The Fourth Shift

- *the Virtualization of Business Computing*

Breaking the Chain!

White Paper by Albert L. Harlow, Jr., President & CEO of iNamics Corp.

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Introduction

While I was writing this paper, I was stuck in a crowded terminal at Newark Airport, outside New York City, on my way back to Cleveland. Because of foggy weather, the extended delay was over five-hours between connecting flights. It was late in the evening and since I was out of the country for 12 days, I needed to catch up on some work. For a moment, I thought about renewing my membership at the President's Club but decided against it because I travel so infrequently these days. So instead, I walked around trying to find an available power plug for my laptop in a terminal filled with frustrated travelers.

Once I found an outlet and was plugged in, I was able to log right into my desktop computer at my office and catch up on the work I had originally planned on doing the next morning. I was able to complete all of it quickly while sitting there at Newark Airport that night. Realizing just how lucky I was with this unique sense of freedom, I strolled into work late the next morning with no worries. The chain from my ankle to the office desk has truly been broken! My office is truly "virtual".

Believe it or not, we are in the mist of another big change in business computing. It is the shifting away from client-based, individual computing, back to server-centric, terminal-based computing. By "shifting" I mean it is radically changing. In my lifetime, I believe we have had three similar events. They were huge shifts in computing and we are about to have a fourth. No doubt, it's going shake things up like an earthquake. Are you ready for it?

This paper reviews the three shifts in business computing, what they were, when they occurred and how we got from there to here, from an historical perspective. I also discuss why I believe we're about to have a fourth shift, as I call it. There are also two case studies cited.

Regarding the history of business computing, I have recalled most of what you'll read here from memory. After the initial writing, I wisely read through dozens of references and then made the appropriate corrections to those historical events I refer to, while adding some photos I found on the Internet to make the paper more interesting and informative. If you are over 50 years old like me, you have also witnessed these shifts and so I invite you to reminisce with me the evolution of business computing. If you're under 50, you'll enjoy learning more about how this world of business computing has evolved, with tidbits of interesting information such as where terms like "floppy disks" originated from.

The main objective of this paper is to pinpoint historical, key changes in business computing and reveal what will be the "Fourth Shift" -- yet another dramatic change that will affect the way we all do our daily business chores digitally. Interestingly enough, it seems that these shifts have happened every 10 years or so. Since history has a tendency to repeat itself, I believe we are about to witness what we saw happen in the mid 70s, early 80s and then again in the late 90s. I also believe this Fourth Shift is yet another opportunity for those who jump in early enough; and I readily admit being an entrepreneur now caught up in imagining the possibilities presented by the technology.

Come on and ride along with me to glimpse at what highlighted computing transitions have transpired over the past 50 years. With every shift I have lived through, it was like the feeling one gets when shifting the gears of a fine automobile. It was both exhilarating and exciting. It was also, back then and still is, very interesting to me and I hope you'll agree.

Background

Besides being a "gadget guy", I am also a history buff and somehow, I seem to have retained more throughout my lifetime about historical events than perhaps most; especially when it has come to the computer industry which I have always had a high degree of interest in. I first became interested in computers back when I co-owned a small plastics injection molding company in

Apple Clone - Basis 108 Microcomputer

Bridgeport, Connecticut, in the early 1980s. To conduct its accounting, we bought a "Basis Computer" which was a German made knock-off of the Apple 2. It used floppy disks when these disks were really "flimsy and floppy".

Then in 1985, I went out and purchased an Apple Macintosh. On that little machine (which created a paradigm shift itself), I created my engagement party invitation and my first sales catalogue for my plastic products business. (Incredibly, that catalogue was saved on *over 20 encased 3 ½" diskettes.* Each had to be inserted and ejected to bring up the catalogue on screen and to print it.) From the moment I bought that first Macintosh, I was hooked, and it began a lifetime quest for ways to make my business computing easier, faster and cheaper. I was what you may call a gadget guy with a *purpose*.

Luckily for me, the computer industry was no disappointment. It had plenty for me to try and do. I've been through every reiteration of newly introduced technology. In 1995, I even made that proverbial jump to the "wicked" PC after a frustrating third crash of the hard disk on an Apple portable I owned -- and there were no offers for an acceptable remedy from the manufacturer. (Steve Jobs had left Apple Computer at that point and

John Sculley was running the show.[1]) Yes, I was, and still am, a tech addict. If I added up all the money I've spent over the years -- of what I spent and essentially threw away, it's sad to admit that it would probably amount to more than my annual salary.

I decided a few years ago to take my interest in computing technology to a new level, and make it my permanent business. Today, I operate an IT company located in Ohio, called iNamics Corporation. We are a Microsoft partner, doing things on computers I would have only dreamed about back when I bought my first Mac, and could have never imagined would happen within my lifetime. This growth in computing capabilities has come with a much more burdensome cost for many others besides me, however. This becomes really apparent when you consider the crowded graveyard of computer and software companies, along with the increase in complaints of back and neck pain as well as carpel tunnel and eye strain.

Luckily for society as a whole, however, we have come to this – the Fourth Shift – because the exciting benefits it will provide to the business computing community are enormous. Virtualization will improve the quality of life, save gas (by not needing to go back and forth to an office as much), relieve stress, help businesses become more "green" and shape a better, healthier future for our children.

All this isn't predicted by just me. "Virtualization" is the new buzz in the computer industry, talked about by many who have "googols" (yes, it's a word) of clout. Take Bill Gates, for instance, who recently said at a partner conference, "…I think (virtualization is) one of the most important change agents in our industry." So what were the other three shifts? Read on…

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[1] NOTE: I had the privilege of meeting John Sculley in New York City at an event last year. He once lived in a house owned by my sister and brother-in-law in Camden, Maine, so we had something in common.

