the latest size reduction of the chip. This rumor cannot be confirmed with Intel. Overall Intel's margins are heading lower for positive reasons. There are many new products where margins are lower. One of Intel's fastest growth areas is flash memory which should contribute about \$1 billion to sales in 1994, it will also depress margins somewhat, because the complexity of building systems with the new Pentiums, many small manufacturers will not be able to afford the R&D required to fully exploit the Pentium. To get around that Intel will OEM Pentium systems next year. Intel expects to build about 1 million systems under different labels. This will give sales a tremendous boost, at the expense of margins. The bottom line is that you can expect higher sales with higher earnings and lower margins.

Fred Hager's Investment Guide and Outlook

Intel Corporation Financial Highlights (000 omitted)

Fiscal years ending	Dec-93	Dec-92	Dec-91	Dec-90	Dec-89
Total Revenue	8900.0	5844.0	4778.6	3921.3	3126.8
Net income	2300.0	1066.5	818.6	650.3	391.0
Earnings per share	5.25	2.49	1.96	1.60	1.03
Dividends per share	0.20	0.10	0.00	0.00	0.00

Investment outlook:

I believe that earnings growth in the first two quarters of 1994 will be somewhat slow, since the full impact of most of the new products will only affect the second half of 1994-I expect earnings to come in at about \$6.85 for 1994. There is no doubt that, as Intel outperforms its competitors Intel's multiple will eventually surpass the markets multiple.

As an index of the market the Dow Jones has become a meaningless yardstick. Its P/E has been over 40 all year as a result of huge losses of companies in its component. I think at this point the S&P 500 is a better benchmark with a P/E of about 23 at this time. Intel has been a volatile stock and will try investors' patience. It is definitely for long-term investors, except for the most nimble traders.

Fred Hager's Investment Guide and Outlook

The Hager Investment Strategy

And How It Beat The Average Mutual Fund By More Than 300% Every Year Since 1986

We believe this information will be worth thousands of dollars to you if you consider the points seriously and act on them. The strategy is very important, but what is more important is the kinds of stocks you choose to buy.

Surely you are aware of the fact that the average mutual fund has lagged the market. A recent study revealed that even the index funds beat their average non-index brethren. Some of the best fund managers think it is an achievement if they beat the market averages by a couple of points.

Why do you think the mutual fund industry as a whole has such a poor record, and on average, the funds don't beat the market?

And how is it that we can beat the average fund by more than 300% over fifteen years?

It really is very simple. The Funds don't have it easy.

The mutual fund industry has to operate under difficult conditions with both hands tied behind its back.

These restrictions and limitations usually imposed by their charters vary widely, from the obvious restrictions of sector funds to specific sectors, to specific geography, minimum diversification, maximum percentage holding per security, minimum cash requirement, and so on. In addition, the race for short-term performance has affected many funds negatively. Moreover, in order to keep within their charter, which permits only a certain percentage position in any security, most funds are forced to cut down the positions of their big winners in order to stay within their limit for individual holdings. Of course, the ugly ducklings do not present a problem and can therefore be held. This is especially true for index funds.

Since there is no meaningful performance difference over a period of time between index funds and other mutual funds, lets look at index funds.

If you buy an index fund, you buy a whole universe of stocks. You buy the good the bad and the ugly.

Why, for heaven's sake, should you buy the bad and the ugly? In addition, you are buying the same amount of a bad stock as you are buying of a good stock. You are doing that with your hard-earned savings, and that to me seems to make no sense at all. Of course, you can't blame the index funds - they are doing exactly what they promised. So why are there so many index funds? That also has a simple explanation: they can prove they do as well as the average mutual fund. The net effect is totally counter-productive.

While all the above points apply more or less to the non-index funds, the non-index funds with their greater turnover, larger commissions, higher expense ratio, etc. have an additional set of negatives affecting their performance, not the least of which is a higher tax liability created by the higher turnover.

Fred Hager's Investment Guide and Outlook

The Seven Keys To Successful Long-term Technology Investing:

Key One: Sector

We only concentrate on the computer technology sector, which is the fastest growing sector in the American economy. This gives me an unfair advantage. It also is the sector with which we are the most familiar.

Key Two: Selection

We concentrate on portfolio performance by picking only the securities we believe to be among the best of the best, la crème de la crème, for the long-term. Fred Hager, who worked in the computer industry for 20 years, and his staff of experts in technology investing concentrate only on technology.

We only pick stocks with which we are totally familiar; stocks that are market leaders or very special situations. We anticipate the earnings of stocks to grow at a rate of at least 25% per year for the next five years. Special situations are only considered if growth can be reasonably expected at a much higher rate, in order to increase our overall performance rate. Our target rate average for our two primary portfolios, A + B, is 35% per year, which has been exceeded for 15 years. (The severe drop in tech stocks in 2001 has reduced our average temporarily). It is, however, important to keep in mind that the past record in no way assures success in the future.

Key Three: Minimum Turnover

We trade infrequently in the model portfolios in order to minimize tax consequences for investors. We believe the more an investor trades, the more chances they have to make mistakes.

For all of 1998, we did not make a single trade. In spite of that, our portfolios were up 100%, and no taxes were applicable.

Key Four: Concentration

We will not have more than five to ten stocks in the core, flagship portfolios. We have averaged over 30% per year since 1986 by doing it this way, and we have no reason to change now.

Key Five: Never Try To Time The Market

Nobody can time the market. There are no timing gurus that have a long-term record of being right. The more arrogant they get, the harder they fall when the law of averages catches up with them. Just look at the awful records of "so-called" former greats like Granville and Garzarelli.

Key Six: Don't Let Anyone Chase You Out Of A Good Stock When It Hiccups

As long as the long-term outlook is still excellent, there is no reason to dump a stock because of a short-term setback.

Key Seven: Don't Panic During A Bear Market

If the stocks you own are real growth stocks, they will come back as sure as day follows night.

Fred Hager's Investment Guide and Outlook

My Rules For Investing In The Technology Sector

By Fred Hager

Investing in the technology environment has always been hazardous, to say the least. The most recent crash has magnified the risk, but with the right outlook and comprehensive understanding of the market, technology investing is still the best place to be for the long-term investor.

Warren Buffett, probably the most successful investor of modern times, put it succinctly when asked about technology stocks. He said, "I don't buy them because I don't understand them."

In addition, the investment community knows that it has been very easy to get burned in the technology sector. Earnings surprises are an ongoing problem. Companies seem to lose their winning ways from one year to the next. The sector has been a veritable minefield.

Someone once said that we do not have a stock market, but a market of stocks.

The implication being that you can lose money in a bull market if you own the wrong stocks, and you can make money in a bear market if you own the right stocks.

This theory is even more applicable to technology stocks. If a company stumbles and comes through with a loss instead of an expected 35% increase, the stock is going to take a beating even in a raging bull market. At the same time, extended bear markets have always had many winners.

Part of my plan is to purchase a relatively small number of issues. Each company must be a market leader in its niche. I must be able to purchase the stock at a reasonable price. Caveat: you may disagree with what I consider reasonable. The security must have the potential to appreciate 35% per year over the next three years. The stock must have the potential of becoming one of the next generation's growth stocks.

Unfortunately, the list of excellent candidates seems to get smaller and smaller each year, and the plan is a lot easier in theory than in execution. Typically, companies that manufacture great state-of-the-art products may not be great investments for the future.

The over-all Hager strategy, as has been illustrated in portfolios A&B since 1986, is to hold on to securities for an initial target of about three years. The target is not rigid, but may be affected by a negative development in the company.

Market timing is never directly considered. Indirectly, when selling positions when they get unrealistically high, there should be a tendency to be less exposed when a bull market turns. This is exactly what happened on August 27, 1987, when I sold a lot of stocks two months before the crash. I was not watching the market, I was just watching my stocks. I am no market timer, and I believe the market timer can't help you outperform the market consistently.

Sometimes, getting bad news about a company prompts me to sell the company's stock. The problem with that is, usually by the time you realize what went wrong, it is too late to sell. The stock is down 20 or 30%, and the next move of the stock will be up. It is also possible that I will buy a stock on bad news provided the bad news had been anticipated and the stock's price has already been discounted by the bad news. If the company has great potential, and the downside risk is minimal, the bad news would not prevent me from buying the security.

The Fredhager.com portfolios are usually not evenly weighted. I try to hold larger positions in the stocks that I believe will outperform the portfolio in the near future.

Fred Hager's Investment Guide and Outlook

Since some technology companies run into specific problems at the very time when others appear to have no problems, it would seem that a strategy of taking that into consideration could yield above average results.

My investment philosophy is guided by a strong belief that many so-called investment guidelines are investment illusions. My strategy will definitely result in a high beta. The reason is the selected stocks are carefully chosen for the long-term. The ups and downs of the market never bother me. I have endured too many decades seeing similar scenarios evolve.

Remember, disciplined investing means not just selling at the right time, but also managing your investment objectives rationally, which can be difficult with technology investing, and the volatility.

I invest by the following rules:

1. Invest in companies that are leaders in their niche and have the potential to grow at over 20% a year, strong balance sheets, proprietary technology, transparent accounting practices, and quality management.
2. Invest with money that you are not going to need in the next three to five years. Due to the volatility of technology investing, and the swings that we will experience, having to pull money out at the wrong time will severely hinder your long-term performance.
3. Do not be afraid of high multiples that investors have put on good technology stocks.
4. Have a strong gut and the will to endure the swings in the market.
5. Avoid the noise of the market and focus on the fundamentals of growth.

Fred Hager's Investment Guide and Outlook

Adding A Small Portion Of The Hager Stocks To Your Selection Of Mutual Funds Can Greatly Enhance Your Investment Performance.

The Hager investing strategy involves minimal trading and is centered on holding a small selection of the very best technology companies for the long-term. Our performance track record proves the strategy works, and our commitment to finding long-term success stories has resulted in minimal tax consequences over the years.

In the last ten years, most mutual funds have evolved from investment vehicles to marketing machines, where bringing in money has become paramount to managing it. At Hager Tech Research, we're not confined by the restrictions that so often limit fund managers, and dull performance. We find the best tech companies for our subscribers, and we hold on to them for as long as we see the potential for significant gains. And because we watch them so closely, if something changes, we remove them from our portfolios, and our subscribers know immediately. The Hager Tech Approach is straightforward and simple, where achieving long-term returns for our subscribers is our primary goal.

So how does one get started with the Hager strategy? Three easy steps:

1. Subscribe to the service, and evaluate our positions relative to your investment objectives.
2. Determine an appropriate allocation of dollars, and weigh positions evenly or as best suits your risk tolerance and investment objectives. Our StockMonitor table of all companies, with price targets and earnings estimates, enables you to easily follow our financial outlook and potential for each company.
3. Read our comprehensive Weekly Updates and Portfolio Update to know exactly what is going on in your portfolio, and when we are moving positions in or out.

Apart from the potential for substantial investment returns, what makes investing with Hager Technology Research an excellent addition to one's investing strategy is the ease of management, and the security in knowing we're watching your technology companies for you. Just think what a little effort on your part can do for your financial future. Mutual Funds are the hands-off approach to investing, which is why most investors never feel like they have a handle on their assets, or their financial future. Isn't it time to take control?

Consider your portfolio your own mutual fund, and think of the Hager Technology Research team as your own private research team. Ultimately, you have control over your money, which is the way it should be. We're here to give you the best ideas, based on our in-depth research and the proven strategy that has produced an exceptional 16-year track record.

Just a fraction of your portfolio invested in the Hager Tech Companies can go a long way for your future financial independence. And now, with the significant evidence pointing to a recovery in the technology sector, and the markets, there is no better time to reevaluate your objectives, and start putting your hard-earned money to work. Get started with a subscription to Fredhager.com today.

Fred Hager's Investment Guide and Outlook

When Markets Crash

If you own the right stocks, most of the time your best bet is to stay put. I did exactly that in October 1987, and I did the same during every major break since. On November 1, after the market had dropped about 600 points as a result of the Gulf conflict, I wrote a letter expressing my feeling about the market at the time. Because the letter is applicable to any market break, I am reprinting the portion concerning the subject.

My point of view of the current market;
(Published in November 1, 1990 by Fred Hager)

When Fred wrote this letter in 1990, his only two portfolios, A and B, were worth \$58,126. Despite that crash, and the current market, the two portfolios are worth over \$600,000, or a gain of over 1000%, as of May 1st, 2002.

As long-term readers of HCTR know, I have always been convinced that nobody can predict which way the market is heading in the near term. (For the long term it has always been up.) Right now, the pundits tell us that we are in a bear market. There is no argument with that, if you accept the general definition of a bear market, which is said to be marked by a drop of 20% or more from the previous high.

The problem is that you only know that you are in a bear market after the market has dropped 20%, at which time it is too late to do something about it. Of course, if you are getting into the bear mood, you now sell everything, because you are now sure that this is a bear market.

