From: Bill Gates
Sent: Tuesday, September 08, 1998 12:44 PM
To: Executive Staff and Direct Reports; Platforms Group; Interactive Media group; Office of the Chief Technology Officer; MS Research Full Time Employees
Subject: The Era Ahead

I've written this memo to share some thoughts on the most important challenges we are facing as a company. It is a confidential document to be kept inside the company.

We're entering a great new era in the evolution of computing, and we are in a position to lead the industry forward. My goal in writing this is to stimulate the incredibly talented teams we have.

the era ahead.doc
(90 KB)

The Era Ahead

Our Position

Our position today within the computer industry is stronger than it has ever been. Sometimes people look at all the products we build and wonder if there is anything left to do. Are there major innovations still to come? I believe we have just begun to fulfill our vision of what computers can do. That is the theme I want to address in this memo – the coming breakthroughs, and how they represent an opportunity to help our customers and lead the industry forward

Microsoft has been responsible for many key breakthroughs in the personal computer business, and these have driven our growth for over twenty years. Basic, DOS, Windows, Windows NT, Office – every one of those and many other products have opened up new possibilities and helped the industry achieve new heights.

But the PC has the potential to offer much more than it does today. Is the PC easy to use? Does it know who its users are and what they want? Is it the simplest way to get information? We have to do a great deal of work before people think of it that way. Do people store their information on the PC? Sometimes. But mostly they print it out and store it in file drawers. Do they use the PC for staying in touch, for buying and selling, for collaborating? In a very limited way. Partly we need to get the word out about what's possible, but it is far more important to make our products much better than they are today.

The breadth of products that we have today uniquely positions us to take computing to the next level of simplicity, power and integration. I want to use this opportunity to share some of my thoughts about the most important challenges and opportunities facing us.

Our People

Before we talk about technology, it's important to remember that everything we do comes down to the people who work here Microsoft, without a doubt, has assembled the best team of software professionals the world has ever seen. We have said many times that people are our most important asset. Whenever a group comes in to give me a presentation, I am struck by the number of great people we have. I am proud that Microsoft has shared its success with its employees more than any company in history. Although many of the employees who have been here for a long time have the means to retire, few of them have done so. We need to make sure our jobs are exciting enough that people get out of bed in the morning and decide to come to work, despite their freedom to do anything they want.

To continue leading the industry, we need to make Microsoft the place where people know that their individual work has a real impact. That confidence is critical for retaining the talent we have, getting the best work out of our teams, and making sure we continue to attract the best. This year alone we will be recruiting thousands of people worldwide, including hundreds into our product development groups. Our R&D investment is growing faster than any other expense, because we want to improve our products as rapidly as we can. Throughout the company, we constantly need to be creative about letting people contribute in better ways. Steve Ballmer and I will focus specifically on this challenge in the years ahead.

Improving the Consumer Experience

I'd like to start with the consumer's experience when they get and use a PC. Windows 95 improved the user interface a lot and made many new applications and hardware devices available, but using and maintaining a PC is still frustrating – computers need to be easier to use and more reliable. We also need to help our customers use their machines in new ways, especially when they are connected to the Internet.

Easier to Use

To make PCs easier to use, we have to start with simplicity. We need to get away from the complexity that we force on customers today. This simplification must touch on every aspect of the PC – installation, operation, replacement, and maintenance. Even Microsoft employees are finding the increasing number of commands, utilities, cryptic files, error messages and registry settings a frustration that prevents us from using the full power of our PCs. New versions of Windows will only sell if they bring major simplifications in all of these areas Just look at all of the directories on a Windows machine and try to figure out what all those files are doing We are not working effectively enough to eliminate this complexity and confusion - we have fallen into the habit of letting the implementation show through in the user interface. We're going to have to do some hard work and be creative, thinking scenario by scenario about how we get rid of files, eliminate commands, and hide implementation details. We are in a great position to do this because we have many people who talk to our customers. We need to use what is learned from those customers to improve our product design.

We also can improve the PC interface. We've already done that by building better mice and keyboards that are more efficient and more comfortable to use. We want to go even further by changing the way people use computers. The keyboard isn't going away, but it will be joined by the computer's ability to listen, to see, and to recognize handwriting. We have been working on all of these areas, and we've been making progress. In handwriting, for example, the Japanese version of Windows lets the user draw out characters because it's hard to get them into the computer with a keyboard. We include the handwriting recognizer as part of our input method editor there. It's been very popular because you can use it for obscure characters that you don't know how to enter using a keyboard. We are working on vision -- cameras are coming down in cost, and we have software running internally that can track gestures. The last few years have seen great steps forward in recognizing speech. We're making progress on understanding natural language, so customers can communicate in a more familiar way with their computer. We have some limited support now, for things such as the help system, but the full integration of these new input systems is still ahead of us. The key Windows APIs of the future will be the ones where applications work with these new input systems. Microsoft is in a unique position to pull all of the elements together on our platform.

We need to do a better job of automatically adapting the interface. Customers give us a lot of information about which commands they use most often, what kinds of things they are interested in, and so on. We've taken some baby steps to exploit this information with file MRU lists, IE Histories, and adaptive menus in Office and NT, but we need to think even harder about making the whole system adapt to the user instead of the other way around.