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The First Shift
The Invention of the Transistor & Miniaturization of the Circuit Board

The IBM 608 "Calculator" was the first completely *transistorized* mainframe available for

commercial installations.[2] Introduced in 1955, it was a

radial departure from using vacuum tubes. It could

do more than 4,500 additions per second and multiply

two nine-digit numbers and derive the 18-digit product

in 11 one-thousandths of a second, and divide an 18-

digit number by a nine-digit number to produce the

nine-digit quotient in just 13 one-thousandths of a

The IBM 608 Calculator

second. Amazing, but these mainframes were

expensive and costly to operate. As a business manager, you needed to have a lot of

available capital (it cost $83,210 in 1956) and a very good justification for such a

machine. You needed to employ people trained in this new field, computer

programming, and if one mistake in the computer code was made, it spit out an error

giving no clue as to what was wrong. Debugging tools, a programmer's friend, had yet

to be invented.

These "Mainframe computers", as the name grew into, were still being used all the way

up until the time I took my first computer class at the University of Colorado in the late

'70s, and I remember all too well making mistakes on those punch cards and the

frustration I felt. I have a creative mind and didn't like the rigidness and discipline that

[2] According to IBM archives

this system required, although I loved the thought of what I could do with the knowledge of operating such a powerful machine. It was then, while at the University of Colorado, when I bought a hand-held Texas Instruments calculator. It could do much more than that IBM 608, which was the size of a small car, while resting in the palm of my hand. I remember the engineering students use to walk around with these things in their pouches hanging from their belts. It was the cool thing to do those days and I must admit I did it too for a short while.

I soon found out that at institutions across America, there were rooms filled with these mainframes. One would pass "instruction sets" to these machines by giving a stack of cards to the "computer operator". These cards had punched holes you would prepare as your "instruction set". Some machines were enabled with a "terminal". I remember using one of these in 1974 at my high school, Roger Ludlow in Fairfield Connecticut. It was "networked" to the mainframes at Fairfield University, which was just around the corner. The terminal was just a monitor and keyboard (there was no mouse yet, of course), hooked to the mainframe by wires. To get this machine to perform a calculation, you would use a computer language like COBOL, as I did.

As I entered the working world, my first job was with GTE at their headquarters in Stamford, Connecticut. It was there that I was given the assignment of using an office PC that they had purchased, to catalogue photographic slides used in corporate presentations GTE produced in the marketing department I was assigned to. Programming on that first IBM Personal Computer (PC) I was exposed to, was difficult, to say the least, but it was light years ahead of what I had been doing with those punch cards just a few years earlier.

Communication at the time I started working for GTE, around 1980, was commonly conducted using such things as Western Union telegrams, which used abbreviated type

(sort of like what one does when "texting" on a cell phone today). Since the early '70s, a lot of communicating between parties was done using machines called "Telexes" or "teletype" machines, which essential meant "typing over the telephone wire". Diplomatic pouches and postal service delivery provided further external communication to the outside world. In my next job at Westport Marketing in Westport, Connecticut, I did a lot of direct mail advertising, which was perhaps much more effective and I believe less costly back then than it is today. Later, facsimile machines allowed more rapid sharing of individual documents, which really didn't get fully adapted until the early to mid '80s. "Interoffice memos" were passed around the company when communication directives when given inside the office.

People from the mid '50s, therefore, had acceptable solutions for doing difficult calculations as well as writing and communicating over long distances. But then something began to change. It was this radical shift to transistors and integrated circuits, beginning in the early '60s and continuing through the '70s, which allowed the manufacturers of machines to make things much smaller, cheaper and much more functional. No one would disagree that the transistor and the integrated circuit changed everything. The world of "electronics" (a combination of the words "electric" and "electron"), no doubt, was an exciting field to be in.

Dr. An Wang

Ten years before the first dramatic shift began to take shape, while under the employment of the Harvard Computation Laboratory, Dr. An Wang was studying the magnetic properties of small doughnut-shaped rings made up of ferromagnetic material. Nearby, at the Massachusetts Institute of Technology (MIT) and elsewhere, researchers were interested in the idea of the magnetic storage of information. Dr. Wang saw that these materials he experimented with could easily become highly magnetized and was soon able to develop a process where one could read the

Dr. An Wang

information stored on one of these rings by passing a current through it. He published an account of his results in a 1950 article coauthored by W.D. Woo, a fellow Shanghai native who also worked at Harvard. Wang then patented his invention and despite a long court battle, earned substantial royalties from International Business Machines (IBM) and other computer manufacturers at the time, which used magnetic core memories. These cores remained a basic part of computer memory into the 1970s.[3]

So at the beginning of the '60s, the state-of-art in computing was terminals hooked up to mainframes, mainly used for calculations. Then the miniaturization of transistors caused this first shift and the first machines to use this technology were desktop calculators. The first successful all-transistor calculator was introduced in 1963 called the EC-130. Then Wyle Laboratories then introduced their magnetic drum memory-based WS-02 Scientific calculator.

The EC-130 is generally regarded as the first transistorized electronic calculator.

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[3] Cornelis Robat, Editor-In-Chief, "The History of Computing Project"

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Dr. Wang, who eventually formed his own company from his royalty earnings, continued to develop new innovative products for this emerging computer industry. As Wang Laboratories, he entered into the calculator market in early '65 and introduced the transistorized LOCI-2. This was the first calculator that produces a logarithm in one single keystroke. Then Wang introduced the 300-series calculator which was an instant success in the marketplace. It inspired droves of customers to buy Wang calculators rather than those of their competitors.