What are the chances that you are going to be ahead of the game by selling now? Your chances are less than 30%. That is about as lousy a bet as you can make. Here is how I figure: On any given day over the last 50 years, your chances of making it on the upside were at least 7% better than on the downside, for the simple reason that the market is upside biased by about 7% over a long period of time. In addition, when selling your securities and buying them again, you pay a commission.

That may not amount to much, but you have another real cost, especially when you deal in OTC stocks. That cost is the curious fact that, unless you are sitting in the broker's office or have a real time quote terminal, you tend to get bad executions. This is especially true if your broker makes a market in the stock. Many brokers make more money on the spread of stocks in which they make a market, than on the commission. The net result is; you should figure that your real return ticket on a small OTC stock is about 10%.

Now you already have 17% working against you. The next problem is, when is the bear market over? The only time you can be sure is when the Dow surpasses its previous high, which means when the Dow closes above 3000. I am just using the time-worn technical definitions. Of course, at that time you will also know that we have been in a bull market for several months, just as sure as you know now with 20/20 hindsight when this bear market started, all you have to do is look at a Dow chart. If you are buying on this new bull market breakout signal (that is what the technicians will call it), you will have lost about 30% of your capital.

So what is the smart thing to do? Generally, if you have the right stocks, the smartest thing to do is to stay put. By the right stocks, I mean your stocks are positioned to outperform the economy and the market. Get used to the fact that in order to make big money in the market you have to be in it, not out of it. There will always be stocks that outperform the market over a period of time. If the outlook for some stocks you own seems to get worse, sell them and buy stocks for the next bull market. There is tremendous value to be found in the market at this time.

I realize that this market could go a lot lower than the current level. So what? Don't let it bother you, after all, you are investing for the long term. You can be sure of one thing, you cannot pick the market bottom - nobody can unless they do it by sheer luck. People who sold already, and

Fred Hager's Investment Guide and Outlook

people who are selling on the way down are selling because they are afraid. Believe me, those people will not buy at the bottom because they will still be afraid, and think the market will go lower still. They will not buy again before there is a new bullish sentiment prevailing, when the market is several hundred points higher. Until the market moves into new high ground every upmove is suspect of being a trap by the market timers.

Most portfolio managers are telling us how much more cash they have in their funds at this time, compared to when the market was doing well. The fact is, usually the average investment fund is caught with a minimal cash position when a market breaks. Generally, after a market has definitely turned around by making a new high, the funds are in a panic to buy stocks and invest the excess cash they have so carefully accumulated on the way down and on the way back up.

Again, with 20/20 hindsight, it is obvious that I should have sold some stocks. However, since my foresight does not match my hindsight, I did not. I also have no plan to sell some now, because our HCTR stocks are exactly the stocks that I want to hold in a bad market. Our stocks got hit pretty hard. Our weighted price/earnings ratio is at a record low, and I fully expect our current positions to keep outperforming the market by several hundred percent. I also expect our portfolios to keep giving us our targeted 35% return.

If you are wondering what makes me so bullish, let me explain. I am not bullish on the market. I am not bullish on the economy. However, I am very bullish on the stocks we hold.

You may be aware, right after I wrote this letter, the market turned around and within five months recovered every point it had lost!

Fred Hager's Investment Guide and Outlook

The Great Investment Illusions

By Fred Hager

It is generally accepted that the important criteria for picking good companies and investing successfully are:

1. A stock must have a low Price to Earnings ratio
2. A stock must be priced at or below Book Value
3. A stock must have increasing Dividends
4. You can time the Market for entry and exit points.
5. Buy low and sell high
6. Investment Guru's are more right than wrong.

Like much so-called investment wisdom, this is sheer nonsense. That's too bad, because it would take only a few minutes to pick the ten stocks that would best meet these criteria out of the whole universe of over 5,000 stocks listed on the New York Stock Exchange, the American Stock Exchange and on the NASDAQ. All I would have to do is put the parameters I want into my computer and scan a financial.

There are thousands of investors doing the same thing with the same database. Everybody uses similar criteria, and everybody finds that these stocks are the most picked-over stocks. Often the ones that seem undervalued are cheap for a very good reason that may not be obvious to the scanner.

As always, the computer cannot help you think. The articles that analyze why the most common criteria for picking stocks simply don't work, and why the major investment institutions, on average, have such a dismal record when they select stocks with their powerful computers.

Fred Hager's Investment Guide and Outlook

The Price To Earnings Illusion

By Fred Hager

I refused to purchase Microsoft at 25 times earnings in 1986, and I paid 5 times more for it in 1990, when I finally paid a higher multiple for the stock. Now I'm happy that I did.

A widely used investment tool is a comparison of a company's growth rate with its price/earnings ratio. The theory is that if a company had a consistent growth rate of 20%, the stock would be fairly priced if its price/earnings ratio were 20% or less. Consequently, a company with a growth rate of 30% could justify a stock priced at an earnings multiple of 30. This theory has some merit because it permits you to purchase some quality growth stocks which you may never be able to purchase at a low multiple. However this approach has many flaws.

Here are just a few:

Earnings of fast growth companies are generally unreliable. The biggest single reason for that is that fast growth presents unique problems. If a company in a fast state of growth has unusually high profit margins, you can be sure that it will attract competitors like honey attracts bees. In the technology sector, fast growing companies are usually technology leaders, which means a substantial amount of cash flow goes into the enhancement of existing products, and the development of new products. Invariably something goes wrong from time to time.

In spite of these setbacks, fast growth companies as a group will always outperform slow growth companies.

In order to retain the purchasing power of your investment, you need annual growth that equals the prevailing inflation rate. For the last 15 years the inflation rate was approximately 6% per annum. It is reasonable to assume that the next 15 years will not differ much. On that basis you would need 6% growth just to stay even. If you invest your money at 10.25%, which is the average mutual fund return for the last ten years, you will barely retain the purchasing power of your money, since you also have to pay taxes. Most investors are in a tax bracket exceeding 30%, including federal and state income taxes. Therefore, if you earn 10.25%, you are at best making 1% net.

Now let's see what happens if a company grows at 30%. First, your net after taxes is 21%. Your net after the inflation rate is 15%, which is exactly 15 times the net return of 1% you get from an 10% investment. It is therefore important to find investments that give you a high return. In the long term, companies growing at an above average rate will keep making a decent return on their investment in spite of temporary setbacks.

To summarize, 30% growth will increase your net 15 times faster than 10%. Therefore, you must go for higher returns and higher multiples. The assumption that a low multiple stock is a bargain is almost always wrong. According to a study in Business Week dated April 12th 1999, the average U.S. diversified equity fund yielded 1.15% in 1998. According to those figures, the mutual fund investors lost a fortune.

In conclusion, I refused to purchase Microsoft at 25 times earnings in 1986, and I paid 5 times more for it in 1990, when I finally paid a higher multiple for the stock. Now I'm happy that I did.

Fred Hager's Investment Guide and Outlook

The Book Value Illusion

By Fred Hager

Book value is another guideline that helps to get you into the wrong stocks for long-term growth. Assets are very much subject to accounting treatment and are often difficult to analyze.

Instead of saying that assets had been overstated, the companies usually report that they are taking a write down on inventory, accounts receivable or on capitalized R&D. Most successful Hager technology companies do not capitalize R&D. Whereas most general manufacturers list almost all of their assets on the balance sheet, computer technology companies in most cases do not show software as a balance sheet item.

In some cases a software company's only major asset is its software, which may not show up on the balance sheet at all. This is applicable to companies like Peoplesoft, Oracle, Microsoft and Lotus.

If you are an asset play investor who makes sure that he gets a book value ratio of 1:1 or better to his stock purchase price, you might never buy a software company or a computer company that has a heavy investment in non-capitalized software.

Fred Hager's Investment Guide and Outlook

The Dividend Illusion

By Fred Hager

A company's ability to pay a regular dividend has for years been an important consideration for many portfolio managers. Years ago some pension fund charters actually prevented the funds' managers from taking a position in stocks which paid no dividends. It is for that reason that companies like Xerox and IBM paid dividends during their stages of fast growth. The dividend yield, however, was insignificant, and from the mid fifties to the mid sixties it seldom exceeded 1% for either company. Obviously the dividend was not an investment consideration for people who purchased these stocks.

As a general rule any company which grows at a rate in excess of 30% can not afford to pay a dividend unless it either sells more stock or issues debt instruments. Typically, if a company is not over-capitalized and goes from \$200 million to \$300 million in revenue it needs about \$20 million more in equity in order to finance additional receivables, additional inventory, R& D, etc. A company which is paying a substantial dividend is telling you: "we do not need this money because our growth is not expected to require more capital." It is as simple as that. IBM increased its dividend for several years, although its earnings have not increased on average over the last five years. Now you know what that is telling you.

As an investment guideline you should assume: the higher the dividend rate, the smaller the potential for growth.

Fred Hager's Investment Guide and Outlook

The Market Timing Illusion

By Fred Hager

If the professional can't make it work, neither can the average investor.

Millions have been spent trying to come up with a market timing system. No one has ever succeeded with any degree of consistency. On his show "Wall Street Week", Louis Rukeyser took a shot at the appalling record of the financial newsletters' bullish or bearish sentiments and pointed out that investors following that indicator would have missed the market at the most important turns. I didn't feel guilty because I have never purchased a stock in the Hager portfolios because I was bullish on the market, nor have I ever sold a stock in the Hager portfolios because I was bearish on the market.

I buy stocks because I like their potential and, because I think the price is right. I sell stocks because I believe the outlook for the company has changed for the worse, or because my feeling is that the stock is substantially overvalued.

When I made a lucky call and sold a lot of my stocks in August 1987, I did not expect a market break. Some of my stocks seemed so overbought that the reason for selling was compelling. By coincidence, the market dropped over 1,000 points two months later. Market Timing, or the proposition that you should sell when you know that stocks are going down and you should buy when you know that stocks are going up, is a dangerous investment fallacy. The reason you should not attempt to do that is because it can't be done successfully.

No technical trading program works for the individual investor who has to pay full commission and does not have enough money to influence the market. In order to influence the market, you definitely need more than \$500 million. To prove this to you, I quote from a transcript of the above mentioned television show:

"Now, before we meet tonight's special guest, let's take one of our periodic looks at why every self-respecting market technician treats the sentiments of his colleagues with contempt, as we track the embarrassing record of market advisors. So come along as we are 'Gonna Take A Sentimental Journey'.

Our trip begins with the Dow at 689 on August 2, 1963, the first year Investor's Intelligence conducted its poll of market newsletter writers. With 91.4% of those surveyed bearishly calling for a short or long-term decline, and outright bulls at an all-time low of less than 9%, the Dow then proceeded to rise 250 points in the next twenty-one months, which represents 38%.

Ten years later, in a week when the Dow was moving to new highs, nearly 62% of those polled thought the market would head even higher. And what came to pass? You guessed it. Down 470 points in twenty-three months. Not surprisingly, by the time the Dow slipped to a twelve-year low at 577 on December 13, 1974, the mood was glum again. More than 63% of market advisers surveyed called for further declines, and true to form, the market rose 425 points, more than 70% in fourteen months.

On January 14, 1977, with just 21% of advisers bearish, the crowd missed the mark once more as the Dow derailed with a 235 point loss over a period of fourteen months. And just eight-and-a-half years ago, with the Dow at 784, the clouds hung heavy over Wall Street in anticipation of further declines, with nearly two-thirds of investors feeling bearish.

The market, in turn, took off with a vengeance, rising more than 1900 points in five years. On August 28, 1987, the week the Dow touched its then all-time high at 2722, more than 60% of the advisers were, not to put a fine point on it, full of bull. Seven weeks later, the Dow, you may recall, was more than 900 points lower. On December 2, 1988, though just

Fred Hager's Investment Guide and Outlook

21% of those polled were bullish, the lowest total since June, 1982. The Dow, then just under 2100, rallied an impressive 907 points in thirty-one months.

I do not have later data on timing accuracy but I assure you forecasting accuracy will not improve in the future.

I have always said you can't time the market. If I had to stand on my market timing record, I would be consistently bullish, and this way I would at least be right about 60% of the time, and thereby beating the average technician without fail.

The reason why these guys are wrong so often is because they are subject to the same psychology we all are. It is the herd instinct. If more people are selling than buying, the market goes down. If more people are buying than selling, the market goes up. Therefore, if the market is going down, the average person simply does not have the intestinal fortitude to buy. Market advisers are no different in this respect. There is another phenomenon affecting newsletter writers. If you write bearish letters during a bull market, you lose circulation. If you write bullish letters during a bear market, you lose circulation. When the Dow hits a low in a bear market, a few new books on how to sell short always come out. Unfortunately, most people like to read the stuff that re-enforces their own convictions. If we could become a little less subjective, we would have it made. Let's face it: how many of us make an effort to read anything that we know does not agree with our view?

I probably don't have to tell you that I am a conservative. In spite of that, I read the New York Times. How can I argue with the liberals if I don't know their point of view?

Fred Hager's Investment Guide and Outlook

The "Buy Low, Sell High" Illusion

By Fred Hager

This is one of the oldest pieces of investment advice on record. It sounds so basic that one could hardly argue with it. The real question is, however: Will it help you improve your investment results?

