



A Story About RISC, x86 and Linux

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IBM’s pivotal 801 processor project, the birthplace of RISC, was named after the building it was developed in, building 801, the main arc-shaped building, of the Thomas J. Watson Research Center located at 1101 Kitchawan Road in Yorktown Heights, NY (pictured above).

This is a story about the evolution of the RISC architecture, x86 and the Linux operating system.



(left to right) x86, Linux, and RISC

In the early 70's, Mainframes dominated the enterprise market with the IBM System/370. But there were two new kids on the block.

In 1972, Intel developed the 8008 processor. By 1978, Intel's 8086 chip would be launched and start a whole new revolution, the home computer market. The 8086 was also referred to simply as x86.

Well, you couldn't have a home computer market without IBM's PC DOS (Disk Operating System) or Microsoft's rebranded version, MS-DOS, that were both released in 1981. Microsoft and IBM would work together on a Graphical User Interface (GUI) for DOS. IBM's was named OS/2 and Microsoft's was Windows. Windows was first released in 1985 and OS/2 in 1987. Microsoft left the partnership in 1992 once Windows took off in the market.

The other new kid on the block was the experimental 801 processor by IBM in 1974. IBM was looking for something that could outperform the IBM System/370 for telephone switching. The concept of the 801 was a RISC, Reduced Instruction Set Computer, architecture. The whole concept of the RISC processor gave way to the classification of the 8086 and System/370 as CISC, Complex Instruction Set Computers.

RISC was simple, standardized instructions that took a single clock cycle to complete, whereas CISC was complex, variable-length instructions that could take several clock cycles.

"Armed with huge amounts of performance data, IBM was able to demonstrate that the simple design was able to easily outperform even the most powerful classic CPU designs, while at the same time producing machine code that was only marginally larger than the heavily optimized CISC instructions. Applying these same techniques even to existing processors like the System/370 doubled the performance of those systems as well. This demonstrated the value of the RISC concept, and all of IBM's future systems were based on the principles developed during the 801 project." – IBM 801 Wiki

While IBM was working on processor technology for telephone switching, Bell Systems, a system of telecommunication companies, led by the Bell Telephone Company and later by the American Telephone and Telegraph Company (AT&T), was developing a new operating system. This new operating system would be known as UNIX. Written entirely in assembler language made it very difficult to port between technologies, but by 1973 a large portion of it was re-written in the C programming language, this made the UNIX operating system more portable. Bell Systems worked with IBM to port it to the S/370 in 1979.

As companies began licensing and making UNIX commercially available, the technology behind the 801 caught the eye as a perfect basis for this architecture. Among the many UNIX vendors with RISC processor technology was Sun Microsystems, HP, and yes, IBM. Sun Microsystems would develop the SPARC processor for their SunOS operating system, now known as Solaris, HP, the PA-RISC for their HP-UX operating system, and IBM, the POWER processor for their AIX operating system. SunOS was released in 1983, HP-UX in 1984 and although IBM first ported UNIX to the S/370 in 1979, were considered late to the game with AIX, which was released in 1990.

IBM's Power Systems with its AIX operating system would eventually take-over and dominate the UNIX market. A pivotal point was in 2004 with POWER5, when IBM introduced its firmware-based hypervisor, PowerVM, for virtualizing the environment. Another co-operative development with IBM's mainframe systems engineers to make AIX and Power Systems a truly enterprise class system.



Linus and me at LinuxCon 2016 - Toronto

The third kid on the block was Linux. Linus Torvalds, the Godfather of Linux, who grew up using MS-DOS, discovered early academic version of the UNIX operating system while he was at university. In 1991, he began working on his own operating system kernel, which eventually became the Linux kernel. This open-source UNIX-like kernel started to become an offering by other vendors as a way to escape Microsoft's monopoly in the desktop operating system market.

IBM, like it had done with UNIX and the RISC chip, was looking for ways to enable Linux in the enterprise as was various Linux Distros, like Red Hat and SUSE.