Another way to improve the PC is to make everything happen more quickly – nobody likes to wait. When you use a PC today, a lot of things take too long: booting up, connecting to the Internet, browsing the Web, and installing applications. We can fix some of the problems ourselves, and we need to work closely with other companies, such as our hardware partners, to fix others.

More Reliable

Today's PCs can do an amazing number of different things, but they can also be fragile. We have worked against ourselves somewhat by making the platform so extensible and opening it to so many other people. There is a great variety of hardware available, but with many different third party drivers running at once, you can't always guarantee reliability. So we're going to need specifications for the hardware and drivers that are a bit more rigid than we've had, to strike a balance that lets us get a system that is rock solid. We want customers to be confident about getting new hardware or software and installing it. This means not only doing everything we can to make sure that faulty device drivers don't crash the entire system, but better development and diagnostic tools so that it's easier to write high quality device drivers in the first place.

Another trouble spot is managing components – we've gotten tremendous advantages by dividing applications into reusable pieces, but we update versions so often that we sometimes run into compatibility problems. We'll have to control our policy for shipping more carefully, and we also need to let applications be more isolated so they don't sabotage each other.

Even when we've made PCs more reliable, there are still going to be some problems. We need to do a much better job explaining to customers what has gone wrong – many error messages are incredibly cryptic. My favorite example, because I get it myself from time to time, tells me that "The DHCP client could not obtain an IP address. If I want to see DHCP messages in the future, choose Yes, otherwise choose No." Now, that is just totally unhelpful to most people – they need to know what a DHCP client is and what it means not to obtain an IP address. There's no button to ask for help and no way to decide if this is a fatal problem, a bad configuration, a temporary network outage, or whatever. I am glad that we have removed this dialogue in NT5.

We should also be a lot smarter about helping customers fix problems. Calling for help today is an inefficient process – you describe what the desktop looks like, read out menu options, use registry editors, try different things, and reboot a lot. The whole process should be monitored from across the network, so a support technician can see what is going on in the PC and take control remotely. When it comes to analyzing a machine that's not working, and there's a pattern there that we've seen before, we should automate this so we don't tie up our support personnel. We've been very low-tech in terms of providing this kind of help.

We want to go even further with an ambitious strategy that we call "Windows Tone" or "Wintone." The idea is that customers don't manage or update their PC at all – that's our job. We back up their data in case something happens to the machine. Wintone offers great benefits for anyone with a high-speed Internet connection. Customers get a reliable machine they can count on to be available and ready to use at all times, and updated with the latest patches and software. We get a closer relationship with customers and a predictable revenue model because they pay us a regular fee for the service.

New Uses for the PC

In the past, we spent most of our time thinking about managing documents and numbers. Now that we have the Web, huge disk drives, and good sound cards, we need to think a lot more about pictures, sound, and video. With pictures, for example, the PC should be more inviting than a darkroom, with software that anyone can use. Everything is too hard today – getting pictures off the camera, searching through them, editing them, and sharing them with other people on paper or over the network. If we don't make it simple, most people will keep handling photos the way they do now, or bypass the PC with specialized hardware.

We're not only seeing digital photography becoming standard on the consumer PC, but we're also seeing digital music. MP3 is a format that is being used for a lot of music out on the Web. There's a lot of piracy, with people trading songs illegally. We can help solve this problem by putting intellectual-property protection right into Windows, so that we protect the rights of people who develop and distribute content such as books and music. It's a tricky problem, because in addition to technical issues such as encryption, there are political and ethical concerns such as ensuring customer privacy. We're going to have to strike a careful balance, but we have some great people working on making this a standard capability of the operating system.

As PCs get better at handling sound, telephony gets more interesting. Using a PC as a telephone isn't a great experience today, but additional bandwidth and guaranteed quality of service on the network will make a big difference. People will always need to work together and communicate. They use email and the Web already, but they also want to see and talk to each other, and products such as NetMeeting have a big role to play. Businesses shouldn't have to buy a PBX and have a separate phone network. They shouldn't need to buy specialized equipment for videoconferencing.

Another big challenge goes back to the vision of "information at your fingertips." On your PC, you keep a lot of information – your favorite URLs, schedule, email, personal address book, and files. You want to be able to go anywhere and still have immediate access to all of this information on any device. Hotmail offers something like that today, letting you get your mail from any device with a Web browser. You don't have to think about it in advance, asking to have the data replicated somewhere – it's just there, thanks to the Internet. Now imagine that all of your information was available the same way. When you go from your PC at work to your PC at home, your favorites list and your files would go with you, and you wouldn't have to re-enter your personal information when you visit customized Web sites. You could coordinate your schedule in a better way If you set up name and address lists or buddy lists, you could share those across different machines. If you use other kinds of devices, they would be included, too. Your handheld should be able to connect to the Internet and immediately synchronize. If you have WebTV, you'd like to be able to browse your schedule or look at some of your documents. You could even dial in and have your mail read to you over the phone, or change something in your schedule with voice commands.