The answer is, probably not. Following this advice keeps you in the wrong stocks most of the time. The reason is quite simple: Good stocks are almost never really cheap compared to the other stocks at any given time. Of course, in bear markets, most stocks are bargains, but good stocks will be relatively more expensive. You generally have to pay more for quality. If you look for price only, you will inevitably wind up with less quality. This actually applies to almost everything.

Most sophisticated investors are also aware of the fact that if you bought every new high and sold it three months later, you would make a lot more money than if you did the opposite, buying every new low and selling it three month later.

The explanation is obvious. The reason a stock makes a new high is the perception of many investors that the stock is a good investment that will go higher. Conversely, the reason a stock makes a new low is the perception of many investors that the stock is a bad investment that will go lower. In spite of this, many investors are looking for stocks that are making new lows to pick from.

There is another school on Wall Street that adheres to another Wall Street adage: buy high, sell higher. In my opinion this makes more sense for many reasons, both fundamental and technical. If you search for your buy candidates among new highs, you will invariably stumble onto companies that have exciting fundamentals, turnarounds, new management's, new products and new markets.

Technically, a new high implies no unhappy stockholders are ready to sell, since they all have a profit in the stock. There is no overhead supply waiting to get out of the stock, which would keep pressure on the price.

Just think of the opposite, a new low, where almost everybody has a loss (except for the shorts) and is thinking about cutting it by selling the stock. The long term holders, who may still have a marginal profit, wonder whether they should protect what profit they have left by doing what everyone tells them to do, which is, "sell the stocks that are going down".

In his excellent book, *How to Make Money in Stocks* William J. O'Neil, the founder of *Investors Business Daily* and a legendary investor himself, tells how he came upon the strategy of buying new highs. I highly recommend his book. I believe it is one of the best book you can find on the subject. I disagree however with his advice of selling when a stock you own drops 8% below your purchase price. This approach would have gotten me out of my big winners.

O'Neil states that he witnessed hundreds of institutions, over a quarter of a century, which concentrate on the so-called undervalued theory of stock selection underperforming the better money managers.

Fred Hager's Investment Guide and Outlook

In 1960, O'Neil did an in-depth study of the three best performing mutual funds for the previous two years. The Dreyfus Fund was the performance leader, beating its competitors in some cases by more than 100%. After looking at over 100 new stocks in the then tiny portfolio over the previous couple of years, he made a stunning discovery.

"Every single new stock was purchased at the highest price the stock had sold for in the past year. In other words, if a stock bounced from \$40 to \$50 for many months, Dreyfus bought as soon as it made a new high in price and traded between \$50 and \$51. The stocks also formed certain recognizable chart patterns before they went into new high ground."

How to Make Money on Stocks

As incredible as it seems, you can improve your investment success by substituting, "buy high, sell higher" for "buy low, sell high". The biggest problem you have in implementing this rule is psychological.

On May 1, 1990, I wrote in this letter that I finally bit the bullet and bought Microsoft at 27 times earnings for \$57.25. A year later, Microsoft was up about 100% in a market where the Dow stayed flat. The stock also split. My problem was psychological; I was not willing to pay 25 times earnings at the time. I had little excuse for not buying it, since I had no question about Microsoft's potential. By the way, if Microsoft had not split since 1990, it would be worth over \$1500 in 2002.

How dumb can you get?!

The caveat here is, of course, if you buy a stock at a new high you have to know what you are doing. The new high puts the stock technically into the right position for a move up. Now you have to make sure that the fundamentals justify your investment. Some new highs are near the end of a trend. It is usually easy to identify those overvaluations. Nothing grows to the sky. You must be careful though, if a stock has had a high multiple for the last five years and its earnings are growing fast, you can assume that the stock will have a high multiple in the next few years.

Fred Hager's Investment Guide and Outlook

The Investment Guru Illusion

By Fred Hager

I have always said that nobody can time the market over a long time on a consistent basis. Why then are there a few timing gurus with outstanding records of calling turns?

The explanation is simple. These gurus are the product of the rule of mathematical probability. Here is how it works: Let's start with 1024 analysts making a prognosis for the near-term market. The assumption is that each of them makes a definite call, either bullish or bearish. The calculation of the odds is identical to the tossing of a coin, which is 1, meaning that the chances of a coin coming up heads or tails are even. By the same law of probability, 50% or 512 analysts will be right no matter which way the market turns. To their clients they have become heroes.

The evolution of the guru is evident from the table below.

512	1	The first 50% of the original 1024 have become heroes by the simple mathematics of probability, they now have a 50% chance at making 2 good calls in a row.
256	2	Of course 50 % of the above were right leaving 256 analysts a chance for 3 good calls without a mistake. These people are now considered market timers. The bad calls are forgotten and the flawless record of the last two calls is widely circulated.
128	3	We are now down to 128 analysts which have been right on three calls in succession. These guys by now are market technicians in their respective firms. The PR departments milk the success of their gurus for all its worth
64	4	Now we are looking at 64 winners out of the original bunch. Being right four times without fail commands a lot more salary. If they don't get it from their current firm, they will be offered more by competing firms. Four good calls gives you true technical guru standing.

Once you have become a guru, you are in a position to make bad calls without losing your standing. People have short memories and the guru will always remind you of all his good calls. This will be advertised in the financial press. When a guru is introduced to make a speech, only his good calls are mentioned.

It is therefore not surprising that Joe Granville can still make good money giving timing advice after being wrong so consistently over the past 20 years. You would have lost 90% of your money had you followed his advice. Old Joe of course is only one of many.

Next time, when you're tempted to follow the advice of a guru with a fantastic timing record, think about the law of averages and realize that the chances of the forecaster being right are 50-50, about the same as yours and mine.

Fred Hager's Investment Guide and Outlook

The Economy And Technology Spending

Why Do We Still Believe the Technology Sector Is The Best Place To Invest?

By Sam Ouyang, PhD

For technology investors, the past two years are full of pain and frustration. It is torturing to watch the NASDAQ drop from 5100 to 1500 and investors' darlings such as Ciena, Juniper, and Amazon and Broadvision lose more than 80% of their market value. It is frustrating to see rallies kept fizzling into devastating plunges, and it is depressing to read bankruptcy stories of dot-coms, and waves of layoffs in tech companies almost every day for the past eighteen months.

With the market plunge, the gloomy IT outlook, continual earning misses, and Wall Street scandals, no wonder investors are losing interest and confidence in technology investing.

Over the past year, as the NASDAQ kept declining, ridiculing high-tech companies has become a popular sport, and everyone seems to be playing it. Some say IT's revolutionary impact is way overestimated. Some claim the IT boom was just hype and a bubble. Some go as far as claiming that Internet stocks were conspiracies of stock analysts and other Wall Street and Silicon Valley sleaze balls.

With so much talk about the overcapacity in the technology sector, and corporations' shrinking IT budgets, it is understandable that investors are scared and suspicious of the potentials in the technology sector. However, the reality is not as bad as some press reports paint. Actually, things are far better and, many signs indicate that the bottom for the technology sector is not far away. Our research indicates, as the rest of this article highlights, the great potentials the technology sector provides are still waiting to be tapped.

How Important Is The Technology Sector To Our Economy?

Despite so many negative reports about the technology sector and the new economy, the information technology sector has become a very important part of the economy. While currently IT-producing industries represent only 7% of all businesses, they accounted for roughly 28% of overall real economic growth between 1996-2000. More than 15% of our GDP already comes from the New Economy. As a matter of fact, Software, IT, and communications equipment provided a massive boost to our national economy, contributing more than 20% of output growth in the latter half of the '90s. And these emerging IT industries are unstoppable on track to represent more than 25% of the U.S. GDP and 50%+ of stock market capitalization by 2005.

Accept it or not, the technology sector has become a significant part, and the most active part of the economy.

More importantly, technology has produced far-fetched impacts on the economy and the traditional industries. One of them is that the technology sector has boosted productivity. Starting in 1996, American productivity growth exploded to 2.5% per year, up from 1.4% per year between 1975 and 1995. IT products and IT-producing industries contributed roughly two-thirds of this extraordinary growth. And it's worth noting that this growth endures. During each of the previous eight recessions, productivity growth turned negative when the economy contracted. By contrast, during the economic downturn of 2001, productivity growth remained robust at about 2%, jumping 5.2% in the 4th quarter of 2001. (Of course, part of the productivity rise should be attributed to layoffs of workers in that period.) A Labor Department report in May showed that productivity--output per hour worked--grew 8.6% in the first quarter and recorded its biggest increase in nearly 19 years. This is critical because the US can never compete in the losing game of "Who can pay their workers least?" Technology-inspired productivity means we don't have to.

IT also lowers inflation and makes economic growth and bull markets last longer and more durable. Falling IT prices have directly pulled down average inflation by 0.5 percentage points a year. From 1989 to 2000, inflation in IT-intensive industries was just 1.3% per year on average,

Fred Hager's Investment Guide and Outlook

compared with 3% in less IT-intensive industries. In addition, by raising their productivity, IT is lowering inflation of other industries. This makes the economic growth more durable and sustainable. In other words, due to the structural change caused by the technology sector, future bull markets may last longer before the Fed steps in to increase interest rates to check inflation.

What Has The Technology Sector Gone Through In The Past Two Years?

What the technology sector experienced a few years ago was a well-known dot.com bubble. Many dot.coms that had virtually no sales, let alone profits, but did have business plans, were able to get millions of dollars from those get-rich-quick venture capitalists. For those dot.coms, getting "eyeballs" was the most important business goal. To achieve that, they bought a great number of routers, switches and servers to have a great amount of bandwidth. When the bubble burst, they had to sell their routers and switches at a huge discount. This inevitably depressed the prices of servers, routers and switches and hurt manufacturers such as Cisco, Sun Microsystems and Juniper, etc.

What the technology sector has gone through is basically consolidation. To put it in a historical perspective, it is quite normal. Whenever a new technology and a new industry emerge, there is some kind of speculative investment boom, though with different magnitude. The enormous promise of new technologies, and new industries lures investment and enriches the first-wave investors. Their get-rich stories then direct more investment into these new technologies and new industries and hence make the area overcrowded and the competition in these industries fiercer. The investment boom inevitably drives down the rate of return on investment (either in public equity or private equity markets), and hence drive many companies out of business, which are weak technologically and financially. In the last century, railroad, automobile, telephone, and personal computers all experienced this kind of boom-bust cycle.

What is going on in the technology today sector is the same. Not long ago, thanks to a great amount of speculative investment, many technology companies came to market in a "pre-IPO stage." In other words, they were not ready for prime time, lacking the traditional qualifications for an initial public offering. They were companies that, in the past, would have been financed by friends and relatives of the entrepreneurs who started them, and by deep-pocketed venture capital firms. But the NASDAQ was gracious enough to allow early-stage companies with little or no profits to list shares. The result was that the technology sector became too crowded. Remember how many wireless service providers and Internet service providers existed three years ago?

What has happened for the past two years is a process of purging and consolidation in the technology sector. Those companies that did not have good management, well-protected intellectual properties, good products, and solid balance sheets have been weeded out. The market is selecting the fittest for survival. This process is certainly painful because a lot of businesses go under water and a lot of investments become worthless. The good news is that after this purging process, what is left are the strongest and healthiest technology firms. And these firms have great chances at becoming the most successful technology players in the long run.

The Technology Sector Is Not As Bad As The Media Portrays It To Be

We have heard too many stories about the sorry states in the technology sector. Unfortunately, most of them are misleading.

Take the IT investment as an example. According to the Department of Commerce, with prices falling, the plunge in IT producers' revenues gives misleading picture of the role that IT plays in the overall US economy. For instance, in the fourth quarter of 2001 businesses spent \$80.4 billion on computers and peripheral equipment, 20% less than in the first quarter of 2000. Because prices declined by 30% over the same period, however, businesses actually acquired 14% more equipment in Q4 2001 than several quarters earlier. And even though real IT investment dropped

Fred Hager's Investment Guide and Outlook

10.7% over 2001, the level for the fourth quarter of 2001 remained higher than any time prior to early 2000. As a result, the total IT investment for 2001 was 16% more than 1999.

Companies slowed down investment in IT initiatives in 2001, but this appears to be catching up to them now, with fewer executives expressing confidence that they are ahead of their competitors in terms of the company's use of technology. According to Darwin Magazine, in January, 42% of executives agreed that 12 months ago their company was ahead of its competitors in terms of its use of technology to improve business. When they were asked this question in December 2001, only one-quarter (24%) believed that their organization was ahead. A greater percentage of executives surveyed (43%) felt their company would be ahead of its competitors in terms of its use of technology 12 months from then. That's why companies' CIOs have longer "to-buy" lists and most firms indicate that they would increase their IT spending from their 2001 levels.

Looking forward, since many types of IT equipment is replaced every three to four years, the IT replacement cycle is going to kick in this year and next year for the companies to maintain their net IT capital stock.

