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TECHNOLOGIES FOR A VOLATILE WORLD

by

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Overview

Today the computer industry is in the throes of radical change. It is impossible to separate traditional computer applications from changes in processes taking place within companies. The change is going to be huge, both for us, the users with many more user-friendly interfaces, and for companies which will have incredible processing and storage capacities at their disposal. In the light of these changes, IBM has chosen to invest in added value. The group favours everything which will give its clients an advantage over others, not only more technologies with the arrival of the grid, 'virtualisation' or autonomic computing, but also, importantly, more specific experience in the clients' industry, combining knowledge of professional know-how with technology. The buyout of PricewaterhouseCoopers is an example of this line of reasoning. IBM's strategy of 'business on demand' involves modernising its clients' computer stocks and also ultimately learning from new technologies by completely reorganising work methods, processes and companies.

TALK : Michel TEYSSEDRE

I am in charge of strategic business opportunities in Europe and I manage a start-up which is responsible for supervising start-ups created within IBM. I am going to talk about changes in computing in the coming three to four years, describing the areas in which IBM is currently investing.

The press has publicised the new concept launched by IBM, namely 'e-business on demand'. Heads of companies are faced with various problems such as the volatility of the economy, the client king, competition, and the absolute necessity not to make mistakes. To take up these challenges, there are certain rules which they have to respect, such as having a clear strategic position, an optimum relationship with their clients, reduced costs and a management culture.

In order to achieve this, computer technology and business processes must be closely linked. This is why we bought out PricewaterhouseCoopers. Even though there was no doubt that we had the technology, we could not necessarily match our clients' professional knowledge. We therefore needed a partner to make the link between business processes and technological aspects.

During the 1980s, we wanted all employees to have access to information. In the following decade, we set out to have horizontal communication between the various pillars of a company (Customer Relations Management, supply chain, and so on). Today, one wants to have a relationship on demand : the byword is adaptability not only within companies, but also with clients and suppliers. The system should be able to react very quickly to market growth or decline. It should stay competitive in its cost structure. In short, the system should be able to evolve.

'E-business on demand' does not depend purely on computer technology but implies a radical transformation of the business processes within a company.

This talk attempts to describe how computer 'plumbing' – the intricacies of its infrastructure – will be capable of dealing with this revolution by combining an overhaul of these processes.

Technology and computing

IBM introduced *Deep Blue* in 1998 for supercomputers. Its capacity for processing was equivalent to that of a lizard's brain, which is admittedly not very kind to Kasparov who played chess and lost against this machine. Next came *ASCI Purple,* designed to simulate American nuclear tests, and which could carry out ten trillion operations per second, in other words, it had the processing capacity of a mouse's brain. *Blue Gene* will be introduced for the purpose of complex simulation, such as all aspects of climatology. This computer has one hundred thousand processors called 'Power' (Power Optimisation With Enhanced RISC).

Today, progress is greater than exponential and will remain so for the next five years. The Moore Law, which states that there is a trend for processing capacities to double every eighteen months, will therefore continue to be borne out.

Why are we so sure of this change ?

Technology

We know exactly which technologies will be applied in the next three years. The *low-k dielectric shield* has a very weak coupling facility which makes it possible to pack the wires closer together without interference and thereby allow electronic signals to move faster through the chip. This technology has already been mastered. The same is true for the *strained silicon* technology which boosts chip speeds by 30 % by increasing electron flow, and for the

double-gate technique which makes it possible to assemble transistors in 3D. These three changes will enable us to double the performance of our computers every eighteen months.

Nanotechnologies will have a large number of applications for computers. Admittedly we are only at the research stage, but the new products will be on the market in seven to eight years' time.

As far as storage is concerned, we are working on the Millipede project. We will be able to store a trillion bits per square inch, in other words, seventy million printed textbook pages, the equivalent of one hundred thousand books, in short, the size of the library at Alexandria. Of course, this project is still in the laboratory stages but the technologies are known and published.

Without fear of being wrong, we can therefore be certain that the improvements which we have seen in the last few years in terms of storage and microprocessors, will continue at the same rate at least.