Today we have pieces of a data-everywhere solution, like IntelliMirror, database synchronization, mail synchronization, IE cache synchronization, and we've got Web sites such as Hotmail Tomorrow, all of these things need to come together in a vision we call Megaserver, which is a logically centralized server that gives you access to all of those bits wherever you go. This will require close cooperation between the IMG and Windows groups

One of the things holding back the vision of data-everywhere is bandwidth. We can do many things to help by using smart caching and replication, but sometimes you just need to send a lot of data through the network. As bandwidth goes up and costs come down, we will have make sure that our software and the PC itself is capable of dealing continuously and effortlessly with video-rate data. Both our networking and storage mechanisms must evolve in order to treat video as the predominant data type.

There are a number of start-ups that provide Internet-based services such as backing up files or collaboration. We're learning a lot from our own efforts – we have built some very popular Internet service sites such as Expedia, Investor, MSNBC, The Zone, CarPoint, and Sidewalk. We are learning about the services that people want most, and new business models enabled by the Internet. IMG's sites will not only become profitable, but the customer relationships will help us with all of our businesses. One of the things we need to be very clear about is that we are not trying to compete in vertical markets, such as financial services. Some of our potential partners, like the banks and the airline companies, are concerned about our motives. We need to show them that we aren't trying to take away their business – our goal is to build software that makes it easier for customers to use their services.

Our Web sites are a start towards what we call the Web Lifestyle. We want to help make the Web an essential part of daily life by offering a wide range of useful services. Being connected to the Internet should help people stay in touch with each other, help entertain and inform them, and help streamline their lives. We've only seen a little of what the Internet can offer. We need to do a lot more creative thinking to find the "must have" services that every customer will use every day. The new Web Essentials team is starting to explore this with our new Portal site. In addition to providing these "must have" services, we must deliver them in concert with great client support. A company such as America Online is in competition for all our information-management software, because they can do it through their servers.

The Enterprise and the Knowledge Worker

The enterprise is a key customer for Microsoft, and we need to support knowledge workers in all of their main activities. As we build these solutions, we will be relying on big advances such as NT5, SQL7, Exchange "Platinum" and Office 2000. I'm very enthusiastic about these products – they deliver a lot of technology that customers are waiting for, and they give us a strong foundation for all of our Windows goals.

Although we are building some great products, it's still too hard to build solutions. It's critical that we keep improving the products to be more secure, more efficient, and more scalable. But we also need to think hard about how the products can be integrated, so that we're offering a great total solution instead of just a lot of pieces of technology. That is one of the reasons I've been working on a new book about what I call the digital nervous system. The idea is that companies can rely on their digital nervous system to capture the knowledge they produce, streamline their internal processes, and ensure employees have quick access to all the information they need.

For example, Nabisco created a system known as Journey that supports their new product development Using email and database technology, Journey organizes project information that used to be in file cabinets, scattered around on hard disks, and in people's heads. Product managers can review projects, looking at financial analysis, market research, and status reports. There are electronic discussion forums and a repository for project documents. Journey also incorporates the business rules that guide Nabisco's new product-development efforts, such as the kinds of jobs and volumes that the company bakeries can handle. Once a project is completed, Journey serves as a central archive, keeping all the project documentation in the corporate memory. Our technology should make it very easy to build a system like this, but that isn't always true today.

Working on the book gives me a chance to think about the most important scenarios and see which ones are still too hard to build with our products. I'll be taking those ideas and feeding them back to the product groups to help make our technology a better way for customers to build their digital nervous system. For example, customers want to have workflow capabilities on top of a unified database that includes Web documents. Today, mail, documents, and databases are separate. We have to make it easy to build applications that work with all of your data at once. Customers need the rich query facilities of a database, the rich structuring and presentation of a document, and the ability to collaborate easily with other people. Combine that with good tools, and customers who want to build systems like Journey in the future will have a much easier time doing that. The corporate digital nervous system represents a huge market, and we must deliver the best products to serve it.

Digital nervous systems aren't just for corporate giants however. We must also remember that small businesses represent an incredibly important class of customer for Microsoft. Some of the work we've done for large enterprises directly benefits smaller companies too -- for example, the auto-administration work done by the SQL7 team reduces the need for administrator involvement. In other cases, we need to go even farther and provide specific features for these customers. Office is doing that in their next Small Business release, for example.

One thing that both small and large organizations need is services that can collaborate beyond the boundaries of their internal networks. As IMG delivers on the vision of Megaserver, we need to have great support from our client applications. While a customer's data might be available from a browser, Office should be the most fully featured client to Megaserver. One simple example that we can show today uses Hotmail, a simple mail client that runs in the browser, and Outlook, our more powerful desktop client. While it is possible for these products to share the same mailbox, we have only just begun to mine the available opportunity. On the front-end, our applications must let the back-end services come from either local or Internet servers, with clients presenting a consistent, rich user experience for either case. On the back-end, our server teams must work together to define common schemas and protocols for our BackOffice and IMG Service offerings

Scalability and Reliability

Starting with the high end, our goal must be to make Windows the best-performing and most reliable platform. Some people ask why we need the high end, when we charge such low prices and have to work so hard to build products that will sell in modest volumes. But we need to build this technology to make sure that customers don't need to leave our platform as they grow. We can't let Sun, Oracle and IBM go to our customers and tell them that when their demands increase, they'll have to throw out all their PC servers and move to another platform. It will probably take two or three years before everybody realizes that we really can scale to the high end, but this will be a very important breakthrough. The high-end part of the market is growing – it's not only the 30,000 mainframes that are still out there. The market is every server on the Internet that needs to manage millions of transactions, and there are going to be a lot of them.