All of these indicate that the slowdown in information technology investment will soon end.

Why Does The Technology Sector Still have A Lot Of Potential?

Despite a lot of talk about the new economy, broadband revolution, and wireless revolution, there is still only a small portion of enterprises and consumers who have just started feeling the real impacts of these new technologies.

Take broadband as an example. As of December 31, 2001 there were 10.7 million broadband subscriptions in the US, 62% more than a year earlier, but only 15.47% of all Internet subscription in the country. And the migration to broadband is accelerating. Over Q4 2001, the quarterly growth rate of broadband subscriptions grew to 15.8% from 14.6% the previous 14.6%. If the present trend holds, in 2003, broadband will reach 20% of households in 2003. One of the important implications is that the much-awaited investment recovery will take off to meet rapidly growing broadband demand once the 20% "critical mass" is reached early next year. The software industry will benefit enormously from this because the more pervasive the for-fee broadband infrastructure becomes across the economy, the more economical it will be for software companies to write broadband-appropriate enabling applications, especially in education and medical service areas. Video on demand and online games will also become more popular and provide software and semiconductor companies many opportunities.

Online business is another interesting example. It is widely known that networking technologies are not only enablers of new sales and purchasing channels and help firms to improve their competitiveness. A recent survey shows that on the manufacturing side, only 19.2% of the firms provide online support to customers and 7.1% engaged in online bidding; and on the sales side, only 11.1% firms received online payment and 19.2% provide sales support, and on the buying side, only 8.6% made online payments and 7.1% engaged in online bidding. These data suggest that firms are still in early stage of exploiting network technologies. Although there are many reasons for this, the truth is that the potential for networking technologies will be great and will be exploited in the next few years.

Furthermore, despite some pessimism about the technology sector, companies are still counting on IT to help improve the bottom line and to pull ahead of competitors more so than before. According to a survey conducted by Darwin Magazine, one third of the surveyed firms said that IT was important or extremely important to the company's ability to meet its financial objectives over the past 12 months. Looking forward, 55% of those surveyed said IT would be important or extremely important in the next 12 months. Additionally, the majority (81%) of executives in the survey said they view their organization's IT as a value center, meaning that IT was a strategic investment critical to growing revenue and differentiating the company from its competitors. This

Fred Hager's Investment Guide and Outlook

is an increase of 5% from the December poll. The remaining 19% said they viewed IT as a cost center – an overhead expense necessary to maintain the company's information and systems.

The point is clear: IT's real impacts on business are just being felt and businesses are still anxious to use IT to improve their efficiency and competitiveness. This means the potential the technology sector provides is still enormous.

Why Is the Technology Sector Still the Best Place for Investment?

The most important force driving stocks' performance is companies' profits. In other words, to have superior long-term performance in a stock, the stock must have exceptional earnings performance for a long time. Given the potentials the technology sector provides, and the early stage of the application of information technologies to businesses, the dynamic technology sector is the only area in which companies can constantly provide exponential revenue growth and earnings growth for a long period in the future.

Although history may not be the perfect forecast of the future, looking at the performance of investment in technology companies in the past 10 years, we can still appreciate how attractive the technology sector has been and will be for investors.

A study shows that in the 1991-2001 period, which covers two bears markets and one long bull market, among the 20 stocks whose share prices increased the most for that period, fourteen were in high technology, and nearly all of them benefiting from the Information technology boom. No. 1 on the list was Dell Computer Corp., whose sales have increased from less than \$1 billion to more than \$30 billion in a decade, in large part because of the firm's agility in selling online and the demand of consumers and businesses for products that link to the Internet. No. 2 Emulex makes sophisticated connectors that speed the storage of electronic data. No. 8 Cisco Systems Inc. is the prime manufacturer of Internet infrastructure. Other well-known tech names on the list include EMC Corp. (4), Applied Materials Inc. (5), Oracle Corp. (6) and Maxim Integrated Products (10). The performance of the 20 stocks was astronomical. Dell's stock price, for example, increased by 7,890%. In other words, an investment of \$1,000 grew to \$79,900 in 10 years. Even the No. 19 stock, Intel Corp., rose 1,668% -- not including dividends.

Undoubtedly technology stocks also rally most when the market rebounds. As the following table shows, in the September/2001—January/2002 rally, compared to other stocks, technology stocks in the Hager Tech Portfolio with solid business models and balance sheets rallied impressively. On average, the Hager tech stocks gained by 49%. From Sept. 30th 2001 to Dec. 11th, 2002, the Hager Tech stocks outperformed the Dow by 635%, and outperformed the NASDAQ by 156%. This means that the market is still expecting quality technology stocks to be the future winners. If in the bear market, these technology companies are able to rally so fast, think about what will happen when the bull market arrives.

Besides the great market potentials the technology sector provides, the other very important reason for investing in the technology sector now is that the risk for losing money is much smaller. After the consolidation process and after many weak companies are purged from the market, the technology sector is becoming a much better and safer place for investment. The market potential the technology sector has becomes realistic and clear. The technology sector is becoming less crowded. Remaining companies are stronger technologically and financially and have much better chances to succeed. If buying technology stocks three or four years ago was speculation, now they are real investments because you are investing in very healthy technology companies which have great chances to become tomorrow's Microsoft, Intel or Cisco.

Fred Hager's Investment Guide and Outlook

Performance of Hager Tech Stocks in the Period of September 30, 2001 to December 11, 2001

Stock #	Price Appreciation
1	231%
2	223%
3	181%
4	167%
5	131%
6	93%
7	77%
8	66%
9	65%
10	65%
11	62%
12	59%
13	57%
14	52%
15	33%
16	31%
17	25%
18	23%
19	21%
Hager Portfolio	87%
S&P 500	19%
Dow Jones	11.90%
NASDAQ	34.20%

Note: In the last market rally from Sept. 30th 2001 to Dec. 11th, 2001, the Hager Tech stocks outperformed the Dow by 635% and outperformed NASDAQ by 156%. Since then, the market has been experiencing a correction. But given the strong fundamentals of the companies in the Hager Portfolio, I believe that these stocks will have similar potentials to rally in the next upward move.

Fred Hager's Investment Guide and Outlook

Which Technologies For The Long-Term Investor?

Technology investing is tougher than ever, not just because of the downturn in tech spending, but also because of the fierce competition among players fighting for survival, or looking to crush the upstarts. No matter how good a technology is these days, there are no guarantees the company producing it is a good investment.

With my team of researchers, we have selected only a few of the best companies in the technology universe.

We believe there are companies in the following sectors that are becoming the leaders in their niches contributing critical technology to their industries

- **Mobile Communications**
- **Optical Communications**
- **Power Management**
- **Enterprise IT**
- **Tomorrow's PC**
- **Consumer Electronics**

Fred Hager's Investment Guide and Outlook

Mobile Communications

By Eric Jhonsa

The mobile communications industry went through its first great transition period in the early-to-mid 1990s. It was during this time frame that the wireless service providers the world over began to replace and upgrade their analog, or 1G, mobile networks with digital, or 2G, networks. By allowing the average mobile phone to be smaller, lighter, and have far greater battery life, and by allowing networks to obtain capacity increases that brought about significant reductions in service rates, a revolution was quickly spawned. Mobile phones soon went from being expensive novelty items used only by business professionals and the wealthy to being well within the reach of the masses, whether in Boston or Bangkok, Seoul or Stockholm. Today, over one billion people around the world subscribe to a mobile telephony service, more than twice as many as those who have own PCs or have access to the Internet. Another billion subscribers may be own board before this decade comes to a close. Likewise, nearly 400 million mobile phones are sold on an annual basis, roughly three times the number of annual PC sales that take place. This type of explosive growth single-handedly paved the way for the industry's leading phone, network equipment, and semiconductor manufacturers to move from being also-rans in the tech sector's pantheon to being among its greatest standouts, with the companies' share prices posting extraordinary returns in the process.

Today, the mobile communications industry stands at the brink of another great transition, and was the case the last time, both the public and Wall Street appear quite unaware of the magnitude of what is set to occur. During the next few years, the industry's structure will shift from one where voice and text messaging services make up the overwhelming majority of revenues to one where advanced, Internet-based data services will also take up a very large piece of the pie. Just as the first transition was facilitated by the movement from 1G to 2G networks on the parts of wireless operators, this one will be the result of a move from 2G to 2.5G and 3G networks that are capable of supporting these lucrative services. Whereas data can only be accessed on 2G networks by means of first "dialing in" to establish a connection before downloading can start, with any downloads being charged based on the number of minutes that a connection is used, the data connections of 2.5G and 3G networks will be "always on", which means that downloads will begin almost instantaneously, and can be billed based on the amount of content downloaded rather than the amount of time consumed. And while 2G networks generally offered download speeds of only 9-14 kilobits/second, 2.5G networks will operate at average speeds of 20-70 kilobits/second, while the first 3G systems will work at 150-600 kilobits/second. Future 3G networks will most likely increase that number above the 1-megabit/second range.

Not only will such technological advances greatly improve the quality of service offered to a given user, they will also significantly improve the amount of capacity offered by a data network, in turn drastically lowering the cost of downloading a given amount of content. Eventually, these capacity improvements should be able to reach a stage where 3G mobile data connections can be used to offer flat-rate broadband Internet access services to homes and businesses, making them a direct competitor to cable and DSL services along the way. Numerous operators have begun launches of their 2.5G services during the course of the past year, and the upcoming months should see a bevy of mobile phones supporting 2.5G connections hit most world markets. A couple of operators in South Korea and Japan have already gotten their 3G rollouts underway, and many others around the world will begin their launches during the next 12-18 months. Nearly all of the world's leading mobile phone manufacturers have committed to releasing phones containing 3G connections at some point in the near future, if they have not already done so. Both 2.5G and 3G networks also stand to be supported by powerful wireless LAN, or Wi-Fi, networks scattered throughout the world. While Wi-Fi consumes too much power and has too short a range to act as 2.5G or 3G substitute, it does stand to give users speeds of several megabits/second or higher in heavily-trafficked urban areas such as airports, shopping malls, and business centers, and at a fraction of the cost of any competing solution.

However, as important as these advances in mobile communications technologies are, the evolution of the mobile phone into a data-oriented Internet appliance will not end with the mere

Fred Hager's Investment Guide and Outlook

addition of a high-speed connection – the continued growth in the amount of computing power that can be crammed into a handheld device will make it possible for a number of other technological advances with regards to product functionality to also occur. One of the more basic changes will be the mass adoption of color screens. Whereas most phones sold today contain staid, uninspiring monochrome displays, the majority of phones sold two years from now will possess color displays capable of showing 256 colors or more, something that should make users far more partial to using their phones for data-related services. Already, over half of all phone sold in South Korea and Japan contain color displays, and their prevalence has played a key role in these nations' leadership positions in rolling out 2.5G and 3G technologies. Meanwhile, one important, yet overlooked advance is the addition of position location capabilities within phones: Whether handled by a satellite system such as GPS or the mobile network itself, this capability, which allows the location of a mobile phone to be detected within a range of only a few meters, will make way for the development of data services that offer major benefits to users both in terms of security (detecting the exact location of a 911 call placed on a phone) and convenience (obtaining traffic reports or weather forecasts based on one's location).

Another major development will be the integration of advanced software platforms such as Java into low-cost, mainstream phones. Such platforms pave the way for software developers, whether large firms such as Electronic Arts and Oracle, or smaller, privately owned startups, to produce applications ranging from games to spreadsheets to inventory-management tools – applications that have immense value to businesses and consumers, and which can quickly be offered to millions of users globally. More expensive phones, meanwhile, will not only contain platforms such as Java, but also advanced handheld operating systems such as Palm OS, Microsoft Pocket PC, and Symbian Epoc, which offer fully-fledged PDA functionality; and it may not be long before technological advances allow the costs of these phones to be low enough for the mass market as well. Last but not least, there is the integration of multimedia capabilities onto phones. Spurred partly by the growth in the processing power of the CPUs that go into phones, partly by the development of low-power 2D/3D graphics processors that can be placed into these devices, and advances in component miniaturization that make it possible for image sensors and converters to be added, next-generation phones will support 3G gaming and streaming video playback, and contain built-in digital camera and/or videoconferencing functionality. In short, the world of the Jetsons will have come just a little bit closer to reality.

Some of the firms that will profit greatly from the upcoming explosion in the wireless data services market be the very same phone, equipment, and semiconductor manufacturers who made their fortunes during the 2G boom; others will be firms who have played a relatively small role in the 2G world, but are uniquely positioned to have much greater influence in the 2.5G and 3G realms; and as was the case with the shift from 1G to 2G, as well as the PC and Internet booms, others yet are almost entirely outside the public radar at this point, but nonetheless have the potential to grow into industry giants should they properly execute on their business plans.