The Secretarial Pool

One of Dr. Wang's innovations that decade was the "word processor". He successfully marketed and sold this type of machine from the mid to late '60s and on into the '70s. The basic two-user Wang 3300 system (pictured left) consisted of the 3300 CPU unit and came with 4K bytes of memory installed. Two additional 4K memory modules were added for a total of 12K bytes of core memory. It also came with a Terminal I/O Controller, two IBM Selectric I/O typewriters (more about the IBM Selectric below), a

dual drive magnetic cassette tape system and the BASIC language software. Included also was system installation and setup. The total cost for the basic configuration was initially just $17,550. A comparable two-

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user timesharing system from Digital Equipment came in at around $20,000, giving Wang the edge in pricing over the competition. [4]

To anyone under 25 years old, I imagine it may be hard to fathom, but most business letters were typed by "secretarial pools" (rooms filled with lots of women typists) using terminals like these, or, competitively speaking, using just the Selectric typewriter.

The IBM Selectric Typewriter

You may find it very interesting that the Selectric typewriter, manufactured by "International Business Machines" (IBM), was used to type to the Wang 3300. IBM, became so dominant in the computer industry. I believe because of this one product. The only added value, frankly, that Wang brought to typing was the ability to memorize and recall what was typed. This was a radical advancement, and everyone wanted it. I remember when working for Westport Marketing in the early 80s, a room where these Word Processors were used and the girls sat there typing all day long. There were three or four of them together in that small room in an old house on Westport Avenue, down the street from a very successful company called Marketing Corporation of America, where there were hundreds of IBM Selectric typewriters.

Introduced in 1961, the IBM Selectric was an amazing electronic mechanism. It ingeniously used a machined, steel globe or golf-ball type-element populated and engraved with raised letters of every character in the alphabet. The ball could be easily changed to permit typing in different fonts and languages. I found it amazing to watch

[4] Rick Bensene, "Wang Laboratories: From Custom Systems to Computers", October, 2001, Updated June, 2002

how this mechanism would snap into the exact position and pound the paper as fast one could type. This machine was, no doubt, was one of IBM's most successful product and was used everywhere by everyone. As if to emphasis this point, one of them is photographed with the then newly formed "computer lab" guys in my 1975 high school yearbook. There were no computers, of course, in the photo with these guys; just the IBM Selectric typewriter which, if I am recalling this correctly, was hooked up to that mainframe computer at Fairfield University.

It's important at this time to again point out that what I call "terminal-based computing" was used mostly for typing correspondence (called "word-processing") and keeping an accounting of the books or crunching numbers. This was essentially all that computers were initially used for at companies: A) Writing correspondences and B) Crunching numbers. Universities used mainframe computers to help in their research. For years before this, analogue computing techniques were heavily implemented in process control applications, such as when blending liquids in manufacturing or making cereal -- or calculating the correct aim of a big gun on board a battleship.[5]

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[5] Rick Bensene

The Second Shift
Transition from Terminal-based Mainframe Computing to PCs

Then in 1975, when I was entering the last half of my high school senior year, an amazing thing happened. It was on the front cover of the January 1975 issue of Popular Electronics. The integrated circuit enabled the first small, or "mico-computer" to be made. MITS (Micro Instrumentation and Telemetry Systems) of Albuquerque, New Mexico, announced the MITS Altair 8800, which was sold by Tandy's Radio Shack as a complete kit you could assemble. Up until then, hobbyists around the USA were trying to figure out how to piece together computer systems from parts found in electronics shops such as Radio Shack. Inspired enthusiast, such as an employee at Honeywell, Paul Allen, and his friend Bill Gates, who was a sophomore at Harvard, worked long hours to produce an adapted version for this machine of the newly popular computer language, BASIC[6]. They felt that having a way to more easily write programs to do things would be in demand as much as the machine itself. After Allen flew out to demonstrate it, Tandy agreed and licensed their basic software. It was at this instance when "Micro-Soft" was born.

Then, a little known company with an unusually creative business name, "Apple", emerges onto the scene. Steve Jobs and his buddy, Steve Wozniak, (backed by a few high-rolling friends, such as Mike Markkula, from what is now known

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[6] BASIC stood for "Beginner's All-Purpose Symbolic Instruction Code" and was a simplified computer language developed by Dr. John G. Kemeny and Thomas Kurtz for teaching students at Dartmouth how to program.

famously as "Silicon Valley") essentially invent the "personal computer". But by the time this company created its second generation, the Apple II, big business still looked upon it as a toy and did not take it very seriously. Partly because one of the only things you could do on it was play games, like "Space Invaders" – a popular video arcade game at the time. The retailer, Radio Shack, offered a kit for hobbyist, where you could assemble your own computer, much like the kits they sold for making shortwave radios. Eventually, one could write letters but the first printers didn't print as nicely as the IBM Selectric did.

Osborn invents the Portable Computer

Although I myself trucked around my Apple Macintosh SE in a specially made bag for years, the first real "portable" computer was made by a company (headed by a man) named "Osborn". At 30 pounds, it was perhaps better described at the time as a "luggable" computer. Business schools site this example as one of their case studies of what *not* to do when running a business. The demise of this company came about because of one fatal mistake: Osborn very publically announced the introduction of the Osborn II a year before

Richard Osborn in 1973, with BEDSAC computer – Monash University Archives

the product was ready to ship and there were still plenty of Osborn Ones on the shelves of retailers like Computerland (where I bought my first Macintosh). Unfortunately, because of this, the first Osborn model suddenly stopped selling. Everyone wanted the new version and didn't want to purchase old technology when something much better was coming out. Eventually, this forced the company into bankruptcy because sales

plummeted. I find it sad in a way that I can't find much in the way of references about this company nor the man that founded it.