In order to scale up our technology, we're partly depending on our hardware partners They've been making great progress. By acquiring Digital and Tandem, Compaq has amassed strong expertise at the high end, and we have plans for some joint projects. HP is also a valuable partner that has been shipping high end products for many years. Intel's advances are also key to our strategy. When we did the SQL 7 benchmarks on the latest Xeon chips, it was fascinating to see that they had not only increased the clock speed, but they had also gotten rid of the bottlenecks in the bus bandwidth. We saw about a 60 percent improvement in the benchmarks just from the hardware alone. The 64-bit address spaces in Alpha and Merced are very important to our high end work. When Merced comes out, Microsoft will be ready to exploit its power. We'll be offering a smooth transition from what people are doing on NT today into that 64-bit world. There are also some breakthroughs coming in clustering. We've been supporting two node clusters and we're moving rapidly to scale up to sixteen nodes.

Our customers will get a nice boost from the new hardware, but we need to improve the software parallelism and administration. Today, Sun not only wins some of the benchmarks, but their support for dynamic clustering is attractive. We should let customers add a new machine to a cluster and have the software automatically take advantage of it. To push our technology even deeper into the enterprise computing market, we need more than just great benchmarks – we also need to support around-the-clock operation.

We have to work very hard to make products secure. Our customers are starting to put some of their most sensitive data on the Internet, and we have to make sure that they can feel good about it being safe. Security features can pose significant architectural and user-model challenges, but we must meet them head on. We must also continue the work we are doing with universities, government agencies, and the Internet community as a whole to review both our designs and implementations. It's also just the reality that there are going to be problems, and we need to be very quick to get fixes out. Our "Windows Update" connection should make it easier to find out that a fix is available and stay up to date.

The Knowledge Worker

With Office and Exchange, we have built an incredible amount of technology for the knowledge worker. These products have been very successful in the market because they offer so much to customers. But even though we've built these great products, we still haven't come close to delivering on the idea of a paperless office. In some ways, we do a pretty good job within the company of using our own technology to communicate through email and the internal network. But visit anyone's office, and it's obvious that we aren't even close to getting rid of paper. Before we get there, we have to advance our architecture.

One area that needs to move forward is our document model. Today, the Web is exposing the big gap we have between forms and documents. To get rid of all paper forms, we need to make Office a superset of our forms architecture. Also, it should be easy for me to write comments on any document, including Web pages, and share them with a specific list of people. Today we have several incompatible annotation architectures, and none of them is rich enough to fulfill the basic scenarios. Authoring is an area where the combination of IE and Office should allow us to lead with innovative extensions.

Another major challenge is unifying our storage technology. For a long time, we've wanted a single storage engine that can hold structured objects. It should handle objects with complicated metadata and support fast querying. That was the original vision behind the OFS project, but we haven't successfully delivered on it yet. In the meantime, we've built more specialized stores such as SQL Server and Exchange, and of course we continue to rely on the file system This lack of unification is a big obstacle for our document management plans, so we're putting together a strategy that we call Storage+. We want to create an object-oriented file system that will store and search for objects such as Office documents, music, photos, and mail messages. Storage+ can't be rigidly relational or even show a relational heritage to its users. Because the store will handle attributes well, applications will want to keep their information directly in it rather than creating their own store. If they need extra features, the architecture will let them do that without creating opaque files that don't support the standard commands.

Our storage engines are also crucial for delivering on the vision of your data being available everywhere. We need to architect our central storage technology so that it can make your data available safely across the network. That's going to take smart replication and caching technology to deliver good performance. The Megaserver team will need to work together with Storage+ to let users share documents and collaborate regardless of how they are connected to the network

Another key area is having a powerful common search capability that works across all stores. We've seen the search and catalog engines become some of the most popular sites on the Web. Microsoft needs to deliver search technology with a unified UI instead of the huge collection that we ship today, so that people can find what they need no matter where it is stored. Even though the Web engines are hard to use, it is still easier to find a document on the Web today than it is on most corporate networks. Consider our own – something as simple as finding a product team's Web site and looking at their specs should be trivial, but it isn't. We must do a lot better than that, so an employee can call up a relevant document from a previous project in less than a minute. Suppose you want to find a post mortem memo done on a project two years ago. Today, it is so difficult that you probably won't even make the effort. Knowledge workers still keep files full of paper – it's easier to find documents in a file folder than it is to find them in the computer. We need to have such powerful searching and indexing that people will want to keep everything online. We need to go beyond simplistic document management and deliver on a paperless office that offers instant access to whatever documents customers need.