Architecture

Improvement in performance also concerns the architecture. Today, there are two major types, the *scale ups*, computers which are increasingly powerful, and also the *scale outs* with a large number of processors at the same time. The major advantage of this technique is its low cost since it requires blades side-by-side which cost less than two thousand dollars each.

Between these two types of architecture, there are *clusters*. These are machines which work together with different operating systems, but which are closely linked.

In the future, *blue gene* type technologies, which will have very powerful processing capacities, will spread both in the US, and in Europe. Admittedly, they do not yet appear in our catalogue, but some research centres already possess not just one hundred and twenty or two hundred and fifty processors in the same cabinet rack, but two thousand with extremely innovative connection technologies !

Therefore, with a technology and an architecture which is currently undergoing radical transformation, users are going to profit from more than exponential growth at least until the end of the decade.

Linux

Like the Internet, Linux was first used by universities. Once a new product becomes available, a small group of users adopts it, and then it gradually ventures into new categories. Finally, the world of work gets interested. The IBM group spends considerable amounts of money on the development of Linux.

The Linux venture started in infrastructures, then developed around applications, and now concerns client workstations themselves (PC – ThinkPad).

Infrastructures

Firewalls, file and print, web server, and e-mail are just some of the infrastructures primarily involved. Companies adopted Linux for its low cost and also to be rid of Microsoft. Additionally, our clients tell us that Linux technology is more reliable. This is why an English bank which works with developing countries decided to change all of its Microsoft sites to Linux to be certain of better security.

Applications

A certain number of applications for e-commerce are also involved : Lawson, whose headquarters are in Japan, decided to use only Linux for its multimedia kiosks.

Today, of everything which revolves around clusters, supercomputers, seismic and oil reservoir simulations and, more generally, industry, 75 % use Linux.

Even though important research centres like the French Atomic Energy Authority are keeping to the more traditional Unix technologies, applications from the major software editors (such as SAP and People Soft) are now available and are often developed using Linux. For example, according to a recent SAP advertisement, it will be using Linux for its strategic operating system.

Client workstations (PC – ThinkPad)

Unlike previous stages, this last stage – the use of Linux by clients themselves – is not yet on the agenda. Therefore, one should be careful and patient. Windows still possesses a wealth of applications which Linux does not offer. Additionally, in two or three years' time, there will undoubtedly be fewer autonomous computers : computer architectures will be independent of machines and it will be completely justified to resort to Linux. In fact, applications will no longer be in computers but centralised, and clients will import what they really need. Linux is in a continuing growth phase whereas Windows is marking time, but Windows will still dominate the market for a long time to come. Above all, one must prevent several Linux-type systems from developing. This is why the Open Source Development Lab (OSDL) is so important. Linus Torvals, Linux's inventor, recently joined this organisation. This consortium brings together the most important industrialists in the World and its aim is to keep the Linux core unchanged so that editors do not have to compile or test their programmes regularly. OSDL will undoubtedly win its bet since all those involved, apart from Microsoft, agree on this. IBM campaigns for an open world, the only one to guarantee growth in the coming years.

Grid computing

Today, we are in the second Internet generation, in other words, if we use our personal computers, we can connect ourselves from anywhere in the World and carry out transactions using just one computer. With grid computing, we enter the third Internet generation, with the possibility of using resources from an entire computer network. This means that one operation will mobilise not just one machine, as is the case today, but hundreds of computers simultaneously.

The intra-grid

The intra-grid is currently becoming widely used by companies. Previously it was impossible for resources, protected in the computer by a firewall, to be used by computers in the same network ; now they can. On a main frame, the user-rate of the machine exceeds 80 % : with a Unix machine the average rate is about 20 % and falls to 5 % with computers such as Intel using Windows. Since huge processing capacities are not used, this technology allows them to be optimised within a company.

