

Introducing Some “Cool” Technology – Linux On S/390!

Linux¹ is getting a lot of attention and press these days, especially since the press articles in January that all IBM server platforms will be Linux ready. This has caused some people unfamiliar with Linux to ask, “Just what is it?” And other “experts” who have heard about Linux on S/390 but never have seen it scoff and say, “What? Linux running on IBM mainframes?” Whether you fit into one of these groups or are just curious, please read on to find out about some real cool technology and an easy way to get Linux applications running on S/390!

What is Linux?

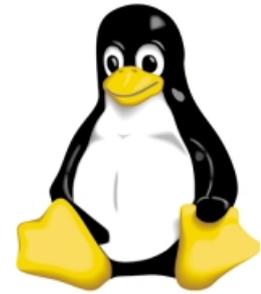
Initially developed by Linus Torvalds, Linux is a UNIX-like operating system that supports multiple hardware platforms. It is an Open Source Software (OSS) operating system and is developed and distributed freely via the Internet under the GNU Public License (GPL).

Linux is gaining popularity because it has a reputation for reliability and performance. Due to the similarity between commercial UNIX systems and Linux, existing UNIX applications can be readily migrated to work under Linux.

Linux on S/390 is an open-source based implementation of the Linux operating system. It runs natively on S/390 hardware as well as under VM/ESA®. It is a release of code to the open source community so that customers and business partners can start to understand how Linux can be used with S/390. This code is not, therefore, supported or serviced the way that other S/390 operating systems are.

Linux on S/390 adheres to the standards and interfaces found on other Linux implementations. It runs in ASCII mode and supports common applications and development tools such as GNU tools. *This is key to deployment and use of Linux on S/390, since application porting is not required.* Our experience is that most applications simply need recompilation to run on S/390 hardware.

Linux consists of *architecture independent* and *hardware architecture dependent* parts. Only the architecture dependent layer of Linux had to be changed for the port to S/390. The system structure of Linux and the de facto interface were not changed, so that all Linux extensions and applications could run unchanged on S/390.



What can you download?

As shown below, the Linux operating system kernel consists of:

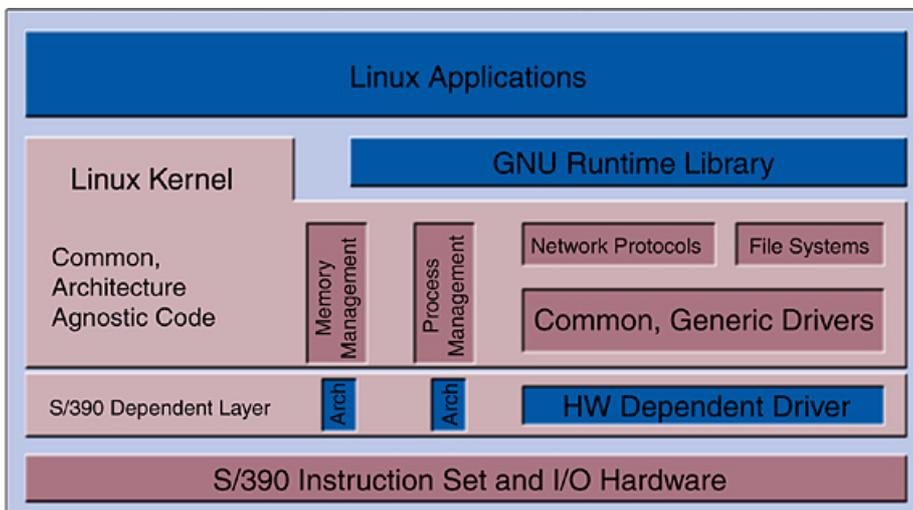
- A process scheduler,
- Memory management,
- Inter-process communication, and
- I/O support for the network and file systems.

Most of these building blocks are “architecture agnostic” (independent of the architecture) and written in portable C. But for some of these blocks, a thin architecture dependent layer is required and had to be provided for the S/390 hardware.

In addition to the Linux kernel itself, the GNU development environment was adopted for Linux on S/390. This includes the GNU C compiler, the binary utilities that include the GNU assembler, and the GNU C runtime library. Using these tools, other GNU and Linux applications can be built.

This code can be installed on S/390 Parallel Enterprise Servers – Generation 3 or newer, Multiprise 2000 servers, and Multiprise 3000 servers. It is self-contained and does not require assistance from other operating systems.

Architecture Layers – Linux on S/390



1. Linux is a registered trademark of Linus Torvalds. The Penguin logo is a trademark of Larry Ewing, the original artist.