One of the biggest breakthroughs is using computers to collaborate with other people. We build many tools that help – email clients and servers, Web servers, and SQL Servers. But it's still much too hard to work together on shared data. We need to make it trivial for a group of people using the Internet to work together on a Word document. Today, groups all around the company build their own tools to manage specs on the Web, because we don't have a product they can use. We have to do better, so that it is easy for any group using Windows to have threaded conversations, do versioning, annotate documents, and search for them. These should be features of all of our client applications, particularly Office, but they should also be part of our development tools. The Outlook team has made some big improvements in email management, but I think there is room to go a lot further. Microsoft employees are all filing clerks spending lots of time organizing their own email which shouldn't be necessary. Some of the key assets of every company are now stored in email, and it's too hard to archive it and publish it so that people who weren't on the original threads can benefit Spam is also a big problem, and we need to help solve it.

Another area we have to focus on is integrating our products more closely. That's true within Office – although we integrate the various Office components in some ways, there is still a big boundary between the different modules, and it isn't always clear which module to use. For a task like storing a list of items, it isn't clear whether to use Access, Excel, or Word. Concepts such as outlining are quite different across the different products. We also have applications that perform similar tasks, such as Word, PowerPoint, and FrontPage, or like the multiple mail clients that we are shipping. I think we will need to continue to focus on the underlying user tasks in order to combine some applications and hide the boundaries far better in the future than we do today. Our low-end efforts, like Works and the CE applications, need to share with Office.

Integration will also help us in our competition with Lotus Notes. On some of the key features, we are way ahead – scalable messaging, for example. But Notes ties its features more closely together, has a more integrated storage model, and provides an easier way to write simple programs on top of its infrastructure. We must make our tools so compelling that customers will think twice before choosing Notes. We will also have to look at having good Notes-protocol interoperability, since Notes has a large installed base. Unless we interoperate, Notes users may stop buying Office updates.

Another challenge that we face is that some of our customers don't see any reason to upgrade. We need to make it very easy to move to an updated version, and must provide a compelling reason why it is worth doing. The test is whether the benefits outweigh the costs – if we fail that test, none of our innovations will get to customers. Since software is an infinitely durable good, every software company has to keep innovating if they want to get any revenue from existing customers. We can't ever be complacent, since every one of our products has to compete against its previous versions. It will take creativity and some risk taking with Office to define new levels of power. The Office 2000 team has done a great job meeting the challenge.

We need to work with new form factors such as the tablet computer. This will require big improvements in screen resolution and miniaturization, but there's no doubt that over the next several years those things will take place. It really opens your eyes to think about what kind of interface you'd like to have for that tablet device. When you bring it to a meeting and you want to take notes, do you just want the word processor, or do you want something that's a bit more flexible than that? Do we need to break down the boundaries between the applications so that you can mix tables and spreadsheets into the document – things that require Excel and Access today? Maybe you want to be able to take any notes that you create and have them viewed as a database, so you can access them at any time. You want to be able to annotate anything that comes up on the screen, whether it's a Web page or rich document. The tablet will force us to rethink our applications, and it's going to take a revolutionary version of Office to work well in that environment. We need great ideas for the UI and along with integration of handwriting recognition The tablet form factor along with our new software is a huge opportunity for us.

Managing and Administering Networked PCs

Another area that needs to be improved is managing networked PCs. It's still much too hard, and there are many ways that software should be helping more. We're making a big step forward with Active Directory and other management features in NT5. We need to keep our customers on the Windows platform by providing great management support – otherwise they will turn to competitors. All of our corporate customers are very worried about controlling the cost of PC networks

Some of the solutions are the same as they are for home PCs – improved reliability, better error reporting, and tools that let technicians diagnose machines remotely. We also need to make it easier to deploy applications across an enterprise, and to update them when new versions are available. Problems with deployment are pushing customers to build applications on the Web, even though they have to deal with the pain of limited tools and crude interfaces. As Storage+ provides an heterogenous object store with querying and COM+ extends our tools to deal with rich objects management will become a showcase application for the power of our architecture

Improving the Infrastructure for Developers

One of the reasons why we've been successful is that we've worked hard to support developers on our platform – our own product teams as well as ISVs and customers. That's always going to be an incredibly important priority for us. We've got to be making the systems that offer the most effective way for developers to build solutions.

Simplification and Unification

An operating system is only as strong as the applications that run on it. Our API complexity and the lack of a clear architecture for new APIs is making it hard for us to get ISVs to follow our new work as quickly as we would like. We need to bring together all of the new API work and share concepts and approaches to reduce the complexity. This needs to be a shared goal for Windows and for the tools.

Another place where complexity is hurting us is in our code bases, which are getting very big. We have to control this or it will keep us from adding new features and improving quality. We can't continue to increase the total lines of code at the rate we did in the past. One key is architecting our products so that we share more. Mark Twain once wrote to a friend, "I'm sorry this letter is so long. I didn't have time to write a short one." It does often take longer to write more compact code, but we have to make it a priority. One research challenge is to find new ways of coding and more automatic ways of testing – I think there are some great opportunities for software to help us do better.

One of the best ways to control complexity is to unify multiple technologies that are doing similar jobs. A number of concepts inside Windows that have been separate should be brought together, and we've started some projects to work on that. We use "Windows DNA" as the umbrella under which we combine the COM+, Storage+, Forms+, and Protocol+ initiatives. You might want to think of Windows DNA as the next generation Win32 API We will achieve a major simplification and unification of the Windows services by delivering on the vision of Windows DNA.