Fred Hager's Investment Guide and Outlook

Optical Communications

By Eric Jhonsa

Of all the tech-related industries that have been hammered over the course of the past two years, none has had a rougher time than the one for optical communications components, equipment, and services. No other tech industry has seen the shares of its companies hit as hard as this one, whether in terms of percentages or dollar amounts, and none is presently witness to quite as much bearish commentary on the parts of investors and pundits. And taking a quick look at the present state of the industry, none of this is particularly difficult to understand. Dozens of formerly promising optical service providers, ranging from backbone operators such as Global Crossing and 360 Networks to local operators such as Metromedia and Yipes, have gone bankrupt. So have many startups developing promising new optical technologies. And while their larger peers may still be around, most of them have seen their revenues drop by 70% or more. Adding to the malaise is the fact that the availability of the cable, DSL, and fixed wireless broadband Internet connections, not to mention low-cost optical Ethernet connections, needed to drive demand for the capacity offered by bleeding-edge optical networks remains limited, as most of the independent competition has died out and left the field firmly in the hands of lethargic local phone and cable monopolies. And with debt and equity markets remaining hostile to the notion of funding new broadband/optical service providers, their chokehold may not go away in the near future. Lastly, the fact that Hollywood's copyright fears have put a choke-hold on the amount of multimedia content available online (at least legally) definitely has not helped in driving consumer interest in broadband, or in driving heavy usage among those who already possess broadband connections. Whereas the dominoes are lining up quite nicely in the wireless communications arena for a major period of growth to take place, the same clearly can't be said for its optical cousin.

So why are we still cautiously optimistic on some of the companies in this sector? First, because a number of them have seen their share prices beaten down to levels that can be considered quite attractive from a value investing perspective. It was not too long ago that the terms "optical" and "value investing" mixed about as well as oil and water, but fate can often play cruel twists. A number of leading optical equipment and component vendors are now trading at or near their book value; some are even trading within close range of their cash value. Of these companies, those that have strong product lines and healthy balance sheets, and can thus be expected to weather this downturn and emerge from it in strong competitive positions, may be able to post solid investment returns even if a full-blown recovery for the industry does not occur anytime soon. A second reason for optimism is that while the current regulatory and content barriers related to increasing the rate and quality of broadband penetration among homes and businesses are formidable, they are not indomitable. There are already significant efforts on the parts of numerous lobbyist groups both in the United States and elsewhere for government agencies to take a more proactive role in bringing new broadband technologies into the commercial marketplace, and increasing their rate of adoption. The demand is clearly there on the parts of both consumers and businesses, and the technology needed to meet that demand in a cost-effective manner is also available. Given these facts, and growing political awareness on the importance of broadband adoption in spurring both IT industry and macroeconomic growth, it is quite unlikely that the current impasse will remain in place indefinitely.

Meanwhile, it should be noted that while the optical communications industry may have fallen into a deep depression, this by no means has put a halt to the development of groundbreaking new technologies and protocols aimed at making optical networks more powerful, reliable, and flexible, and less costly than they are now. The most important of these are as follows:

1. Dense Wavelength Division Multiplexing (DWDM) Systems - DWDM allows multiple beams of light, each of which carries high-speed optical signals, to be sent down a single strand of fiber. The world's first commercial DWDM systems offered the ability to carry four beams of light on a fiber, with each beam operating at a speed of 2.5 gigabits/second, making for a total fiber capacity of 10 gigabits/second. Today's high-end DWDM systems can carry up to 320 beams operating at a speed of 10 gigabits/second each, allowing for a total capacity of 3.2 terabits/second. Capacity levels continue to more than double on an annual basis.

Fred Hager's Investment Guide and Outlook

2. Tunable Lasers - Of the various analog components needed to make an optical network run, none are more costly than the lasers used to transmit DWDM signals over a network. Each laser used in a DWDM system must be based on a different color; in order to prevent interference from occurring, and in order to maintain an adequate reliability level, duplicate lasers have to be kept stored. By allowing a laser to be dynamically "tuned" to any color instead of being fixed at a single color, tunable lasers have the ability to drastically cut down on the number of spare lasers that have to be kept in stock in order to guarantee high reliability levels, and thus the amount of money spent to accomplish this task.

3. Ultra-Long-Haul Transmission - With the aid of devices known as erbium-doped fiber amplifiers (EDFAs), traditional DWDM systems are able to carry optical beams for a distance of up to several hundred miles without losing signal integrity. While this feat may sound impressive, the problem is that the distance between network junctions on many optical backbones can be well over 1,000 miles, and in some cases, 2,000-3,000 miles. Thus, when a beam has traveled to a distance where it is no longer to maintain signal integrity, the signal has to be converted from optical to electronic form and then "regenerated", a process that requires the installation of a whole new DWDM system at the point of regeneration. By using specialized DWDM components and a new form of amplifier technology known as Raman amplification, ultra-long-haul transmission systems make it possible for a signal to go 2,500 to 4,000 miles (depending on the capacity of the system being used) without the need for costly regenerations.

4. All-Optical Switches - Today, whenever an optical beam reaches a network junction where the information carried via one optical fiber (and hence one beam) has to be moved onto another, it is necessary for the optical switches at the junctions to convert the optical beams carrying the information from optical to electronic form, regardless of whether or they are in need of regeneration for signal integrity issues. The recent development of all-optical switches, which can deflect and redirect beams from one fiber to another, will put an end to this need. While a number of technologies are being used to develop all-optical switches, ranging from sophisticated, three-dimensional mirrors known as micro-electronic mechanical systems (MEMS) to an advanced variant of the bubble-insertion technology used for inkjet printers, virtually all platforms will have the ability to reduce the costs of optical switches by at least 60% when compared with the pricing levels presently maintained by traditional, opto-electronic switches.

5. Optical Mesh Networks – While over 2/3s of all traffic on most optical backbone networks is related to data (primarily Internet-related traffic), most networks are still built using the exact same architectures that existed when voice services (e.g. phone calls) accounts for the lion's share of all traffic. Such architectures, based on a platform known as the SONET ring, are both wasteful (for every optical link used, another has to be kept available for backup) and inflexible (it takes weeks, if not months, to move an optical beam from one fiber to another). The optical mesh platform, meanwhile, can reduce the number of links needed for backup from 50% to 20-30%, while allowing the provisioning of a beam from one path to another (i.e. directing a beam originating in Los Angeles to go to San Francisco instead of Phoenix) in the course of minutes, via an easy-to-use software application. The benefits of these two advances don't merely extend to a drastic reduction in operational costs and an improvement in the speed of deploying services, but also to the creation of new, time-sensitive, revenue-generating services that otherwise were not possible.

6. 10-Gigabit Ethernet – The Ethernet standard, which presently operates at speeds up to one gigabit/second, is by far the most inexpensive, high-speed optical and non-optical communications protocol in existence. As a result, it is the standard of choice in most corporate, local-area networks, and, as stated previously, is being used by some telecom carriers to offer last-mile optical Internet access to businesses at a fraction of the cost of competing solutions. But since the speed of the most powerful Ethernet links remained 1/10 of the 10 gigabits/second that has been capable with traditional SONET links running on the ATM protocol (note: the SONET standard is used both with SONET ring and optical mesh networks), it has stayed out of the realm of metropolitan and long-haul optical networks. The developments of the 10-Gigabit Ethernet standard, for which chipsets have already been developed, and for which products are already in trial mode, will obviously change all of this. Presently, it is expected that network capacity offered via the first 10-Gigabit Ethernet networks will cost 70% less to provide than

Fred Hager's Investment Guide and Outlook

comparable SONET offerings, and these cost reductions should only grow in magnitude as the technology becomes more mature.

7. MPLS and IPv6 – 10-Gigabit Ethernet may be able to cut down on costs, but there is still a need to make sure that adequate levels of quality-of-service (QoS) are provided when compared with ATM/SONET settings. Although done at great expense, ATM/SONET possess a number of built-in QoS mechanisms that can not be found in a standard, no-frills Ethernet deployment. And in the telecom world, where reliability is placed at an even greater premium than price and performance, this is no small thing. The MPLS and IPv6 protocols allow Ethernet to reach an even footing with ATM/SONET, while still keeping its price/performance advantage intact. In the case of MPLS, this is done by using advanced software algorithms to analyze the content of a packet of Internet traffic in order to determine which route it should take over a network. For example, packets containing video, Internet telephony, or corporate e-mail content could be given greater priority than other types of content, and hence sent down less-congested routes. Routes could also be dedicated to individual corporate customers, thus granting them greater flexibility with regards to their ability to lease and use a network's capacity. Meanwhile, IPv6, which is meant to act as an upgrade to the IPv4 protocol that most of today's Internet packets – whether traveling on an Ethernet or an ATM/SONET network - are based on, should get rid of some of the need for ATM/SONET for multimedia applications by offering Ethernet networks the ability to make sure that video and Internet telephony packets are delivered to a user via the assigning of a "logical sequence," which guarantees that they arrive in the right order. Looking beyond QoS-related matters, it should be noted that IPv6 should also greatly improve the capabilities of Internet-based communications on optical networks by improving the efficiency with which Internet-based video transmissions can be "multicast" to millions of users at once, and that it should improve their performance by reducing many of the latency-related problems tied to the processing of IPv4 packets by Internet routers.

Taken individually, none of these technological developments possess the ability to lift the industry out of its present slump. However, the whole is clearly far more than the sum of the parts here - taken cumulatively, their effect will be to completely transform the modern-day optical network into something far superior to existing solutions in virtually all respects. An optical network in which nearly every component, product, architecture, and protocol used has been created with the specific aim of tailoring to the market for high-speed, high-quality, high-reliability Internet services. Once this network comes into shape, it would be surprising if investment-related interest in this industry (both for building out networks, and investing in the companies themselves) does not begin to improve.

Without a doubt, the optical communications industry is presently in a state of turmoil. But that turmoil is also being well reflected on the ticker tape, and there are signs out there – both business and technology-related - suggesting that a select few companies in this field have the ability to be excellent contrarian investments, provided that one has the patience and fortitude to weather the current storm.

Fred Hager's Investment Guide and Outlook

Power Management

By Eric Jhonsa

Mention the term “semiconductor” to someone, and he/she will most likely think of products such as microprocessors, digital signal processors (DSPs), flash memory, and Ethernet transceivers. In other words, chips whose primary functions involve computing, storing, or communicating bits of information. And in all fairness, these chips have traditionally contributed the bulk of the semiconductor industry's annual revenues. But there is another part to this industry, and it particularly bears watching at this point in time: semiconductors used to handle not information, but electricity flows. The market for these products, generally known as power chips, predates the invention of the transistor itself, and some of the companies with leading roles in it were founded decades before Intel, AMD, and Micron came into being, and even before older firms such as IBM and Samsung got into the semiconductor business. But with the power semiconductor market's sales over the past three decades having been dwarfed by those of the information technology (IT) semiconductor market, and with most of its sales having revolved around low-cost commodity chips selling for less than \$1 each, the attention given to it by Wall Street has been fairly limited. The dynamics of this situation have been shifting dramatically as of late, however, and just as a confluence of trends – the emergence of the PC, the explosion in digital consumer electronics, the growth in digital communications platforms – spurred the meteoric rise of the IT semiconductor market during the 1980s and 1990s, a similar scenario is unfolding in the power semiconductor arena – and before all is said and done, it may have finished creating its own versions of Intel and Micron. These are the trends that should have the greatest impact:

1. **The Continued Growth in PC Performance** – An average PC CPU manufactured today consumes over ten times as many watts as one manufactured fifteen years ago, all while running at a significantly lower voltage. This has led the dollar value of the power chips needed to properly condition the electricity flows to a CPU to grow above \$5, with many of those operating at speeds above 2 GHz. requiring over \$10. The laptop CPU market has to handle the power issue as well, but must do so with the added demand of preserving battery life, thus requiring an even greater level of power chip content. Graphics processors, which now operate at speeds as high as 300 MHz while requiring even more transistors than CPUs, are also increasingly in need of more sophisticated power chip solutions. As Moore's Law continues to boost both the performance and power consumption levels of CPUs and graphics processors, dollar values should continue to quickly climb.
2. **The Proliferation of Data-Centric Mobile Devices** – PDAs are morphing from simple, inconspicuous devices containing monochrome displays and low-power, 16 MHz microprocessors, and capable of handling only a few basic organization-related tasks to bleeding-edge information appliances containing high-resolution color displays and running on 200 MHz+ processors, and able to handle 3D gaming, MP3/movie clip playback, and corporate database access applications. In the cases of next-generation mobile phones, not only will many of these PDA functions be included, but the design of the product also has to keep in mind the processing needs of a built-in, high-speed Internet connection. And since product designers to take into account the fact that people will still use these devices for mobile phone calls, the importance of battery life conservation should be a fair amount higher. Thus, while most PDAs and mobile phones today can operate properly with only a handful of low-cost, commodity power chips, this is definitely not the case for many of the newer, high-end products that have been released. And it is will not be a very long time before the features found in today's high-end products begin to enter into the mainstream and low-end markets.
3. **Increases in Power Densities for Servers** – The market for servers, both for those used by corporations to handle software and storage-related tasks, and those used by Internet service providers (ISPs) to handle content requests, is rapidly diverging into distinct market segments. On one side are the mammoth “big iron” boxes, devices that routinely sell for over \$50,000 apiece, and contain dozens of microprocessors and upwards of 20 gigabytes of memory. Here, the need for greater power chip content is

Fred Hager's Investment Guide and Outlook

easy to see – many of these devices already consume more power than a small office building, and the continued growth in power consumption per CPU continues to exacerbate the situation. On the other side of the server market, meanwhile, are modular “blade” servers, which often sell for less than \$3,000, and can quickly and easily be “plugged in” to a corporate or ISP data center. The problem here is not one of power consumption *per se*, but rather one of size: Most blade servers are only 2-5 inches thick, yet they still have to contain upwards of 15 power-hungry CPUs without frying any internal circuitry or dissipating an excessive amount of heat. Blade server proliferation is one of the leading reasons that the amount of power chip content that will be needed for the average server CPU is expected to grow from its present range of \$5-\$7 to nearly \$20 by 2005.