The IBM PC

As before, with the business mainframe and word processors, IBM entered the market with its own version of the personal-sized computer, or "PC" as they coined the phrase. As the fable goes, IBM awarded that little known software company, Microsoft, with the task of providing their new PC with an operating system. Microsoft beat out the leader in its day – a company whose name has long been forgotten. The lesson here was that Bill Gates laid out the red carpet when IBM came to visit. The operating system Bill Gates and his partner, Bill Allen wrote for IBM was called simply the "Disk Operating System", or DOS.

"A transition of significant proportions -from mainframe to personal computing- was also underway, supported by the evolving de facto standards that were beginning to emerge in the PC marketplace.

"The original IBM Personal Computer was actually introduced with several options in operating systems, including the CP/M-86 from Digital Research and the UCSD P-System. But the IBM PC represented a new platform for computing, which -like all shifts in this industry- offered a shift in the paradigm of computing and allowed for the creation of new products with new capabilities. Building on the core of a product acquired from Seattle Computer Products, Microsoft took advantage of the technology breakthroughs

represented by the IBM PC and, in the evolving versions of MS-DOS, provided a foundation for an entire generation of computing."[7]

The Apple Macintosh, Changes *Everything*

But then, once again, Apple knocked the business world on its knees with the introduction of the MacIntosh (the Mac) in 1980. It was a radical departure from the typical hard-to-use computer where you needed to know the "computing language" in order to operate it. The Macintosh had something never seen before: a "*computer* mouse" and a "user- friendly" operating system (actually invented by Xerox) that could be used to do really useful things, like word processing, without needing to memorize special keystrokes. The Macintosh 128K was the first commercially successful personal computer to use images, rather than text, to communicate.[8]

IBM attacked the marketplace with lots of money backing it up along with big business support. After all, it was the leader in mainframe computers, and people just expected that it would lead in personal computing as well. But much to the surprise of many, and mainly because of the MacIntosh, Apple survived and continued to introduce new innovations. The term "Client Computing" came into being, where each computer operated independently, with an operating system and installed software; each purchased or "licensed" separately.

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[7] http://www.thocp.net. Note: I have not been able to identify the author, but wanted to quote this directly, because I thought it was very elleguently worded.

[8] Wikipedia – Go to http://en.wikipedia.org/wiki/Apple_Macintosh for more information

The Local Network

The first "networking protocol" that was invented was called "AppleShare", which enabled a "network" of Macs to connect to a single "Laser Printer". This was the first main purpose of "networking". Macs could now share this expensive laser printer (which made the black print on paper look as good as an IBM Selectric Typewriter). AppleShare was in operation for users successfully and easily implemented at small businesses long before TCP/IP for IBM PCs came into being. We used AppleShare at my manufacturing company successfully for years for sharing a printer.

Adobe and the Printing Industry

Another interesting historical note is that Adobe was the inventor of digital type-setting, and received a royalty of $1,000 for ever laser printer manufactured throughout the life of its patent. Digital type-setting, and laser printing, turned the printing industry on its ear.

Introducing "Windows"

The success of the MacIntosh operating system was soon followed by "Windows", which was installed in an IBM PC (distinguishing it from the Apple brand). Windows was

Would you have invested a million dollars with this motley crew? It would be worth $1 billion today if you had!

an all out assault, a knock-off of the MacIntosh. It was "user-friendly", with its "user-interface" written as a layer on top of DOS. It emulated what the MacIntosh operating system did, but

with this extra layer of complexity. However, because it was a layer on top of DOS, the Macintosh and Apple's progressive operating system still worked much better.

Some will argue that the Apple OS continues to be far superior to this day, but this was

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true only because DOS was antiquated. (With the introduction of the Vista operating system by Microsoft, however, there is no longer this underlying complexity.)

Wisely, IBM opened its source code to software developers, whereas Apple protected theirs and treated it like the family jewels. Eventually, Apple lost its lawsuit against Windows and its unique, user-friendly operating system was open to copy at will.

Increases Seen in Worker Productivity

So in the '80s, as hardware got beefier with more memory and disk space, and software got smarter and easier to use – with Apple leading the way. Less and less was the emphasis on needing a mainframe down the hall and "terminal-based computing". A business could *save money* simply by purchasing personal computers for their employees and networking them to a printer. They could perform their work better and more efficiently. The PC now evolved into a "desktop" computer, but it was still mostly used for just word processing and accounting.
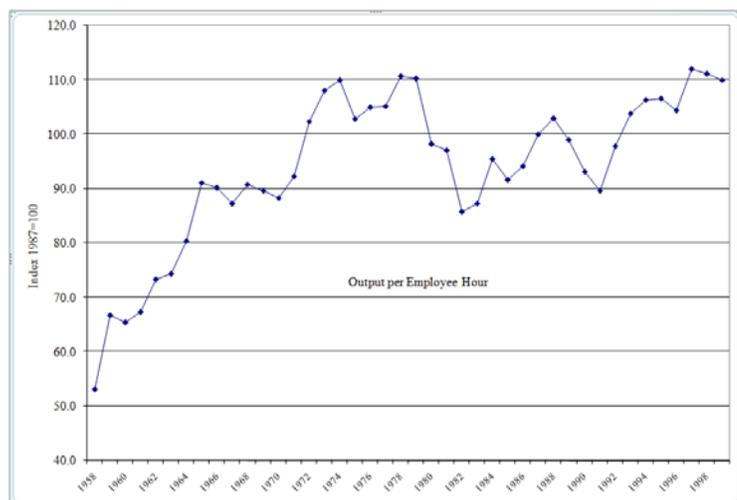
Software languages that operated these machines also were improving and began to take hold. Developers were beginning to come out with new products, applications of the machines and new solutions. Lotus became a leading software development company with Lotus Notes – a word processing program. VisiCalc and Lotus 123 were popular spreadsheet programs, as well. Then Microsoft introduced Word, Multiplan and Chart (which eventually were combined to become Excel), initially just for the Mac, which eventually combined into the Office Suite. It was about this time that big business

began to take notice and realized that this phenomenon was here to last. Except during periods of recession, the productivity of the American office worker saw dramatic increases, at times accelerating at the fastest pace ever before seen in history, partially attributed to the office computer.