As discussed earlier, Storage+ will unify our various storage systems by combining the best of the file system, mail store, and web storage, and presenting these to our customers as a single store. Protocol+ is a project that will unify our protocols and align them with Com+. Our forms/UI unification, Forms+, will enable major UI advances in a future version of Windows NT, especially when combined with the other Windows DNA elements There is already some exciting prototype work going on for this release of Windows, which is code-named Neptune.

As we unify these technologies, we need to keep in mind the incredible power that having object-oriented architectures can provide. In our storage work, in our UI work and in our API work object orientation is a key theme. For example, if we really can treat procedure calls and methods as arbitrary objects, we can leverage all of the automatic functions that our platform provides. We can persist them, query them, distribute them, filter them, etc., all without any special code devoted to these tasks. The architecture that we create for system management should benefit from this unification as well. One can imagine a custom VB program that monitors events from multiple servers. It could scan a set of management events similar to how a VB program scans database records today Upon finding an interesting event, it could query a device, and display its properties, just like drilling down on a database object is performed today.

Distributed Applications

One of the biggest challenges and opportunities for us is the growth of distributed applications. Of course we've been doing that for a long time with two-tier applications based on tools such as VB and the data access libraries. But the Web has changed the way that our customers want to build applications, and we need to work hard to meet their needs.

It's very difficult to build a distributed Web-based application today. You have to choose between many different technologies, and you don't get enough tool support. The most sophisticated applications are being built from scratch and are often running on non-Microsoft platforms. We need to have a great platform for building these applications, support for scaling them to very large numbers of users, great tools to help, and easy ways to deploy and manage them. We are not delivering that today. We have to make sure that we are integrating our products better, so that our platform is the best place for customers to build end-to-end solutions.

Distributed applications are a huge opportunity for us to lead and innovate, but they also represent a threat. We have tough competitors such as Sun, Oracle, Netscape, and others who are doing everything they can to make sure the new applications won't be based on our technology.

One rallying point for them has been the Java runtime environment and class libraries. The Java environment started out as a threat on the client – it promised to hide every aspect of the system, such as its user interface, underlying memory management, and security. That's bad for customers, because it means that applications are locked off from the richness of an environment like Windows and it adds a lot of runtime overhead. It's also an incredible challenge, as we know from our tremendously hard work keeping existing Windows applications running while the operating system evolves. Sun hasn't delivered on its promises and several high-profile Java efforts have failed.

But that doesn't mean we can stop paying attention. Our largest competitors, including Sun and IBM, continue to rally around the most extreme Java promises as an alternative to using a common operating system. We need to do a lot of technical and marketing work to show that our approach is far better for customers. The same naivete that applied to Java on the client is now repeating itself on the server with Enterprise Java Beans. As Sun, IBM, and Oracle all compete to be the "true" Java server solution, the incompatibility of their products and goals will become more evident. We need to offer a better alternative by delivering the first environment that makes it easy to write distributed component-based applications.

In order to be a great platform for developers to target, we've got to make some important improvements to our technology and extend those benefits to include distributed Web-based applications. We need a clear application model. Windows is missing this today – applications install themselves by dropping files all over the system and making all kinds of changes that are hard to track, such as updating the registry and shared components. The fact that uninstallers are among the best-selling PC software products is a clear sign that we have failed to do a good job on this problem. Things get more complicated when you move to a distributed application that has code running on both the client and the server. We have to improve the PC, and we have to offer developers a great reason to build and deploy distributed applications on Windows. Otherwise they might decide simply to target the basic browser, ignoring the richness that we offer because it is too hard and complicated to deal with.

We also need to give developers a clear message about how they should build their UI. Reconciling Win32 and the browser presentation models is a top priority for IE, Win+, and tools. The solution has got to be fast, as simple and powerful as HTML, and with a great programming model that can be targeted by tools. Our approach has to allow new code to run easily on an offline client. Approaches that are server centric play into the strengths of our competition and give up the advantages of the PC client.

The Storage+ technology is also critical for developers. The file system has been a key part of the operating system, but we are running into the limitations of the basic model. It does a nice job of hiding details like the layout of bits on the disk and delivering those bits efficiently, but it doesn't support objects with rich semantics and it doesn't understand how different objects relate to each other. We're increasingly working with objects that don't fit the model of a sequence of bytes. Web pages have hyperlinks to each other and to images. We must get smarter about images, serving up different renderings depending on the context in which they are displayed. The store should maintain the integrity of links between objects, and should understand meta-properties.

Another thing Storage+ has to provide is optimized access to data. With universal naming, you can request the data no matter where you are. But even though bandwidth is going to increase a lot, there will always be reasons to store information locally. We need to use caching and replication so that we can provide very fast access to the data that users need most often. You should be able to get all your data from any computing device you use, but we can be smart about predicting what you are most likely to look at. You probably aren't going to edit spreadsheets on your handheld, but you'll want to see your mail and appointments right away. It will be a while before every device is attached to the network all the time, so we need to make it possible to work offline. Today's Web-based applications usually don't work if you are disconnected. We'll need to have a way for the device to figure out what needs to be stored locally – which Web pages, images, and code – and which data sets need to be stored in large remote database engines, etc. We'll need to cache edits that the user makes and reconcile them when the system is reconnected.

