BY LIONEL B. DYCK

Linux on S/390 or zSeries: Getting Started

How do you learn enough about Linux to install and begin using it? This article will attempt to help you with that process. Although this article will not give you all the information you need to be an expert, after reading this, you should have an idea of what you can do and where to begin.

By now, you have heard about Linux on the mainframe. Your management may even be considering it, or perhaps management told you to install Linux in an LPAR for evaluation. Where do you start? How do you learn enough about Linux to install and begin using it? This article will attempt to help you with that process. Although this article will not give you all the information you need to be an expert, after reading this, you should have an idea of what you can do and where to begin.

Linux on the mainframe has been available for more than a year now, with official distributions since the last quarter of 2000. This article will not review the history of Linux; instead I will present information that will help you get started. For more information on specifics, see the series of articles written by Adam Thornton that have appeared in *Technical Support* magazine beginning in the November 2000 issue.

If you are new to the world of Linux, I recommend that you go to a bookstore and purchase a copy of one of the major Linux distributions to install on a PC. I would suggest that you pick up a copy of the Linux distribution that you plan to use on your S/390 or zSeries since, other than the initial install and hardware configuration, they are the same.

According to IBM, the officially supported hardware platforms are the Multiprise 3000, a G5 or higher S/390 or a zSeries processor. Turbolinux indicates that they support the G4 S/390 as well. You can also install Linux on a P/390 and on a PC with Hercules, which runs under either Linux or Windows NT (see the following sections for more information on Hercules). According to some posts I have seen on the Linux-390 Listserv, it is possible to install and run Linux for S/390 and zSeries on a G2 or later S/390. However, that is not an officially supported platform.

The beauty of this flavor of Linux is that it is 99 percent the same as every other Linux platform (there is a small percentage of hardware-specific code in Linux for each platform). Therefore, you can learn about Linux on the Intel platform as well as learn things that will work on your S/390 or zSeries box.

GETTING STARTED: OBTAINING A DISTRIBUTION

First, you will need to get a copy of Linux on a S/390 and zSeries, which can be acquired from one of the following sources:

- **Marist College Distribution:** This completely free distribution is built upon the Red Hat level of Linux. Although no support is available, this is an excellent distribution you can use to get started. When I wrote this article, Mike Kershaw of Marist College was in the process of updating this distribution. This version should be available soon. You can download the installation files from www.linuxvm.org; click under "Software" on the Marist File Distribution. You can click on the "Ported Packages" links to download additional packages. Note that there are no CD images for this distribution; Marist only supports the Tape IPL or VM Reader installation method onto a bare metal LPAR.

- **RedHat Distribution:** As of this writing, the commercial version is still in beta. Given the quality of the RedHat distribution on other platforms, this will be another very viable option. You can download the CD images once they are available from www.redhat.com. If you are a brave soul, you can download the RPM files and build your own Linux for S/390 and zSeries. (However, if you know enough to do this, then you probably do not need this article.)
- **SuSE Distribution:** This commercial distribution is easy to install. The prompting and automated configuration makes it easy. To download the three CD images (.iso format), go to www.suse.com and click on "Download" and then on the S/390 link.
- **Turbolinux Distribution:** This distribution just recently became available for download. It is a single CD image (.iso format). I have not tried it but have heard it is also an easy install. You can download the single CD image from www.turbolinux.com/products/s390/index.html and then click on the "Download" link. Turbolinux indicates in their documentation that they will support a G4 class S/390.

Next, you will need to have an available S/390 or zSeries box, an LPAR on a box, or VM (either VIF, VM/ESA or z/VM), along with the necessary DASD and network connectivity, to complete the installation.

If you cannot wait for one of these to become available, your other option is to get a PC with Linux or Windows NT installed, install Hercules (a free 370/390 simulator that can be found at www.conmicro.cx/hercules/) and then install Linux for S/390 and zSeries under Hercules. I have done this on a Pentium III, 400MHz, 64MB system with 6GB DASD running SuSE Linux 7.0 and it worked reasonably well. The Hercules program indicated that I was getting up to 3.12 MIPS. You can download Hercules from this site as well as find the necessary documentation to get both Hercules and Linux for S/390 and zSeries installed and running.