The Third Shift
Introduction of the World-Wide-Web and Internet Browsers

While the computing industry continued to grow, a government defense initiative, DARPA (Defense Advanced Research Projects Agency), also evolved, mainly through government grants given primarily to universities. The reason for DARPA originally being formed in 1958 was in response to the Soviet launching of Sputnik in 1957 (the year I was born), with the mission of keeping the USA military technology ahead of its enemies.[9] It is responsible for many computer-related technologies, including, of course, the Internet, which was originally meant to be a means for mobilizing the population in case of nuclear war.

The Internet was developed entirely separately from the personal computer industry. Mainframe computers were used as the engine that it was operated on. This communication tool gave birth to simple "electronic bulletin boards"; where you could post and share information about anything for anyone who could connect through a 28k modem over the phone line and was willing to read the postings. Access to these "online" institutional networks was granted to students and professors. CompuServe, which I was a member of, emerged as a leader of "public bulletin boards" (PBBs) in the

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[9] Wikipedia – See http://en.wikipedia.org/wiki/DARPA for more information

mid to late eighties, connecting anyone willing to pay a monthly access fee with other people easily. It was essentially a modern day shortwave radio with the keyboard as its microphone. Out of this U.S. government initiative emerged an "International network" of, at first, government and institutional mainframe computers. These larger computers became known as "servers" because they *served up* digital information. This international network eventually became know as the "Internet".

Tim Berners-Lee Invents the World Wide Web

On August 6, 1991, CERN, which straddles the border between France and Switzerland, publicized the new "World Wide Web" project. The Web was invented by English scientist Tim Berners-Lee in 1989. While an independent contractor at CERN from June to December 1980, Berners-Lee proposed a project based on the concept of hypertext, to facilitate sharing and updating information among researchers.[2] While there, he built a prototype system named ENQUIRE. After leaving CERN, in 1980, he went to work at John Poole's Image Computer Systems Ltd., but he returned to CERN in 1984 as a fellow. In 1989, CERN was the largest Internet node in Europe, and Berners-Lee saw an opportunity to join hypertext with the Internet: "I just had to take the hypertext idea and connect it to the TCP and DNS ideas and — ta-da! — the World Wide Web."[10]

ViolaWWW was an early web browser which was popular, based upon HyperCard; another Apple innovation. This was eventually replaced in popularity by the Mosaic web browser which also used this hyperlink, markup language, HML. In 1993, the National Center for Supercomputing Applications at the University of Illinois released version 1.0 of Mosaic, and by late 1994 there was growing public interest in the previously

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[10] In Wikipedia, The Free Encyclopedia, see http://en.wikipedia.org/wiki/Internet for more information.

academic, technical Internet. By 1996 usage of the word *Internet* had become commonplace, and consequently, so had its use as a synecdoche in reference to the World Wide Web.

At this time for me, however, the Internet wasn't very useful until Netscape blew onto the scene with their "Internet browser". Within a few years, companies quickly discovered that they could lease space on a server and create an "electronic brochure" showing their products and services and provide general information about their company. It was a way for a company to communicate to the entire outside world. Thus, companies established their "domain" in this new communications world and registered their business names with dot com at the extension to their name, meaning "communication". Suddenly, small companies could look like big companies to the outsider who viewed this electronic information from afar. It was an easy way to reach prospective customers worldwide, inexpensively. As more and more companies discovered this cheap marketing tool, the Internet search engine was developed by software engineers to combat the increasingly difficult task of finding what they were looking for using query strings. But with the introduction of Netscape's browser, the World-Wide-Web (www) quickly grew into a national obsession – even at just 56 kilobytes per second transfer speed.

Now, magically, the "desktop computer", had a speedy connection to this online, web of information through a "modem" which the phone company was happy to lease to you. You could find information on just about anything in the comfort of your own home. But a night on the world-wide-web soon jokingly became the world-wide "*wait*" over a 56k modem preoccupying your telephone line. Still, for many, it didn't matter. One was easily connecting and becoming a part of a larger community of like-individuals who shared an enthusiasm for this wondrous technology that held much more promise than

being just a word processor and a cruncher of numbers; especially when combined with the power of the Internet. But there was more yet to come.

So to reiterate what was discussed above, in a historical perspective, beginning over 30 years ago, the business community essentially went from server-based computing to client-based computing, starting to exchange data, server to server.

Evolution of Servers & Network Speed

Servers have evolved just as personal computers have. But have no misconceptions about it, servers today are much more powerful than personal computers. They are the beast of burden in the high-speed networking world of today, the workhorse which the Internet and the future of data exchange and storage solutions will rely on.