As we compete with other platforms, we always have to remember that we have a big advantage. The PC can do a lot of work locally – it will always be more powerful and flexible than a limited box such as the network computer or a handheld. The extra power of the PC will let us do many extra things to help the customer, even for server-based Web applications. We can put logic on the client that allows more powerful rendering – for example, showing a multi-dimensional data set without going back to the server every time the user wants to change the pivot. We can integrate servers with the productivity applications that users rely on. We can use rich graphical transitions. We can keep track of every command and operation the user performs, and then calculate which commands the user might want to perform next. We can do speech recognition and natural language processing on the local machine. We can support offline use.

Whenever we think about building distributed applications, we should think about how to use the local machine's power to do better than you can with a simple closed device. We need to make it very easy for developers to take advantage of the extra power on the client – it's much too hard today, so many Web applications just don't do any client processing at all.

Schemas and XML

Computers today don't understand very much about the world. You are going to be hearing more and more about 'schemas' as we try to build up a common understanding of objects in the real world. Today, two programs that deal with places or people or time usually have totally different models. It's very hard to tell whether two events happened at the same time, whether two people are really the same, or whether two places are related to each other. What we have to do is to define some common models and publish tools for creating models. We need to have tools that can take two models that aren't exactly the same, find the common parts, and let you interchange information.

Microsoft has a great opportunity to lead here, because we make a lot of the building blocks that people use to manage and store their data. We've been working on things such as standards for particular industries, the WBEM systems management objects, and the repository. In many places in our strategy, we're realizing that we've got to have higher level descriptions. We need to bring all these efforts together into one approach and have the system understand a common schema for people, places, things, and even perhaps customers and products. Because we don't have that, corporate customers buy a lot of products that just bridge from one application or store to another. We can make all that much easier by having a shared model and common protocols for exchanging data. There are both commercial and consumer scenarios that are important and that need a common model – things like sharing calendars across the Web, sharing business cards, and sharing payment information. We can help a lot to make these things easier by building some support into the system

Not only will our own applications share data better, but it's even more exciting to think about sharing schemas on the Internet. Today, when you talk to a Web site, you get back HTML. That's been an incredibly effective way to put documents online and build applications like Amazon's book buying site. But it is hard to do anything with HTML except display it – it's hard to take a stock quote from Investor or a book listing from Amazon and do any processing on it. You'd like to compare data, aggregate data, query across multiple types of engines, do incremental updates, and understand attributes such as what a document is about and who wrote it. XML will make the Web more than just a place to share published documents – it will turn it into a giant database. Web sites should use XML to provide COM+ descriptions that allow easy programming and data navigation. We need to make sure that our platform is the most powerful and effective way to add information into that database and to build applications that use it.

New Platforms

Most of the challenges I've been talking about are related to the PC, the heart of our business. The PC is going to be our central focus for a long time, but there will be a lot of other devices that have powerful CPUs in them and that offer computing services to people. 60 percent of Americans don't have a PC today, but many of them will buy these specialized systems.

Our strategy for supporting the new devices is based on Windows CE. The CE team has done a great job building up their technology and partnering with hardware manufacturers on a whole range of devices, but we have stiff competition. Sun, for example, is proposing the JavaOS and is trying to standardize the Java APIs on these devices even when their operating system is not used. SUN's strategy includes the idea of migrating JAVA code between devices. We are going to invest heavily to make sure that we are the leaders in designing computing appliances.

In the past, many people have had their computing environment dictated to them by their "enterprise." Today, this landscape is rapidly changing People are supported by a plethora of connected devices, and many of them are independent of the enterprise. Both PCs and appliances must increasingly support the individual, with a dual role of offering the web lifestyle and doing business in a company that has a digital nervous system. Yet, these two environments are not easily brought together. At work, there is an IT organization, and a requirement for specific policies regarding security. At home, things must be automatic and intuitive. Building the bridge for the individual between these environments is a key challenge for the company.

On the Road

People want to stay in touch today no matter where they are – they want to communicate with each other, use computer services, and work with their data. One problem is figuring out what kind of device they want to carry. We've recognized that the initial hand-held Windows CE design was caught in the middle – it was too big to fit in your pocket and too small to have a good keyboard – so we've taken that form factor in two directions. We've gone up to create a much larger device with keyboard and screen that's code-named Jupiter. Those devices will cost $600-$700 and be wonderful little portable computers. We're also scaling down to the palm-sized PC products that are now out from Casio and Philips.

One problem with all of the portable devices today is that each one is its own little island of data. You can synchronize your handheld with your PC, but that's about it. If you are on the road, you won't be notified when a meeting is rescheduled or you get new email. You change a phone number in the handheld, and the phone speed dialer isn't updated. You get a page, but you have to type the number in to the phone or copy the message into your handheld. You forgot to copy a file to your laptop, and now you are stuck in a meeting and don't have the data.

We're going to see two things that help – devices are going to converge so you don't have to carry so many of them, and wireless technology is going to mean that the devices talk to each other and to the net. Small handheld devices like the Palm Pilot or Windows CE machines are going to talk to or be merged together with cell phones. They are going to be pagers. Cell phones will have data capabilities as well as voice: schedule management, data tables, personal directory and other applications will run on the Intelligent Phone platform. Recently the leading phone manufacturers (Ericsson, Motorola, and Nokia) announced a joint venture with Psion, called Symbian, that will represent serious competition for us in this space.