The extra-grid

Certain experiments have already taken place to allow companies to pool their computing resources with their outsourcers and their clients. Subsequently, to draw an aeroplane wing, the processing capacity necessary is extremely large. To achieve this capacity, it will be possible to ask all the internal computers in the company and those external to the company for help for a few weeks. When Concorde crashed, a greater than average processing capacity

was necessary to understand the reasons for the accident. Here again, use of the grid could have been a vital factor.

The inter-grid

All the research centres in Germany, Great Britain and France have developed this type of grid. Progress in this area varies enormously from one country to another. The English are the most advanced : Tony Blair decided to inject three hundred million pounds into this technology over three years. IBM has developed several projects in partnership. One of these caught the attention of the press, namely the 'e-diamond' project for the detection of breast cancer. Five hospitals are linked by a network and have created a grid database. When a woman comes for a mammogram, the system shows the doctor if there is a suspicious-looking lesion, indicates whether further tests should be carried out, and gives him a résumé of treatment concerning past patients who displayed the same pathology. From now until 2007, this system will be operational and the idea is that it should be available in the ninety-five NHS hospitals in England. Identical projects have been carried out in Italy and Belgium. France has not yet reached this stage but remains active all the same.

History of the grid

This system was developed in the 1990s at the request of scientists. The Global grid forum, a method of organisation aimed at standardising the grid, was created in 2001.

There were three stages :
- firstly, supercomputers in research centres took advantage of this technology ;
- secondly, since 2001, the grid has moved away from centres purely dedicated to research and has spread to companies. In the next two or three years, one way or another, all companies will test these technologies. IBM has worked with Globus to develop this technique and to make it accessible to the business world using the architecture known as OGSA (Open Grid Services Architecture). Today 95 % of all installed grids use the Globus tool kit, the kind of kit which enables one to construct one's own grid ; a grid cannot be bought, it has to be built ;
- and the final stage will bring together grid technologies and web services. Once this norm has been adopted, the third Internet generation will really be able to take off.

The grid : concrete examples

Below are several case studies which help to appreciate the usefulness of the grid.

The IBM grid

IBM itself uses the grid to create circuit simulation, and also for the virtualisation of computer resources at the disposal of software editors to test IBM technologies.

Two and a half years ago, the 'Grid innovation center' was created in Montpellier. Initially we thought that 80 % of projects presented would consist of optimising existing resources. This turned out not to be the case : four out of five projects concern developments which their creators would never have imagined to be successful without this technology. They are able to innovate, thanks to a processing capacity which is much greater than they previously had.

Companies specialising in life sciences have a huge demand for processing capacity. However, this demand may be very sporadic, for perhaps one week at a time followed by three months' work to analyse the week's findings. In Montpellier, we advise buying capacity on a weekly basis. In the same centre, a certain number of applications were developed for finance, life sciences, the car industry, the aerospace industry, agriculture, the electronics industry, the oil industry, education, and so on. This type of technology is not confined to important companies: very dynamic small and medium-sized entreprises are also interested in

it. In order for companies to adopt these new technologies, there has to be a business approach. In a company, we do not install a grid to modernise the existing means : we choose an application for which the return on investment is favourable. We then "gridify" it and go on to the next application.

Finally, IBM is in the process of taking part in a project on a European level to link up all the European research centres in order to create a virtual supercomputer, bigger than the one which already exists in the United States.

The Charles Schwab Bank

Charles Schwab is a bank specialising in on-line trading. In the banking sector, credit risk, market risk and operational risk services are traditionally independent and the rate of use of their computers varies from 2.5 % to 40 %. Our aim was to share these unused resources so that they could be operational much more quickly. To carry out an operation with a client, Charles Schwab needed fifteen minutes. Today, its services can do it in thirty seconds, simply by using the existing resources ! Additionally, portfolio analyses took place every 48 hours ; now they take place every half-hour. For a banker, knowing his risks as quickly as this, helps him make substantial economies. This technology has therefore completely changed his business model.

The CERN (European Council for Nuclear Research) Data grid project

This organisation will develop ten petabytes in 2007, in other words, one terabyte a day. Six thousand scientists spread throughout the world over roughly one hundred sites will be able, at a given moment, to launch data processing on all the computers in these centres.