 To qualify as a "server", industry experts believe that a rigorous standard must be followed. They must be fail-safe. This assures that a network will never go down. In today's competitive, fast-paced business world, this need is critical. In order for a server to guarantee this, redundancy, for one, has to be *everywhere* in the design of the components in order to properly protect against a catastrophic failure. For instance, the data drives must be mirrored and "hot-swappable", so if one fails the second drive picks up the data calls, until the failed drive can be physically replaced. This is achieved without even one moment of down time. The power supplies and network connections must also be duplicated. Attention to every detail in regard to providing for the best possible performance should be paid attention to, such as having gold connections for the fastest possible electron speed. By industry standards, these are the main component requirements in hardware in order for a computer to qualify as a server.

No doubt about it, a server has much more complexity than a desktop computer today. However, some use the term "server" loosely. While it may have server software

installed, it would still be incorrectly considered a "server" if it lacks industry standards. Unfortunately, there are some companies which represent a computer, with no fail-safe technology, as a server. You'll find these "dedicated servers" for lease in data facilities for a low monthly fee. Recently, while touring a server hosting facility in Michigan, for example, my associates and I saw a bank of stripped-down, desktop computers represented to us as "servers". It simply isn't true and don't buy it – that is, unless you're okay with losing all your data unexpectedly or can accept being down for hours or even days, while your "server" is repaired.

Servers have evolved alongside increases in network speeds. In 1987, I started on a 9600 baud modem over a POTS phone service and now, 21 years later, operate with a DSL connection ranging from 768k upload to 6,124k download speeds, which is a significant increase. It only gets better, in that this upward trend in networking speeds and bandwidth capacities has yet to hit a brick wall, while the costs just keeps on falling.

The Fourth Shift
Virtual Computing

Every *shift* in business computing has unfolded because each new solution brought savings along with added capabilities, enabling people to do *more* for *less* – in less time and for less money. Businesses are always looking for ways to lower expenses. "Cost-justifying" a piece of equipment, such as a computer for instance, entails evaluating how fast that business machine will bring enough in savings to pay for itself. If it's within a reasonable amount of time, where it can start producing a savings after the equipment is paid for, then in practice, that purchase should be made.

Partly because of this underlying effect and partly because the technologies enabling it have developed to a point where it's now possible to not be tied to a desk, the computing world is about to come *full-circle* – to server-centric business computing, similar to the word processing days of the 1970s where all the data was stored centrally. The enabling technologies both pulling and pushing the business computing world are: A) fail-safe server technology, B) the emergence of new speedy network connectivity and C) new, advanced hardware and software capabilities. There is also a push to find better solutions for locking down computer systems and making them more secure – moving away from the vulnerabilities associated with worms, viruses and system attacks. With this all taken into consideration, a fourth shift is brewing that will bring business computing back essentially to terminal-based, server-centric computing. But only this time, the central computer will be in a remote location, which essentially can be anywhere; thus the true meaning of the word: "virtual".

In computing, the term "virtualization" covers a wide spectrum of ideas, referring mainly to the division of computer resources into cooperating components.

Virtualization enables the utility of computer applications with the resources it takes to operate and enable those computing tasks hosted elsewhere by another component, or "appliance". Operating resources are remotely executed by another computer, or server, which then relays the screen displays back to the virtualized workstation. The resource or host computer could be either in another room or in another building -- in another state. The Internet, then, *becomes* the network.

Not a New Idea

The term, "virtualization", is actually an old one which has been widely used by computer scientist since the 1960s. As a concept, however, it was introduced in 1974 by Gerald J. Popek and Robert P. Goldberg, in their article named "Formal Requirements for Virtualizable Third Generation Architectures". Here they outlined a set of conditions which a computer's architecture needs in order to meet and support efficiently, virtualization.[11]

The original motivation for virtual machines was the desire to run multiple operating systems, since it allowed for the time-sharing of a single computer between several operating systems (such as Linux and Windows)doing multiple tasks. We use this ability today extensively in my office, for instance. As a matter of fact, I am typing this using a computer that has both Windows Vista and Windows XP running "virtually". XP is installed for all those legacy applications which still aren't able to run on Vista without problems.

By simply having the ability to network to a server and change the resource allocation around a bit, you essentially have a "virtual computer" which you connect to from afar, or "remotely". We do this with our servers located downtown Cleveland, from here in

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[11] Wikipedia – see http://en.wikipedia.org/wiki/Virtual_machine for more information

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Chagrin Falls, which is a 23 mile separation. We use "Remote Desktop" which uses terminal services that's built now into *all* of Microsoft's operating systems since Windows XP. You could get it as an add-on or along with the service packs in earlier versions, such as Windows 2000 and it will work with operating system versions as early as Windows ME, – although I wouldn't suggest it.

Citrix

None of this would be possible without Citrix. Originally named Citrus, an ex-IBM developer, Ed Iacobucci, started Citrix in 1989. ("Citrix" is a combination of the words of "Citrus" and "UNIX".) Many of the founding members worked for IBM on the OS/2 project and the original vision was to build it with the ability to support multiple users. When IBM decided not to develop this idea, Iacobucci left IBM to organize his own company.

Citrix introduced "WinView" in 1993, which provided remote access to DOS and Windows 3.1 applications on a multi-user platform. It became Citrix's first successful product and along with Microsoft's investment of $1 million and Roger Roberts (appointed CEO in 1991) pledging his life's savings, the company avoided bankruptcy.

Then in 1995, for the first time, the company began to make a profit with their new product, "WinFrame". Corporations spotted the advantages of this type of computing and Citrix began bringing remote access solutions successfully to businesses worldwide. With $1.4 billion in sales in 2007, on-line commercial products you've probably heard of are: GoToMeeting, GoToWebinar, GoToAssist and GoToMyPC.