4. **The “Computerization” of Consumer Electronics Products** – The technological line separating the personal computer from “traditional” consumer electronics products is quickly blurring. Today, advanced versions of many of these devices contain a level of computing power that would put the average PC from 1995 to shame. High-definition TV sets require a Pentium-class microprocessor, over 2 GB/s of memory bandwidth, and an advanced 3D graphics chip in order to function properly. The latest digital cable set-top boxes contain a 400-500 MHz. CPU, a built-in cable modem, a 3D graphics chip, and even a multi-gigabyte hard disk drive in order to offer personal video recording (PVR) functionality. Microsoft’s XBox video game console, meanwhile, has an 800 MHz. processor, an Nvidia graphics chipset that rivals many PC graphics solutions, a memory solution that is 50% faster than the fastest PC memory platform, and a 10 GB hard disk. The successor to Sony’s current PlayStation 2 products stands to be an even more powerful device. Yet in spite of such technological advances, consumers still expect these consumer electronics products to be packaged using the same types of designs and form factors that have traditionally been used for their less functional counterparts. This naturally requires heavy use of power chips in order to make sure that they run reliably, and without overheating.
5. **The Development of Energy-Efficient Home Appliances** – The situation here is quite straight-forward: Newer, sophisticated versions of home appliances such as refrigerators, air conditioners, and washing machines can cut power consumption by 30% or more over existing versions of the same product, but they need the help of a number of different power chips in order to do it. Over the past couple of years, products based on these chips have been developed by nearly all of the leading firms in the home appliance market, including GE, Sharp, Maytag, and Whirlpool; and since these products presently control less than 10% of the overall market, there is still plenty of growth left in store.
6. **The “Electrification” of the Automobile** – Thus far, the bulk of the attention that has been given to the subject of fuel-efficient automobiles has been centered on either the use of hydrogen fuel cells, or of “hybrid” engines in which a powerful electric battery supplements a traditional internal-combustion engine (ICE). Fuel cell-based automobiles may indeed go fully commercial someday, and hybrid cars may eventually move out of their present niche position and come to threaten the hegemony of traditional, ICE-based vehicles – and power chip manufacturers should profit greatly either way – but it is clear that neither of these events will be occurring during the next several years. During this time period, the gains in automotive fuel efficiency for most car, truck, van, and bus platforms will not come from replacing existing ICE architectures with something radically new and different, but rather by doing so to many of the components, devices, modules, and sub-systems within an automobile that an ICE winds up powering. By and large, this will be accomplished by replacing the mechanical platforms used to carry out most power-intensive tasks within an automobile, such as steering, braking, fan control (air conditioning/heating), and suspension control with electrical ones. In effect, gears will give way to wires, and since wires are lighter, more efficient, and are more capable of “turning off” the devices they power for short periods of times than gears, this transition will bring with it significant improvements in the overall fuel efficiency of a car. Although exact numbers vary, the general estimate for fuel efficiency improvement an automobile in which all of the platforms capable of being electrified have done so is in the range of

Fred Hager's Investment Guide and Outlook

20-25%. Furthermore, in addition to fuel efficiency, electrical platforms for steering/braking/fan control/etc. also bring with them the benefits of higher reliability, faster response times, and improved torque and acceleration. All of this can only be accomplished, however, through the aggressive use of power chip technology in order to make sure that the electricity flows within these platforms offer the stability and precision required by an automobile. Dozens of power chips are also needed to control the device that converts all of the ICE-produced energy needed to power these platforms from mechanical to electrical form, known as an integrated starter/alternator. And once the number of all-electric platforms within an automobile reaches a sufficient level, it will also be necessary to make sure that vehicles are built not with the 14-volt electrical "grid" that has been used to provide electricity within cars for the last half-century, but with a more powerful, 42-volt grid; this, too, will inevitably lead to a jump in power chip content. It is estimated that by 2005, the value of the power chips used within an automobile for such advanced applications will be close to \$900.

While these end-markets are the ones that offer the greatest growth potential from the power chip industry, there are other ones that show promise as well, such as the markets for cutting-edge, price-insensitive military equipment (many advanced fighter/bomber planes contain several hundred thousand dollars worth of power chip content), high-end telecommunications equipment (power consumption and heat dissipation requirements are playing an ever-greater role in the way in which Internet routers and optical switches are designed), and virtually all types of earth-orbiting satellites (the need for these devices to handle extreme temperatures has always made them a large market for power chips, and the demands of today's more CPU-hungry satellite platforms are adding to the demand). The market for power chips is expected to grow from \$10 billion today to over \$70 billion by the end of this decade, and those companies whose product lines are focused on advanced, non-commodity power chips stand to grow much faster.

Fred Hager's Investment Guide and Outlook

Enterprise IT

By Eric Jhonsa

In light of the downturn in information technology (IT) spending during the past couple of years, it has become fashionable to write off the spending boom of the late 1990s as nothing more than as a period of gluttonous, Dot.com-driven excess, and that the present weakness is just part of a process to bring the situation back to normal. There is no doubt that the late '90s brought with them their share of excesses in corporate spending (anyone remember the days when every other TV ad had the word "e-business" in it?), but to take such a dim view of events would be to ignore the significant gains in corporate productivity that occurred during this time period...and even afterwards. According to the Department of Labor, between 1992 and the 1st quarter of 2000 (the NASDAQ's peak), non-farm worker productivity per hour grew by 14.8%, no small feat considering how slowly it is that many "old economy" industries are able to rejuvenate themselves. Equally impressive is the fact that, in the two years that have followed, in spite of the crash in equity markets and the recession that ensued, the number has *risen* to 22.8%. This statistic stands as further evidence to the theory that the large-scale layoffs made by dozens of major firms during the course of the past year were only partly the result of the economic downturn – much of it was due to these companies reaping the efficiency benefits that their investments in PCs, servers, applications software, storage equipment, and other such IT platforms had brought with them. Unfortunately for the sector, this occasion has also produced a slowdown new spending on IT projects. But there are plenty of reasons to believe that this slowdown is only temporary in nature.

To get a better grasp of the current corporate IT spending environment looks like, and what it portends for the future, it has to be understood that the history of this sector is one that is based upon a series of technological waves that built upon each other to mold the enterprise IT world into its present form. The first wave, the longest of them, occurred during the 1960s and '70s, and centered on the proliferation of mainframe computers. The second wave, which took place in the late 1970s and early 1980s, was primarily about the proliferation of high-performance workstations known as minicomputers. The third wave played itself out during the mid-to-late 1980s, and it was during this time that the personal computer came of age. The early-to-mid 1990s brought about the fourth wave, which was rise of corporate networking and the client/server architecture (e.g. settings in which computers use the corporate network to access software that is housed on a server and usually connected to a database). And the fifth and latest wave came towards the end of the decade, driven by the growth of the Internet and the adoption of sophisticated enterprise application software suites for tasks such as enterprise-resource planning (ERP), customer-relationship management (CRM), and supply-chain management (SCM). Two points are worth keeping in mind about these technological waves. First that each one was invariably larger in terms of revenues than the one that preceded it, and second that in the instances where one wave was not immediately followed up another, there were often lulls during which the growth rate for corporate IT spending stagnated or even fell for a brief period of time.

A classic example of such a "lull" occurred during the early 1990s, at which time the initial PC wave, which had primarily centered on using the devices for applications such as word processing and spreadsheet programs, was slowing down, and the corporate LAN and client/server wave, not to mention more fu had yet to fully arrive. Thus, when a recession arrived, much of the corporate world found it to be a perfect opportunity to cut back on IT-related spending. But once economic conditions improved and new technologies were ready to go mainstream, the situation quickly reversed itself. We stand at a similar state of affairs today. The Internet and applications software boom has mostly played itself out, and with the economy having turned south, CEOs and CIOs are waiting for something new to arrive before they loosen their purse strings again. We strongly believe that this "something" will prove to be a concept known as web services.

If all the various software platforms that companies use to share, analyze, generate, manipulate, and communicate information for dozens of different tasks are looked upon as the building blocks of their IT infrastructure, then think of web services as the glue that effectively binds them

Fred Hager's Investment Guide and Outlook

together, and allows them to function as a single, integrated entity. Today, thanks to the last boom, the average large or mid-sized corporation has a fair number of highly functional business software platforms at its disposal, but their inability to work properly with each other continues to prevent them from realizing their full potential, and which has played a large role in infusing the air of cynicism regarding the capabilities of new IT systems in transforming a company's business. A modern-day CRM software suite may be able to do an excellent job of analyzing the demographics of a company's customer base in order to determine the proper pricing plans it should offer, but it may also have little success in sharing this information with its ERP software suite, so as to factor in the present state of the company's top and bottom lines when making a final decision on the matter. A company's SCM applications may be able to provide a company with a solid grasp of its inventory levels, and just how much inventory needs to be kept in order to meet expected demand levels, but it may also have a hard time communicating with its customers' SCM applications to get a better understanding of what the customers' own inventory levels are, and what they imply for future demand. Or even if this information is available, it may still be impossible to have its implications quickly analyzed, and have the information be made available online for those who need it. And so on and so on. There are literally hundreds of different scenarios that get played out in the corporate world each and every week in which the inability to share information between different software platforms, both within the walls of a company, and with a company's customers and suppliers, leads to the creation of significant inefficiencies that otherwise need not exist.

Enter web services. Using an open-standards protocol known as the Extensible Markup Language (XML), as well as derivative, application-specific variants of the protocol such as Universal Description, Discovery, and Identification (UDDI) and Simple Object Access Protocol (SOAP), it should eventually be no more difficult for enterprise applications to be configured to seamlessly communicate and obtain information from each other than it is to have information be shared between two files in the same application. For the IT world, this is about as close as you can get to information nirvana on the software side of things. But the benefits of web services don't end there. By allowing such seamless information sharing between different types of applications, they also make it possible for a cadre of smaller, more modular, and less expensive software to carry out functions previously limited to the realm of more expensive applications, in the process allowing small and medium-sized businesses to have access to tools that until now were available only to their larger counterparts. And this type of functionality will also go a long way in bringing the vision of software being sold as a subscription-based online service to fruition. In short, by the time that it has fully played itself out, the web services wave, which should begin to see its initial rumblings during the second half of 2003, may represent the greatest transformation in the role played by software within the enterprise environment since the movement from command line-based operating systems such as DOS to graphical user interface-based ones such as Windows.

But while the promise of web services is undoubtedly significant, the technology will not be able to reach its full potential without the aid of three other technology platforms that are either reaching maturity or are on the verge of doing so at this time. The platforms are as follows:

1. **Application Servers** – Though its name might lead you to think otherwise, the application server is not a hardware platform, but a software one, upon which enterprise and Internet software programs meant to be housed on a (hardware) server are written. The application server acts as an intermediary between these programs and the operating system that the server runs upon, containing much of the "infrastructure" code that a program needs in order to work with a given operating system. Furthermore, it can have extensions built in that allow it to act as an intermediary between said programs and software housed on other servers, such as databases and third-party applications. Thus, the use of an application server by a software developer, or by the in-house software development team of a corporation or an Internet Service Provider, generally brings about a significant reduction in the time and resources needed for programmers to write the code for an application, as well as to modify it once the code has been written. Web services, by nature, will require that a premium be placed on the ability of software to be easy to develop and re-develop, and the application server plays very well into this motif. Meanwhile, due to the fact that they share a common code infrastructure, software

Fred Hager's Investment Guide and Outlook

programs built on top of copies of the same application server platform possess a unique aptitude for being smoothly developed in a way that exploits the ability of web services to make small, low-cost programs to work well in tandem to carry out complex business tasks.