The Décrypton project

The Décrypton project consisted of asking Internet users to send us their PCs' unused processing capacities so that we could do research on the genome. Eighty thousand people agreed and we gave teraflops to the French association for myopathies (AFM) to decrypt genomes. In the space of two months (whereas we had thought it would take four), the AFM decoded an impressive number of proteins and not a single Internet user was affected !

Currently, in the United States, there is an identical project called *Smallpox* and we are going to launch a Décrypton II in France which will be permanently available : the AFM will be able to use the existing resources on a university network and the unused processing capacities of willing Internet users.

The grid is therefore available in research centres, in universities, and is starting to appear in industry and in banks. As a result, almost all the dealing rooms have adopted Linux and put a grid in place which has led to a complete change in business models. These technologies are starting to be used in the world of engineering and design. Simulation modules of space in 3D, which used to take several days, can now be devised in four or five hours. In the oil industry, Shell is in the process of rethinking all its simulation activities thanks to the grid.

This revolution established itself very quickly because of its reasonable cost. It was not necessary to buy new materials but simply to use existing resources better.

Virtualisation

What is virtualisation ? It is a process by which the mainframe is linked to an environment composed of processing and storage capacities which can be totally relocated without the end user noticing any difference.

It is an extremely important evolution since one of the current sticking points concerns the management of very complex computer machines. This is why Linux, as well as Microsoft, have added an additional software layer to their programmes which allows them to virtualise resources. The advantage of virtualisation is that there is no human intervention any more : the system runs itself. Those who manage the system allow a user a given response time. If overheating takes place and the delay increases, new resources are assigned so that things revert to normal. When the demand decreases, the system takes away machines and redistributes them to other users.

Virtualisation already exists for processing capacities, storage and networks. Companies have shown keen interest in this technology which enables them to use existing resources better and to optimise the cost of use.

There is no risk at all of saturation of the network since the fibres are black, and 90 % are unused in Europe, and also in the United States. Telecommunications systems have effectively put in place oversized networks which can handle volumes much greater than those today.

Towards independent computing

In 2000, we noticed that one of the fundamental stumbling blocks to growth in the computer industry was the complexity of computer management. Some of our clients spent 80 % of their computer budget maintaining their existing computers ! They had less and less money to invest in innovation and to change business processes which have always been sources of value within their companies.

IBM decided to solve this problem by including elements which made virtualisation possible and also optimised and made the resources secure in its software and servers. As a result, if a virus attacked the system, the system would react by itself, protect itself, recover and reconfigurate itself, in other words, it would act independently. We share this technology with our partners and clients. Our aim is to arrive at a stage where the computer structure can run itself, with a minimum of human intervention. We have been working on this aspect for the past four years and we have all the necessary components at our disposal.

On a scale of five levels ranging from pure human intervention to complete independence from computer systems, we allow our clients to position themselves using a methodology.

These ‘autonomic’ technologies are ‘open source’ and are clearly at the disposal of all our partners on the IBM site.

However, the ultimate level has not yet been reached. One can start to manage infrastructures by business policy but total independence is not yet attainable despite huge investments devoted to it.

Capacity on demand

Capacity on demand consists of invoicing our clients on the basis of what they use, both in terms of storage and of hardware or software. Even if the market in this area is going to expand, we are already suggesting to some of our clients that they should have variable costs according to their demand so that they can adapt themselves to their market and environment as quickly as possible.

Change with respect to the client workstation (PC –ThinkPad)

The cost of client workstations is significant and represents an important item in the computer budget if one includes the global costs of installation, maintenance of applications, data and system backup, in other words, the entire range of costs incurred for computer use. Improvement will come in the form of centralisation of applications and of tools available from a central server. All the costly complexity of the management of applications and backup will then be centralised and it will signal the end of the nightmare for the end user. In the client workstation (PC, ThinkPad, palmtop, telephone…), there will certainly be only what is called a 'container'. Everything the user needs will be downloaded during the Internet connection on demand. This is a sort of programme synchronisation. As is the case today, this technology enables one to work independently between two Internet connections, in other words between two synchronisations. All the complexity of the management of software and installations will be centralised. In addition, this system will give users much better security since the container will only accept that which has already been scanned for viruses.