In 1997, Microsoft agreed to license the Citrix technology and Citrix agreed not to ship a competitive product while still retaining the rights to sell an add-on to Microsoft's products called "MetaFrame". Thus was born, "Windows Terminal Services" which

started with Windows NT Server 4.0 and continues to be used to this day. The core technology that Microsoft did not license was the ICA protocol from Citrix. Microsoft bought another company to provide the backbone of the RDP (T.share) protocol that they use in their most current 2008 Server release.

Thin Client

The idea of being able to have multiple users on the same computer, or server, developed into the realization that resource tasks could be divided up into separate components. Personal computers are "thick" or "fat" because they do all of the processing autonomously, only passing data to independent servers for communications and storage. In contrast, a "Thin Client" (or "Lean Client") offloads all the application processing demands onto the server, and mainly conveys the inputs and outputs between the user and this remote server. "Many thin client devices today run only web browsers or remote desktop software, meaning that all significant processing occurs on the server. However, with the advanced in flash memory, Thin Clients can now run complete operating systems without the need for a hard disk and cooling fans.

No Local Hard Disk or Cooling Fan Necessary
Computers have come a long way in a relatively short time. Every 2 to 3 years on average for the last 20 years, memory capacity and speed has doubled while the size of computer appliances has been halved. Much of the speed advancements have been achieved simply by reducing heat. Much of the heat dissipation has been achieved by using "heat sinks" and cooling fans, which are noisy and plagued by failures.

Computers also operate using two sets of memory formats: Random Access Memory (RAM) and Hard Disks. RAM does the power-lifting, running the basic start-up functions (Bios) stored permanently, while Hard Disks spin to access applications and stored data. Spinning disks are noisy and plagued by failure. When a hard disk fails, the memory may be lost. At the very least, the user of the device is inconvenienced and precious time and money is spent recovering what is salvageable, if a backup isn't available.

All the heavy lifting can be stored on a one gigabyte flash card. Therefore, a Thin Client using flash memory doesn't need a fan or hard drive, and is not plagued by these problems. Also, since the data is stored remotely under the watchful management of your IT department, having a backup scheme is likely and data can't be easily lost or stolen.

Before the release of Window Server 2008, deployment of remote desktop as a solution enterprise-wide wasn't economical for small and medium size businesses. But, just like computing was done 25 years ago, businesses now can come back to server-centric, terminal-based computing, which makes much better economic sense. So what's going to drive this shift in business computing, as all dramatic changes in the economy, is cost savings.

Understanding how virtualization evolved is less important than knowing what it can now do for you and how you can benefit from it.

Green Technology

This type of computing for businesses is better for the environment. It is often referred to as "green computing". Because there is now rarely the need for a spinning hard drive and cooling fans, some Thin Clients can run on as little as 4 watts of power, compared

to over 200 watts typically used to power a PC. Thin Clients can now run using flash memory, making them also more damage-resistant.

When we say it's a green technology, we're not just talking about less power consumption, however. Once virtualized, offices may also find that there's less need to travel. As businesses increasingly go virtual, workers could eventually realize more and more that they don't need to leave their home base unless absolutely necessary, much less go out and visit with customers physically, in far off cities. While I admit, it's hard to beat the advantages of a face-to-face meeting, with the advent of webinar services such as LiveMeeting by Microsoft, businesses can get a higher number of meetings done a lot more efficiently today while sitting in the comfort of their own homes, or in smaller satellite offices. With this trend towards less business travel, the demands on hotels, airlines and downtown office space, for that matter, will subside as population growth concurrently eases, as is projected by futurists. (I myself won't be investing in these industries for the long haul.)

Increased Security and Control

One of the biggest, yet less apparent advantages of virtualizing business computing and using Thin Client's, however, is the fact that IT management can now be focused on much fewer machines, reducing overhead expenses significantly. Autonomous, user-centric operating systems are problematic by nature, and require a lot of concentrated resources to manage. With a virtualized office, where the operation of software applications is instead concentrated and server-centric, the IT staff has a lot less to manage and much more control.

In an enterprise, a single point, server-centric depository of business information enables control over access businesses just can't get any other way. For example, when an employee joins or leaves the company, it is simply a matter of switching on

and off the user accounts. Data back-ups schemes and disaster recovery solutions also become much simpler to implement and manage. Overall, virtutalization makes better economic sense than how these necessary procedures are currently controlled and managed by most IT professionals today.

Other Compelling Advantages

There are many compelling advantages that virtualization and Thin Client computing can provide right now for much less than what computing systems are currently costing businesses. For instance, the most obvious advantage is that you no longer need to be tied to a desk, or for that matter, a computer to conduct your business. The freedom this offers is incredible and by itself, inspires a conversion from user-centric computing, to server-centric, virtual computing.
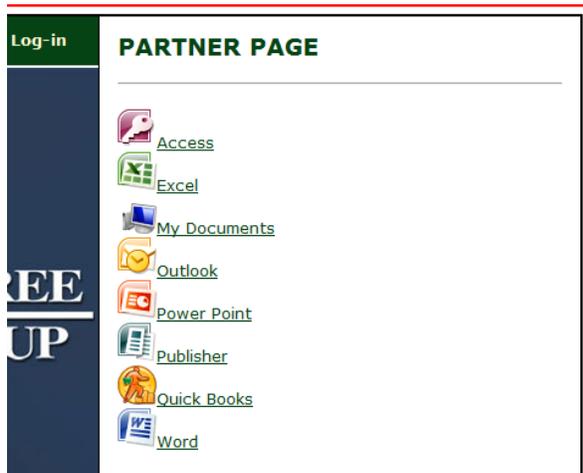
Service Model Software

Microsoft recently opened up their licensing from a *purchase* model to a *service* model, so now remote computing can now be implemented on a large scale without the huge upfront costs or commitment required previously. Referred to as "software-as-a-service" (SaaS), it's a purchase model much like leasing where you pay monthly for the use *and management* of the software. What's different is that included in the service are all the updates and new versions that come along which are tested by the service provider before installing them on your system. My company, iNamics, has successfully implemented this added-value service for many of our valued customers because of the many distinct advantages it offers.