But an even more important breakthrough is that the devices are going to be connected to the network most or all of the time. You want to see the latest email, get paged, see scheduling requests, or look at the latest news and investment data. Every device should be a window on your data that shows all the changes as they happen – you don't want to wait until you get back to your home or office. The idea behind Megaserver is that it can make your data available from anywhere. Wireless technology is getting much better, and we will also need to be smart about using caching and replication to make data access efficient. This is an area where we can innovate and where we need to work closely with hardware and communications partners.

We're starting to see some companies that are building electronic books. Maybe you will read books on a tablet, or maybe on a more specialized device. It is inevitable that books are going to be distributed electronically, once we see some breakthroughs in display technology. There are some hard intellectual-property protection problems that we can help solve by building some support into our platforms I am sure competitors will emerge that build systems from scratch to optimize for these new devices, and we need to make sure that we don't fall behind. We have a special group focusing on electronic books in MS Research, and the Windows CE team is looking at these kinds of devices as well. Fully powered tablet computers and electronic books based on Windows CE will need to share UI and protection formats.

Another way that computers can help people who are on the road is when they are built into cars. Our first effort to build AutoPC software has taught us a lot. One key challenge is coming up with a good user interface that doesn't distract the driver. If the car is moving, you need to be able to give voice commands that are easy to remember and don't make you look at a screen. Also, you can't just use locally stored data – many useful services, such as traffic updates, need to know where the car is and then get data from remote servers. We are just at the beginning of integrating computer services into cars, and we are building great partnerships with several auto makers.

At Home

We're going to see a lot of new computing devices around the house as well – this will be a huge market. In addition to having multiple PCs, people will have a network-enabled TV, smart phones hooked up to the Internet, and flat-screen panel PCs.

The TV is incredibly important, and the WebTV team has done a great job making the Internet available via TV. The TV opens a very important new market, and lets us bring the benefits of Internet access to a huge new community. While many people don't have a PC yet, almost everyone has a TV. We can think about new kinds of applications, too, because people often set up a TV where it is more a part of their daily life than the PC that's in the home office or den. We should also think creatively about distributing data using the broadcast infrastructure for TV.

To make the TV a more compelling way to use the Internet, we are investing heavily with companies such as Comcast and Time Warner to make high-speed connections available to everyone. We're helping phone companies with DSL and cable companies with their cable modems. We're working with standards bodies to push HDTV along and get better screens. This year we will pick some locations to do Intelligent TV pilots, and show how we can take Windows CE and WebTV technology and provide great new services. These devices will have to have automatic update and management features so that customers don't need to actively manage them. Some of the companies we are working with are also piloting solutions from competitors such as Sun and Oracle. We must rise to the challenge and prove that our solutions are easier and more fun to use for the consumer, while being more scalable and simpler to manage and deploy for the operator.

It's also interesting to think about having a computer mounted on the wall with a touch screen. It could show everyone's schedule, show incoming email, display artwork, keep up with the latest headlines – whatever is useful to see in a central area that doesn't need a lot of input from the user. You probably wouldn't do word processing on it, but you might accept an invitation or check off bills that are presented for payment.

One of the things that will make appliance computers much more useful is letting them talk to each other and to your PC. Just like with mobile devices, each system should be working with the latest version of your data. Since most people don't want to run wires all over their house, wireless technology makes a huge difference in making it possible to share data. One of the things we have to think hard about is what the standards should be for home networking, and how the PC should work with these other devices. Do you want to have a home server that everybody synchronizes with? If that is the right answer, then we need to make that server incredibly simple to administer. The way we do things today is much too hard – it must be automatic and maintenance free, or people will never buy it. But if we can make it easy to build a wired house, we'll open a whole new world and a big new market for Microsoft.

Conclusion

We are the leading company in the best business in the world. We have to maintain the values that have gotten us this far – taking the long term approach in hiring great people, listening to customers, investing in innovation, and building partnerships. Our products are incredibly successful, but they are not nearly good enough for the years ahead. Can you find a document easily regardless of where it is stored? Can you run a PC for months without needing to reboot it? Do our applications share the same schemas for their data? Do we have a unified storage and presentation model that applications can target? Is the PC platform a great place to build and deploy distributed applications? Can users roam their state and share information with others across the Internet? Do users share and collaborate on their documents? Are PCs the machines to use for building large-scale servers? These are major challenges for us, and we will continue to increase our levels of investment so that we have the resources to take them on.

We will need a lot of creativity – not only in all our product areas, but also in the way we manage the business. As we grow, we must learn to change the way that we do things. We have evolved from a company that ships many relatively independent products into one that builds a unified platform. This means that groups have more dependencies on one another and must learn to work together more closely. It's a difficult change, forcing teams to rely on and co-operate with each other more than they did in the past.

I need your help in conquering all of the challenges laid out here I know our work will have an incredibly positive impact on the way people work, learn, and communicate. I feel very privileged to be a part of it.

Further Reading

If you are interested in reading more, there is some material at http://interface/msstrategy that discusses the challenges we face, and explores opportunities to improve our products and our company.