E-business on demand

There is another possibility : e-business on demand enables one to share risks. A client who changes all his computer business process expects productivity gains from it. In the future, he will be able to ask us not only to share the risks, but also the profits. We have not yet reached this stage but we will be getting there, sooner or later.

Conclusion

In the 1940s, data started to be digitised. Then, in about 1965, transactions were digitised. In 2004, the next revolution is the digitisation of processes, in other words, e-business on demand. This will call for huge processing capacities but one good piece of news is that we will be able to have them, and at a reasonable price, and it will be possible to calculate the gains for the company and relate them directly to their business model.

DISCUSSION

The metamorphosis of IBM

Question : *In the space of ten years, IBM, which has been invited four times to speak at the École de Paris, has greatly changed : its workforce has been cut by half while at the same time it has changed from producing just hardware, to supplying the entire range of services. In addition, with Linux, IBM is opting for a free operating system. But while I was listening to your talk, I couldn't help wondering if IBM isn't in a certain way going back to its roots : in the near future, all your clients will be connected to a large central server, a sort of head architect.*

Michel Teyssedre : I do not think so. When we guarded our secrets jealously, we almost lost it all. The change was painful : we disclosed our secrets because our clients demanded that we do so, and we went from four hundred thousand to two hundred and thirty thousand employees ! We then turned our attention to the 'open system'. When Linux arrived, we had to invest a billion dollars to transfer all our hardware and middleware over to Linux. If we had not changed tack, we would certainly be in a very difficult situation today, similar to that which computer manufacturers are going through. Yesterday's IBM is dead and will not return. Our clients want us to help them to adapt to a world which is changing more and more quickly and of course we can do that in terms of infrastructure and also in terms of business process.

Q. : *Why did you buy out numerous companies ?*

M. T. : At the present time, IBM is investing four billion dollars in fundamental research and not only in computer research. In the last ten years, we have been the company which has taken out the greatest number of patents. However, we do not feel that we have a monopoly on intelligence and it is natural that those who create new software or new technologies are included in our development. In fact, we carry out more acquisitions in the software area than in hardware.

In addition, we have also concluded a number of partnerships, such was with Microsoft, Cisco and others. For example, we signed an agreement with HP, Alcatel, Nokia and Nortel to develop a Linux system for telecommunications.
Finally, we work with industrialists, governments, universities and laboratories.

The PricewaterhouseCoopers buyout

Q. : *When data was digitised, one worked with computer scientists. With the digitisation of process, one works with professionals : therefore the people you are dealing with are no longer computer directors but your product-users. How do you contact them directly ?*

M. T. : We had a preferential relationship with the computer department but little contact with the functional, professional departments. This is why we bought out PricewaterhouseCoopers since they knew the process and they have contacts with all the companies. With the PricewaterhouseCoopers know-how, we are going to be able to link the process of a company with a computer system which will allow us to distinguish ourselves from our competitors. We can then envisage very different business models, for example by sharing the risk, which I mentioned earlier.

In the 1980s, certain car manufacturers chose to concentrate on production (such as Renault and Volkswagen), while others preferred concentrating on added value (Mercedes and BMW). As for Citroën, Alfa Roméo and the English manufacturers, they did not choose either strategy. Today we can see that those who made a clear choice have become the leaders. The same is true in the computer business : IBM chose to concentrate on added value, Dell on volume, whereas others did not clearly position themselves and today are encountering problems.

Q. : *How do you handle the integration of PricewaterhouseCoopers ?*

M. T. : Our two groups are powerfully complementary. Admittedly, IBM proposed services for its material and its software, but had little activity in terms of advice in the sense of business transformation, which is PricewaterhouseCoopers' speciality. Integration is not simple but it is not particularly painful. IBM's results over the past two years confirm that things are going quite well.