An On-Location Report From LinuxWorld Expo

Device drivers for networking, disk access, and console interaction are available. Network drivers include Ethernet and Token-Ring for the OSA-2 interface or other LCS (LAN Channel Station) devices. For communication with other S/390 operating systems, Channel-to-Channel and virtual Channel-to-Channel drivers can be included.

With a full-featured TCP/IP stack and the existence of many networking applications, it provides everything needed to build a powerful Internet server.

Data can be stored on DASD using the ECKD drivers for IBM 3390, 3380 and 3945 devices, which also provide Linux boot support (as IPL is called in the UNIX world). Most installations use the second extended Linux file system as disk format. Under VM, the option also exists to use a minidisk as disk device.

Several applications already have been recompiled for Linux on S/390. These include the Apache Web server, Samba file and print serving, THE editor (an Xedit clone), SSH secure shell, and several XWindows applications like X3270 (a graphics-based 3270 emulator supporting the TN3270 protocol).

Additional information

To learn more about this cool technology on S/390, please feel free to contact linux390@de.ibm.com. To download the code that makes up this open source contribution, use the URL shown in Ed Gauthier's report on the right.

The Open Source and GNU Project home pages are:

<http://www.opensource.org/>
<http://www.gnu.org/>

The general IBM site for information about Linux at IBM is:

<http://www.ibm.com/linux/>

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Note: The Web location of this article is:

<http://www.ibm.com/s390/ftp/bulletin/issue27/linux.pdf>

Proving a simple point

It's 10 o'clock on Wednesday morning February second. Boas Betzler and I are at LinuxWorld Expo at the Jacob Javits center in New York City. We're getting our demonstration position ready. We've got Linux running on an S/390 Multiprise 3000, and it's being shown by IBM for the first time here at Linux World.

Our demonstration is a simple one, to prove a very simple point. We have a server running on Linux on our Multiprise 3000. It feeds MP3 music streams to a "jukebox" installed on a client workstation also running Linux. The point we make is that what's driving the S/390 is Linux – *not another operating system that appears to be Linux, but real Linux, running on the metal.*

So where's the big mainframe?

One of our friends from the Server Group Linux team stops by. He tells us that Linus Torvalds, the creator of Linux, mentioned S/390 in his keynote address, and we should be prepared to be very busy. Our friend from Server Group is right. It seems as if everyone at the show wants to see Linux on the S/390, and "everyone" at a Linux event covers a lot of ground.

Some people know what S/390s are and spot our Multiprise 3000 right away. Some of the visitors circle the IBM booth a couple of times looking for the great big mainframe and don't find one. Eventually, they see the sign above our position and stop by. Some people, even after seeing the sign, remain quite skeptical. One fellow accuses me of standing next to a control unit!

We meet college students who use Linux at school who stop by to see what a mainframe looks like. We see elementary school students attracted by the x-pilot game we have running. We meet people who worked with S/390 processors "years ago," who stop to reminisce and can't get over the compact size and power of our Multiprise 3000.

We meet members of the press, and we meet people from Fortune 500 companies who are very curious about Linux running on S/390. They tell us that they have logical partitions on their S/390s that were used for Y2K purposes until recently which are now available for something new, and they are quite curious about Linux on S/390.

The basic questions

- ❑ **"Is it really Linux running on S/390, or is it a Linux personality on another operating system?"** We tell them it's Linux running on the metal; and if they don't believe us, here's a terminal take a look for yourself. Some take us up on the offer, and are quickly convinced.
- ❑ **"Is this an IBM product?"** No, it's an Advanced Technology Project; and it's available to download from the Internet at no charge.
- ❑ **"Why run Linux on S/390?"** Where should I begin – reliability, scalability, the ability to work closely with other operating systems without network latency, large numbers of Linux servers running on VM/ESA. I could go on and on.
- ❑ **"Has any code been recompiled to Linux for S/390?"** Yes, quite a bit, like the Apache Web server, Open LDAP, Perl, Regina, and a lot more.
- ❑ **"Where can I get Linux for S/390?"** We hand out business cards with the URL of the IBM developerWorks Web site on them. It's comforting to see them going into shirt pockets and wallets instead of bags full of t-shirts and toys that everyone seems to be carrying.

So if you can't be here to get one of our cards, here's the URL to reach the IBM developerWorks page for Linux on S/390. Pass it along!

<http://oss.software.ibm.com/developerworks/opensource/linux390/>

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