In combination with the recent introduction of new advanced server software from Microsoft, the problems, restrictions or restraints remote computing once had are no longer obstacles. Virtualization of an office will now cost a lot less while providing

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stability, accessibility and freedom to office workers. Companies gain more control, securing their data while increasing online computing safety.

## Case Study 1 – (Company name withheld on request)

Employees of this company are on the go all the time, traveling throughout the country, working on real estate deals. Plans for growth include never being tied down to a desk, where employees can be scattered throughout the United States. Only through the use of virtualization technology provided by iNamics, are they able to log into their office from anywhere in the World, from any computer connected to the Internet, at any time – 24/7/365. Through their web page, employees of this company log into their office applications, which reside physically on a virtual server located in an iNamics data center located in downtown Cleveland. (See below)

When an application icon is selected, the windows computer (XP or greater) opens a login window where the employee enters his or her credentials. Once entered, the application opens on the desktop and looks and, more importantly, *performs* no differently than as if the application was installed and opened on their local machine. Even though the application is remote, printing to a local printer is accomplished as it normally would be. Mapping to a local printer, as long as the drivers are installed on that local machine, is automatic.

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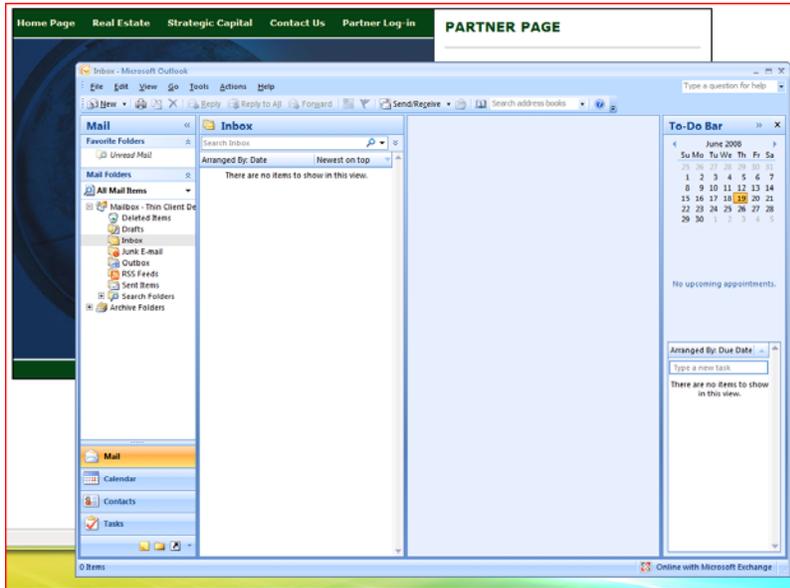
This company estimates that this remote setup will save them thousands of dollars annually, in both company and employee expenses. While it's still too early to provide exact figures, the President and CEO of stated, "iNamics has provided us with a complete computing solution in-step with our plans for future growth."

Case Study 2 - Carney Construction

Carney Construction (http://www.carneyconstruction.com) ran into some trouble financially, with the downturn in the construction industry, and needed to downsize quickly. They also operate in two locations, one in Florida and the other in Ohio, and found it difficult to coordinate the two as one organization. The solution of working remotely sounded good, but their small business server was located in their offices in Highland Heights, Ohio and because of this they felt they couldn't incorporate a mobile office to save on rent and other expenses and become a more cohesive operation. They were pretty well stuck.

iNamics stepped in with a solution of taking their current server off their hands and moving their data and applications to a new, 64 bit virtual server located in its downtown Cleveland data facility. A credit was given to the company for the hardware while the work in moving the data and licensed applications to the new, remote server was completed. Because of this, Carney Construction has been able to reduce it monthly

operating expenses by thousands of dollars while operating seamlessly between the two locations remotely and with much more efficiency.

Jack Carney says, "The virtual solution iNamics has provided has saved us a boat load of money while making our job between the two locations completely mobile and a whole lot better. The crew at iNamics has been terrific!"

To learn more about iNamics Computing Solutions for small and medium size business, go to: http://www.inamics.com/computingsolutions.

Conclusion

Virtualizing business computing will bring dramatic, beneficial changes to the way business is conducted in America today. The virtualization of business computing will have the same impact on small and medium size businesses as the Personal Computer did 25 years ago. The desire to "go virtual" will drive this conversion from autonomous, user-controlled operating systems, and therefore problematic -- to server-centric, "thin client" computing, with the Internet serving as its network connection to the computer room. This trend will be dramatic and will be the fourth shift in business computing.

This paper has discussed the advantages and benefits of virtualization. However, it becomes quickly apparent when you're able to actually see and try it; investigating further for yourself how it would apply to your business.

Looking back at when I bought my first Macintosh, I regret that I didn't know enough back then to invest early enough in these things I believed in. That mistake is not being repeated this time around with this Fourth Shift in business computing, however. As illustrated in the two case studies cited above, the company I founded in 2003 and run today, iNamics Corporation has invested in the necessary software, personnel and equipment so that we are able to virtualize companies quickly, and economically. We've can set up a 30 day trial for companies interested so they can try it for themselves, before deciding to move forward.

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