IBM formed the IBM Linux Technology Center (LTC), an organization focused on development for the Linux kernel and related open-source software projects in 1999. Rather than creating their own distro of Linux, IBM decided to contribute to the open-source community. Over the next 8 years, IBM would be a top 5 contributor to the Linux open-source kernel. IBM contributed enterprise class technology based on AIX to the Linux kernel during this time. Technology which included memory management and the ability to not only increase memory dynamically on the fly but also to reduce it without a reboot. A capability that AIX had in conjunction with the PowerVM hypervisor. It was at this time that the defunct SCO company was purchased, and under this name, SCO sued for the rights to UNIX and thus contents of the Linux kernel. This action, if successful, would have made Linux a licensed program product rather than an open-source project. Lawsuits were against Novell, IBM, Red Hat, and some large companies who deployed Linux.

IBM stepped up to the plate and took on SCO on behalf of all companies who were deploying Linux and for the future of Linux itself, a little known fact that should really be more globally recognized, as at the time IBM was not allowed to discuss it.

Novell was unanimously found to be the owner of the UNIX and UnixWare copyrights in 2010. In 2016, SCO's lawsuit against IBM was dismissed with prejudice. That is 9 years that IBM spent defending open-source Linux and the businesses that use it.

In 2018, IBM purchased Red Hat, the second largest contributor to the Linux kernel next to volunteers.

To this day, IBM continues to be a top contributor to the Linux kernel, and with the inherent UNIX-like design of the Linux kernel, it is well suited to the RISC processor architectures that IBM offers today with its enhanced mainframe architecture and POWER-based Power Systems.

So, when you are deploying Linux, don't forget one of the biggest strengths that it has to offer, remember that it can be deployed anywhere. If you are running it on x86 based systems you are fulfilling Linus' dream of providing a better operating system alternative for x86 than Windows, but if you are looking to deploy enterprise solutions with a UNIX-like operating system and want to get the most out of it, you should be considering enterprise technology like IBM Power Systems and LinuxONE that provide unmatched security, availability, reliability, scalability and performance.

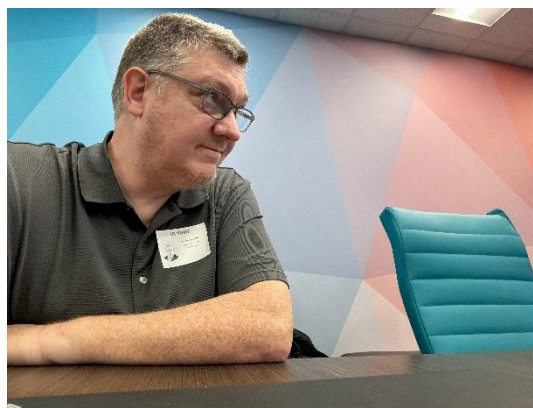
Never heard of IBM Power Systems?

Well, it is actually deployed in 45 out of the top 50 US Fortune enterprises. IBM has never really advertised their Power Systems, so they only got there by word of mouth and even then, many companies consider it to be a competitive advantage, so they will not advertise the fact.

No, you have to ask for Power Systems. Even then it will be dismissed as too expensive or proprietary. Both of which can easily be disproven. One of the main reasons why IBM Power Systems will not be recommended to you is because of the software savings that you can realize by deploying it. In fact, the software savings alone can justify the implementation. Who is not crazy about software savings you ask, well just about everyone in the IT industry. There is simply more profit to be made on software.

Next time you think of deploying Linux I hope that you take a moment to consider the vendor who created DOS, the first RISC architecture, who made UNIX enterprise capable, who, in the long term, won the UNIX vendor race, who also made Linux what it is today with their open-source contributions, and who defended Linux from becoming another licensed program product; IBM. And don't forget there are many benefits to running Linux, a UNIX-like operating system on RISC, the processor built for UNIX.

So in addition to AIX and IBM i, you can run RHEL, RH OpenShift, SUSE, and other distros all on the same physical IBM Power System.



E. Bruce Turgeon - Consulting IT Specialist - Q-Speed Enterprise Consulting Inc.

I hope you enjoyed a bit of technology history, albeit a little over simplified, and don't hesitate to reach out to me to find out more about IBM Power Systems and how you could benefit from it.