2. **Infiniband** – By making it possible for business software programs to more thoroughly and effectively share information with each other, web services will significantly increase the number of situations in which a task being carried out by a given type of program will not be the result of direct human intervention (i.e. a person using an ERP program to formulate a table of operating expenses), but rather the result of automatically doing something that it was pre-programmed to accomplish (i.e. an ERP program required to analyze future operating expense expectations given the changes inputted during the course of each day, and subsequently send the information over to a CRM program that takes it into account when determining pricing strategies). The result will be a large jump in the computing demands placed on the servers used in many environments, and particularly with regards to their ability to communicate with the Internet, with other devices on a corporate network, and with the storage systems it happens to be using. Built with the understanding that going forward, the performance of the average server will be increasingly tied to its ability to handle communications-related tasks well, the Infiniband standard addresses these demands by radically altering the server's basic architecture. Whereas today, the adapter cards that a server uses to communicate are installed within the server itself, an Infiniband-based architecture would have them moved onto a separate switch connected to multiple servers via high-speed optical links. Since the switches are powered by processors tailored to handle communications-related needs, and since the dismembering of the "traditional" server into two parts allows each half to have its resources scaled in a more efficient manner, the performance benefits stand to be quite significant, enough to keep enterprise and Internet data centers running smoothly as the web services boom unfolds.
3. **Networked Storage** – Considering how the concept of web services centers around the continuous and widespread flow of information both within an enterprise's borders, and to and from them, it should come as no surprise that the demands that will be placed on the devices used by companies to store their information will grow at an abnormally high rate. First, the development of dozens of new ways for enterprise software platforms to share and use information will inevitably bring about a large jump in the quantity of new data that such software will generate, and thus the quantity of storage that a company will need. Second, the fact that web services will lead to a company's existing data being accessed far more often for use by these software platforms, the performance of storage systems relative to the amount of data they store will also have to grow. Lastly, the aforementioned ability of web services to allow information to be shared in novel ways, and between seemingly unrelated applications will boost the importance placed by companies on having the ability to centrally manage and access all of their storage resources, and subsequently move around, manipulate, and replicate them as they see fit. This will all play in perfectly with the proliferation of networked storage systems, which presently account for less than 20% of all enterprise storage deployments, but should account for over 80% of them within a few years. Whereas traditional storage systems are directly attached to individual servers, networked ones, as their name implies, reside independently of servers, and are accessed via data communications networks. Since networked storage systems are not tied down to single, regular servers, they can scale to much higher levels in terms of both capacity and performance; and centralized management is made possible by the fact that the devices can be "pooled" together and treated by storage management software platforms as a single, unified entity. There are two different types of networked storage systems. One, known as the storage-area-network (SAN), works by having an array of storage systems accessed via one of a number of different servers, using a high-speed, storage-specific communications protocol known as Fibre Channel. The other, known as network-attached-storage (NAS), bypasses the need for regular servers altogether – by having the device act as its own server, thus treating the hard disks it contains the same way that a PC views its own hard disks, NAS systems can be accessed by users directly over a network, without the need

Fred Hager's Investment Guide and Outlook

for an intermediary. Traditionally, SANs have been viewed as the more "established" of the two technologies, and the one more apt for use in high-end, high-performance environments; but recent hardware and software advances in NAS systems have all but eliminated this gap. Both technologies should play major roles in meeting the needs of next-generation enterprise storage requirements.

Before one gets the impression that this technological wave is right around the corner, it should be taken into account that, of the various enterprise technologies that have been discussed, only the ones that relate to network storage can be considered to be existing in something resembling a state of technological maturity. Infiniband is still in trial mode; application servers, while having been deployed by numerous firms, have yet to contain all of the functionality needed to properly support web services; and web services functionality itself has only begun to find its way into leading enterprise software platforms. However, by the end of 2003, if not a little earlier, all of the pieces needed to bring about the web services wave should be firmly in place, and thus the groundwork should be in place for the next major round of enterprise IT spending to occur. And as is the case with the mobile communications industry, many of the companies that will benefit the most from this period of growth, both in terms of their bottom lines and their stock prices, will not be among those that did so for the last period.

Fred Hager's Investment Guide and Outlook

Tomorrow's PC

By James Rockwell and Eric Jhonsa

The growth rate of the PC industry, whether for desktop or mobile computers, has slowed considerably over the past couple of years, and it is unlikely that the industry will ever grow quite as fast as it did during the boom times of the 1980s and early 1990s. Nonetheless, it is estimated that the industry will resume positive growth next year, and there are plenty of reasons to believe that a good amount of growth potential still exists for it. Only now, the growth will be driven less by new users purchasing PCs for the first time, and more by existing users finding reasons to discard their older PCs in the name of purchasing newer, more advanced models.

At the end of 1997, most desktop PCs being sold had microprocessors that operated at clock speeds of a mere 300 MHz or less. By the end of this year, the fastest PCs on the market will most likely contain processors running at speeds of 3.0 GHz (3000 MHz) - that's a performance increase of ten times, occurring in the course of only five years! Similar performance jumps have been seen by the multimedia peripheral boards that come with most PCs, with the processors found on average, modern-day video and sound cards having become more than ten times as powerful as they were a few years ago. Likewise, whereas the average high-end PC sold five years ago only contained 64 MB of dynamic random-access memory (DRAM), with the memory itself offering a peak communications speed of 800 megabytes/second, today's high-end PCs almost always come with a good 512 MB of DRAM built-in, with the peak communications speed of the fastest type of DRAM having jumped to 4.2 gigabytes/second (4,200 megabytes/second). And whereas the most powerful hard disk drives available for PCs ten years ago had a maximum capacity of roughly 8 gigabytes, high-end disk drives can be found containing as much as 160 gigabytes of capacity. As these trends continue, with microprocessors racing towards 10 GHz levels, hard disks drives eventually containing over one terabyte (1,000 gigabytes) of capacity, and multiple gigabytes of DRAM being shipped within systems, the performance-based incentives for consumers and businesses to upgrade their existing PCs will inevitably grow.

This is all fine and well, some may say, but the biggest problem facing PC demand isn't one of *hardware*, but rather *software*. Namely, what applications are on the market, or will be coming onto the market in the near future, that will require the use of such massive amounts of computing power, and simply will not be able to function should PC users try to run them on their existing devices? When considering this question, it should be kept in mind that it has been asked thousands of times over the years, with those asking it invariably underestimating the extent to which new applications would prove able to soak up the processing power and memory capacity of a PC. Even Bill Gates once quipped that 640 kilobytes (.640 megabytes) of DRAM capacity should be more than enough for any PC user. Gates may have been on the mark regarding many PC-related trends over the years, it is unlikely that he looks too fondly on this particular prediction of his, and the fact that even he, at one time, misjudged the potential of the PC market to such a large degree shows just how easy it is to underestimate the extent to which new applications can continue to spur demand for more powerful PCs.

So which new applications do we see that will keep PC demand chugging along at a healthy pace? First and foremost is a concept that has been with us for quite some time, but which has yet to live up to its full potential: voice recognition. Thus far, voice recognition software has advanced to a point where it has been able to find a home among business PC users in customer service markets and other such niches, and among home users that are particularly averse to using their keyboards to type out documents; but it has not advanced to a point where the average business or home PC user will opt to use it for most of the applications for which it could be applied. First and foremost, the underlying technology behind the software has to become good enough to "correctly hear" the average speaker all the time, being able to take into account the nuances of his/her voice when processing voice commands, without the need for specialized training of the software for the specific individual. Furthermore, a significant amount of "intelligence" will also have to be added to voice recognition applications, so that they will understand or question ambiguous and imprecise commands from the user. When "clear hearing" and "intelligence" has been added to the voice recognition software modules, there will be an explosion in the number of applications that utilize voice recognition. Eventually, the speakerphone could replace the keyboard and the mouse as the primary device the average PC

Fred Hager's Investment Guide and Outlook

user utilizes to input commands and text. Perhaps a sign of things to come, the latest edition of Microsoft's Office suite already has built-in voice recognition support, although, as one might expect, its present abilities are far from perfect.

But such sophisticated forms of voice recognition software will require considerable amounts of CPU power and memory, not to mention considerably fast forms of memory. These requirements are easily above and beyond what most PCs are capable of handling today. Many people will upgrade their PCs in order to obtain these new capabilities. This could cause a large surge in the PC growth rate as obsolete PCs are replaced.

Meanwhile, an application that is already a mass-market today, and always seems to need more speed from the PCs that run it, is computer gaming. It has been because of this never-ending demand on the parts of computer games for greater levels of 3D graphics quality and photo-realism that the market for the graphics cards used in PCs has held up much better than the overall PC industry during the course of the past couple of years. Newer games such as Max Payne and Aquanox continue to push the envelope; mid-range PCs are only barely able to handle them even at relatively low monitor resolutions (i.e. 800x600, 1024x768), and with all of a graphics card's major 3D quality-enhancing options turned off. Crank up the resolution a little (i.e. 1280x1024, 1600x1200), and turn on graphics card options such as high-speed anti-aliasing and anisotropic filtering, and only the most powerful PCs will suffice. And in spite of the monumental advances in 3D graphics quality that have come over the past several years, much work still remains to be done. As incredible as today's graphics may seem to anyone who grew up playing 8-bit Atari games during his childhood, they are still a far cry from being the visual equal of the world that we see around us each day; and until parity – or something close to it - is achieved, the demand for greater computing power on the parts of gaming enthusiasts should remain quite strong.

A third application is that of editing of multimedia files. Tens of millions of PC owners now use their devices for playing music, and viewing DVDs, short video clips, and digital images. In addition to being a productivity tool, an educational platform, and a gaming system, the PC has also been transformed into a jukebox, a photo album, and a home theater. The proliferation of technologies that make it possible for users to generate their own multimedia content, such as PC speakerphones, digital cameras, and digital camcorders, has added fuel to this fire. While these applications, in and of themselves, are generally not enough to drive a need for a more powerful PC among most existing users, the story changes considerably when users begin to learn how to manipulate these types of files. This has meant a variety of actions, including converting files between different audio, video, and image formats (i.e. WAV, MP3, Divx, JPG), dubbing sound into movie clips and picture clip shows, joining together audio and video clips from different files in order to create new files, and changing the contents of the files themselves using advanced software programs.

As those who have carried out such activities on a PC can attest, multimedia file editing can soak up computing resources in a way that almost no other type of application can. For example, even on a high-end PC, dubbing a large sound clip into a video file can take several minutes. Converting a large WAV audio file into MP3 form can take over ten minutes, using up virtually every CPU cycle that is available during this time. Meanwhile, breaking down a fully-fledged, two-hour movie into 20 or 30 individual clips can take upwards of 45 minutes, and converting a DVD movie of such length into a Divx video file will take at least 90 minutes. Clearly, we have a long way to go before computing power increases to a point where the issue of reducing these times will no longer matter to home PC users. And with hard disk drive capacities continuing to increase at a pace of nearly 100% per year, and CD-rewritable drives (maximum capacity of 700 MB/disc) slowly becoming replaced by DVD-rewritable drives (maximum capacity of 4 GB/disk), the declining costs of storing all of this content should play a large role in driving demand.

Form factor changes will also be a major selling point. The PC will continually become smaller, more portable, and less noisy - and who doesn't complain about the length of time it takes to turn one off or re-boot it? Eventually, with the aid of CPU advances and the proliferation of new forms of random-access memory (RAM) that retain their information even after losing power, PCs will be able to boot and turn off instantaneously. For those users who find themselves irritated by the

Fred Hager's Investment Guide and Outlook

fact that their PC cannot be turned on and off like their television set or toaster, this technological advance will definitely be welcomed with open arms.

And of course, there's the market for non-desktop PCs, such as laptops. Here, not only do many of the aforementioned, performance-related demand drivers apply, they often apply to a much greater extent, since these devices naturally have peak performance levels well below those of desktop PCs. For example, it was all but impossible to play the latest 3D games on a laptop until recently, as the graphics chips that went into the systems were simply too weak; and while this situation has begun to change as of late, much work still needs to be done. But there are also a number of other demand drivers for the laptop market that are not related to the desktop market at all. One such driver is the issue of battery life; newer laptops are being built with more power-efficient CPUs, hard disk drives, and LCD screens, and as a result can be used for much longer periods of time without the need for a recharge. In the future, battery technology advancements such as the development of hydrogen fuel cells will also play a major role in boosting usage time, and hence customer demand. The continued proliferation of wireless data communications technologies should also spark demand, especially from business users. By means of installing a modem card that supports the technology into the device's communications slot, technologies such as 3G and Wi-Fi allow laptops to have inexpensive, "always-on" wireless Internet connections at speeds ranging from several hundred kilobits to several megabits per second – and speeds should only improve from here.

Meanwhile, the development of such communications technologies has also sparked interest in a new type of portable computing platform known as a "tablet PC," inexpensive, rectangular, relatively lightweight devices that would contain a low-power CPU and boot almost instantaneously, and whose primary goal would be to provide their users with fast and easy access to e-mail and web browsing applications. Tablet PCs could have enormous appeal among those PC users who either prefer not to, or don't feel the need to carry a laptop around, but would like the ability to access the web while away from the desk. And last but not least, there is some truly breathtaking work being done in the field of handheld PCs. By this, we aren't talking about PDAs, such as Palm OS and Pocket PC devices. Rather, we're talking about fully-fledged computers that, although capable of being carried around in a user's pocket, are replete with gigahertz CPUs, 10 GB hard disk drives, and the Windows operating system, and, when hooked up to a monitor, can function in much the same way as a desktop PC. At this point, such devices are only coming out of development stage, but it may not be long before they begin to be sold by the millions.