Q. : *When the times comes for you to tackle the digitisation of business processes which will involve inevitable change, you will be coming up against companies each with different processes from each other. Would it not be better to integrate this concept of 'on demand' to allow companies to take advantage of systems which have sufficient means of adaptability ?*

M. T. : Today I talked about infrastructure – the internal plumbing for computers – to show which future technologies are going to simplify the company environment. But the process aspect is effectively essential and BCS (Business Consulting Services/ PricewaterhouseCoopers) is working on it flat out !

Relations between Microsoft and IBM

Q. : *How are your relations with Microsoft, given that you use Linux and that you encourage your clients to do the same ?*

M. T. : We have very strict partnership agreements with Microsoft but we are not 'married' to Microsoft. Our clients ask us for several solutions and this is why the grid also functions using Windows. There will not be a war between IBM and Microsoft. Furthermore, we live in a world which is constantly changing and it is not certain that tomorrow's Microsoft will be anything like today's. In three or four years' time, microcomputers will undoubtedly be running out of steam since new, light tools will be offered to clients, such as the palmtop and the smart phone, with more user-friendly interfaces. The keyboard is not an end in itself and it will not go on forever ! The three main manufacturers of games consoles have already understood this : their future machines will function using Power architecture which will completely change the relationship between the player and his console.

Novelties and resistance

Q. : *Will these new technologies not force users to alter their behaviour ? Will they agree to this ?*

M. T. : Everything should be as simple as possible for the end user. If it is not, then technology will not advance. Internet is a very good example of this : in the beginning, it was complicated and few people were interested. When it became more accessible, everyone became a convert.

Around this table, no-one has used the grid. But if I were to ask your children whether they have ever downloaded music using Kazaa, they would all say yes ! And yet this is a sort of grid !

Q. : *Are the changes slowed down because users cannot think at the same rate ?*

M. T. : Yes and no ! It depends on the amount of money we can make. Two years ago, we put a system in place to share resources in a bank and today all the banks are working on similar projects. But such a change also completely transforms our profession : we are no longer there just to sell hardware but also to give added value.

The IBM advantage

Q. : *Given the fact that the cost of computer equipment is falling, how does IBM see its future ?*

M. T. : We sell material and software, but above all the service which goes with it. Today, the service part represents 50 % of our activity. That does not mean that there is less demand for processing capacity : last year it doubled and this progress should continue and even increase in coming years. Even if the unit cost decreases, growth in demand is such that we are not at all worried.

IBM staff confronted with change

Q. : *IBM employees are allocated computer resources and square metres of office space according to their needs. Therefore, we know exactly how much they cost and what their financial return has to be. How has this been accepted ?*

M. T. : IBM France wanted to make its employees completely mobile : for the past two months, there are no more assigned offices and the staff has the necessary technology at their disposal to communicate from their cars or from their homes. Even the directors no longer have an office or a secretary ! It is a dramatic change and a shock for the older members of staff. Since this new policy is very recent, it is still a bit early to draw conclusions.

In addition, we put factories into competition with each other and follow their manufacturing costs for the same product very closely. When a site makes a productivity gain, it can keep its know-how secret for six or twelve months. Thereafter, it has to transfer this competitive advantage to the other factories in the group.

Complete reliability ?

Q. : *Is there not a risk that a system which is so open, will break down if it is confronted with a massive computer virus attack ? Are your clients ready to take such risks ?*

M. T. : We make huge investments so that our systems are able to protect themselves without human intervention. In the grid, as it exists today, we are inside a firewall. When we move over to an extra-grid, which will involve suppliers and clients, there will have to be an extended, virtual firewall. For the moment, the projects we are currently working on are extra-grid and they communicate between each other using specialised networks.

Q. : *Since IBM employees have privileged access to all the client codes, would it not be possible for a dishonest employee to cause considerable damage ?*

M. T. : When we sign a contract with a client, we guarantee the integrity of our employees. Thereafter, it is a question of ethics. There are also laws and it is not because our employees do not work on the same physical site that they do not have someone to manage them ! The rules of the game are very clear even if the ways used to run teams has completely changed.

Presentation of the speaker :

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