The chasm separating what computers are capable of, and what we wish they were able to do is still significant, and as new technologies, applications and system architectures come to market, the demand for more performance and/or greater battery life and convenience from the latest desktops, laptops, tablet PCs, and handhelds will obsolete most of the huge existing base of PCs in the world, to the benefit of nearly all segments of the PC industry, ranging from the manufacturers themselves to the semiconductor firms that make their products function to the software developers that find novel ways to harness the power of the semiconductors. The PC market has clearly slowed down, but it just as clearly has more than a few tricks left up its sleeve.

Fred Hager's Investment Guide and Outlook

Consumer Electronics

By Sam Ouyang, Phd, and Eric Jhonsa

While there are over a half-dozen different major market segments that fall under the header of "consumer electronics," four of them manage to stand out for the investment opportunities that they present: DVD Players, digital cameras, video game consoles, and digital set-top boxes.

DVD Players

Just as audio compact discs replaced cassette tapes in the late 1980s, Digital Video Discs (DVDs) are rapidly replacing VHS tapes in the market for video-based entertainment and media. Compared to VHS tapes and VCRs, DVD discs and players have many technological advantages, such as far superior image quality, the ability to support multi-channel audio, immunity to the decay in quality that afflicts VHS tapes upon repeated viewing, and the ability to skip easily to any point within a movie.

Because of these advantages, DVD players have quickly jumped to the forefront of the consumer electronics market in terms of popularity, and are ranked as the No.1 overall product consumers expect to purchase, according to the Consumer Electronics Association (CEA). Already, in the course of only five years, over 60 million households have come to possess DVD players - it took 15 years for the VCR market, and 13 years for the TV market to reach a similar penetration rate. According to Cahner's In-Stat Group, over 60 million DVD players will be shipped worldwide in 2004, and more than 69 million in 2005. This compares with only 28 million shipments in 2001, and a mere 4 million in 1999.

Although the DVD player market is clearly set to mature in the upcoming years, it will nonetheless continue to grow steadily during this time period. Much of this growth will occur in areas outside of the United States, where the device has already made its way inside a remarkable 25% of households. Due to its sheer size, the U.S. will most likely remain the largest market for DVD players during the next few years.

Meanwhile, the DVD player itself will continue to evolve, both in terms of form factors and functionality. Already, the past year saw a number of "early adopter" DVD player owners replace their existing systems with new ones featuring such amenities as support for optical audio and component video outputs. Recently released "home theater-in-a-box" systems, which combine the functions of a DVD player with those of a high-power Dolby 5.1 audio system, have been quite well received. As have mobile DVD players, which, by hooking together a miniaturized player with an LCD screen and a lithium ion battery, allow their owners to watch DVDs while on the road. Video game consoles have opened up yet another market, as next-generation systems such as Sony's PlayStation 2 and Microsoft's Xbox offer DVD playback capabilities. Looking into the future, a number of digital set-top box developers, ranging from Microsoft to established manufacturers such as Motorola and Scientific-Atlanta to startups such as Diego, have plans to integrate DVD functionality into their next-generation offerings. And a number of Asian consumer electronics firms are looking to eventually bring to market DVD players that utilize blue lasers for disc scanning purposes. The use of blue lasers allows a DVD disc to contain up to four times as much storage capacity as the infrared lasers used by today's systems.

Then there is the market for DVD recorder/rewritable drives, devices that, when installed within PCs, make it possible for PC users to make copies of DVDs or use DVD discs for file storage use. As prices for DVD recorders come down, they should rapidly grow as a percentage of the overall DVD player market, and eventually, like the position of CD recorder drives CD drive market, come to account for the vast majority of DVD players sold in conjunction with PCs. DVD recorders are presently available in the form of a number of different technological standards, with the most prominent being DVD-RAM and DVD+RW. As has been the case with nearly all other consumer electronics standards battles, only one of these platforms will emerge victorious; but since the two platforms are quite evenly matched on a technological basis, the issue of which one wins out should not have much of an effect on the success of the overall market. It is

Fred Hager's Investment Guide and Outlook

expected that annual shipments of DVD recorder drives will pass the 10 million mark in 2005, and, like the estimates made for DVD player shipments a few years ago, this estimate could prove to be a conservative one.

As demand for DVD players grows, so should demand for the chips that are needed to make DVD players work, ranging from the microprocessors that power the devices, to the semiconductor lasers that read the video signals off of a DVD disc, to the decoders that convert the video signals take off the disk into a viewable format. The proliferation of mobile DVD players, DVD players integrated with other consumer electronics devices, blue laser-based DVD players, and DVD recorder/rewritable drives all provide room for those developing these chips to keep their products from being commoditized, and thus the ability to maintain strong profit margins. Between the potential for high profit margins, and the strong growth expected for the overall market, the DVD component field stands to be an attractive one for the foreseeable future, and may present a number of compelling investment opportunities.

Digital Cameras

Just as the DVD player is replacing analog VCRs, the digital still camera (DSC) is slowly but steadily replacing traditional film-based cameras as the medium of choice for the task of picture taking. According to Cahner's In-Stat Group, worldwide unit shipments of digital still cameras will increase from 17 million in 2001 to 40.8 million in 2004, as the market grows from primarily consisting of hobbyists and PC enthusiasts to being dominated by mainstream consumers. Furthermore, it may not be long before tens of millions of mobile phones and PDAs are manufactured with built-in digital cameras. Already, Japanese wireless operator Japan Telecom has sold over one million of these devices, and leading mobile phone manufacturers such as Nokia, Ericsson, and Samsung have committed to bringing "camera phones" to the leading European and Asian markets during the course of this year. Releases for American markets should arrive soon afterwards. By allowing consumers to be in possession of a digital camera whenever they take their mobile phone with them out of the house, and by allowing them to instantaneously e-mail pictures that they have taken to others, these devices stand to greatly increase the addressable market for digital camera products.

Today's DSCs are improving in quality and decreasing in price, as new generation designs go into production. Rapid price drops for the removable flash memory cards used to store pictures with a digital camera have also helped spur demand. Though higher-resolution cameras continue to decrease in price, this is being offset by demand for devices that offer greater image quality. Today, the average digital still camera sold allows for a picture resolution of roughly two megapixels. As selling prices for four and five megapixel cameras gradually fall, the superior quality offered for the buck should entice film camera users to make an initial purchase, and many existing digital still camera owners to purchase new devices. Another area where improvement is ongoing is that of form factors: Whereas the first digital cameras were large, unwieldy devices that weight more than half a pound, some of the latest designs from Japanese manufacturers can comfortably fit in a user's pocket; and, of course, the same holds true for virtually all mobile phones with built-in digital camera functionality. Advances in printing technology are also helping matters out considerably; with many mainstream inkjet printers capable of printing over four million dots per square inch, consumers are now able to develop photo prints from their cameras that are comparable in quality to film-based prints. Last but not least, the development of inexpensive, easy-to-use devices known as "digital photo printers" should go far in increasing the appeal of DSCs to those individuals who would like to be able to use them, but are either unable to or uncomfortable with using PCs for viewing and printing pictures.

Although the semiconductors used in the aforementioned flash memory cards tend to be commodity products where it is difficult for a single manufacturer to stand out from the pack, a number of the other chips needed to make a digital camera function are not. The most prominent of these chips are the high-speed, analog sensor chips used for capturing an image with the camera, and the special-purpose digital signal processors (DSPs) needed for subsequently rendering the images. As consumers continue to demand smaller, lighter, less power-hungry, and higher-quality digital still cameras, the producers of these chips will have to continue to push

Fred Hager's Investment Guide and Outlook

the technological table in order to adequately meet their customers' needs. As a result, these markets stand to be particularly lucrative ones for those firms whose chip offerings possess strong competitive advantages.

Video Game Consoles and Digital Set-Top Boxes

From humble beginnings, video game consoles have become a part of the leisure activities for nearly 60 percent of all Americans, an even greater percentage of Japanese and South Korean citizens, and tens of millions of others scattered throughout the world. In the year 2000, between hardware and software sales, the console business commanded over \$9 billion in revenues from the United States alone, more than the total gross revenues of all box office movie receipts. That revenue number grew to nearly \$15 billion for the year 2001, and should continue to grow at a healthy clip going forward. Meanwhile, the sale of digital set-top boxes, now used by over 15% of all cable TV users in developed markets, and the vast majority of all satellite TV users, has also turned into a major consumer electronics market. According to Cahner's In-Stat Group, worldwide revenues for this market should grow from \$9.1 billion in 2000 to \$16.4 billion in 2004.

Both the video game console and digital set-top box markets are presently undergoing a period of massive evolution and convergence. Taken on the whole, the current wave of changes are the culmination of nearly three decades worth of computing, graphics, storage, and communications-related advances. Historically, these two devices have been viewed as "dumb terminals," products that have little in common with a platform such as the PC. But now, both consoles and set-top boxes are quickly bridging the technological gaps that have traditionally separated them from PCs – and each other.

One aspect of this evolution relates to the issue of processing power, with consoles such as Microsoft's Xbox and Sony's PlayStation 2, and high-end digital set-top boxes such as Motorola's DCT-5200 containing microprocessors that, at the time of their release, lagged those of leading-edge PCs by only a couple of years, and graphics chipsets that lagged by as little as one year. When combined with the fact that consoles, unlike PCs, these products are built from the ground up for specific purposes; this has meant that games created for consoles have been able to provide previously unheard-of levels of 3D realism. For set-top boxes, such computing advances have made it possible to offer a plethora of new features, including high-definition television (HDTV) decoding, high-resolution video-on-demand services, and advanced interactive TV services that possess PC-like levels of graphics detail. A second aspect, meanwhile, deals with the inclusion of support for high-speed, two-way communications. With phone jacks and Ethernet outputs (the latter of which can be connected to cable and DSL modems) being placed into new consoles, multiplayer online gaming is no longer limited to the confines of the PC; and with cable modems being built directly into set-top boxes, the concept of broadband Internet access being accessible straight from a TV set is now a possibility.

But it is the third and last aspect of the technological sea changes hitting these markets that is perhaps the most eye-opening: the integration of technologies that do not directly relate to the traditional functions of a game console or a set-top box. As has been previously mentioned, leading-edge products from both markets are being with DVD player support; but it doesn't end there. A number of next-generation set-top box designs involve the use of personal video recorders (PVRs), while many are also doubling as Internet telephony gateways and, whether via the use of phone line or wireless-based technologies, home networking hubs. And then, of course, there is the convergence of video game consoles and digital set-top boxes themselves. Already, software platforms have been developed for use with high-end set-top boxes that allow for 3D games to be played; and Microsoft is planning that the successor to the Xbox will be able to act as a fully-fledged home entertainment hub, containing both digital set-top box and PVR functionality in addition to the ability to play state-of-the-art video games.

Undoubtedly, these changes being experienced by the video game console and digital set-top box markets open up many new opportunities for consumer electronics semiconductor firms, such as developers of 2D/3D graphics chipsets, digital video tuners and decoders, and high-speed, chip-to-chip communications platforms. The potential for software firms is also significant, not only for game developers, but also for the companies that supply the operating systems and

Fred Hager's Investment Guide and Outlook

infrastructure software needed to make the advanced functions of newer set-top boxes a reality. At a time when valuations for many of the companies that derive a large portion of their sales from "non-traditional" consumer electronics semiconductor and software markets are particularly low, investments in the better-positioned companies servicing these two could pay off exceptionally well.

Fred Hager's Investment Guide and Outlook

Conclusion & Near-Term Outlook

By Fred Hager

Today, most companies are on the defensive, and virtually all of them have taken their beatings. Fundamentally though, the same precept that good companies can excel in a bad market holds true. The big difference now is we are at the bottom looking up. Famous last words, right? As of this writing, the market is teetering at around 1500, and could go lower. I don't believe anyone can time the market, as you've heard throughout this report, so whether or not the market could still go lower is not my biggest concern. I am more focused on the companies whose stock could be 300% higher or more two years from now.

In large part, the challenge today lies in the public's perception of technology investing, and while there are those companies out there that are showing signs of excelling beyond the bear market, most investors are not convinced yet. Smart ones, though, see through the negative sentiment and have the patience to wait for the solid returns.

There is no question we have been through a lot of pain in the last few years, but that pain will easily and quickly go away once investors see the potential in their portfolios again. Enthusiasm does drive the overall market more than most anything, and considering at this juncture you can't pick up a newspaper without mostly bad news in it, we'll either rally like crazy when something good actually happens, or the bad news will become old news, and more and more companies will improve.

While it may be hard for some to justify taking the seemingly apparent risk of investing now for the long-term, every investor who is looking to achieve financial security must ask themselves this: where will we be in ten years, and are there companies out there who have the technology, products, management and competitive advantages to reward their investors long-term? There are, I assure you.

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