RESOURCES: LEARNING ABOUT LINUX

Before you go too far, you will want to learn about Linux for S/390 and zSeries.

The beauty of this flavor of Linux is that it is 99 percent the same as every other Linux platform (there is a small percentage of hardware-specific code in Linux for each platform). Therefore, you can learn about Linux on the Intel platform as well as learn things that will work on your S/390 or zSeries box.

Please note that this list of resources is not complete or exhaustive. These are resources that I have used and found useful and I believe that you will as well.

- The Linux/390 Project site (www.linuxvm.org) is an excellent starting point and is where you can find the Marist distribution. This site also includes three excellent articles, which I recommend, by Neale Ferguson about Linux on the Iron Penguin. This site has links to each of the available distributions and more. Even if you are not using VM, do not let that prevent you from going to this site; you do not need to have VM to learn a lot from here.
- The IBM site (www.s390.ibm.com/linux) is the obvious place to get information about Linux on the S/390 and zSeries hardware. Here you will find numerous links to helpful sites (do not ignore the Linux seminar).
- Linux Headquarters (www.linuxhead-quarters.com) is a very useful site and contains many helpful tutorials. This site is mostly PC-based but is a good starting point for novices.
- IBM Linux Documentation (http://oss.software.ibm.com/developerworks/opensource/linux390/docu.html) is where you will find the necessary documentation for the IBM hardware updates to Linux, plus other interesting documentation. Also, do not forget to look on the IBM Redbook site for current documentation (www.redbooks.ibm.com). A search on Linux will provide you with several excellent hints.
- IBM Developer site (www.ibm.com/developerworks/linux/) contains a lot of useful information, including a vi Tutorial (look under the Most Popular Links).
- Jim Elliott of IBM maintains the Linux for zSeries and S/390 page (www.vm.ibm.com/devpages/jelliott/linux.html). Here you will find information

about upcoming IBM events, presentations and more links.
- The Linux Newbie Administrator Guide (http://sunsite.dk/linux-newbie/) is an excellent overview of Linux installation, setup and administration. This guide is targeted for first time Linux users using RedHat Linux on a PC. However, do not let that prevent you from reading this guide, as most of the information will be helpful for Linux on your mainframe (remember that Linux is Linux).
- The Linux-390 Listserv. This listserv is an excellent source of information and a place to get answers from very knowledgeable individuals. To join the listserv, go to www.linuxvm.org and click on the link on the left-side for the Linux-390 Listserv, and then scroll to the bottom of the page to subscribe. You can also view all past and current postings from this link. This listserv is the best place to ask your questions and seek information from others, especially if you do not have any formal support contract in place (which is probably the case if you are just evaluating the capabilities of Linux on your S/390 or zSeries).
- The Linux/390 at Princeton site (http://penguinvm.princeton.edu/) contains useful information as well as several presentations.
- Linux on the IBM ESA/390 Mainframe Architecture site (http://linas.org/linux/i370.html) contains interesting and useful information, including presentations that will help you better understand Linux.
- Linux 390 Links (http://linuxvm.org/info/l390link.html) provides links to useful (and some not-so-useful) information.
- The Linux Documentation Project (LDP) (www.linuxdoc.org) is the best source for documentation about Linux. This site includes guides, how-to information, FAQs, and manual (man) pages.

The following Web portals provide additional information:

- Red Hat Documentation (www.redhat.com/apps/support/documentation.html)
- SuSE Linux Portal (http://portal.suse.de/en/)
- Turbolinux Club Turbo (www.turbolinux.com/club/)

INSTALLATION METHODS

There are several methods available for installing Linux. This section assumes that you will be installing Linux on a bare metal LPAR; if you have the luxury of having access to a VM system, then the installation will be even less painful. Note that IBM has a product called the Virtual Image Facility (VIF), which is a slimmed down VM designed to run in an Integrated Facility for Linux (IFL) engine with special tools to simplify the installation and management of Linux guests. z/VM 4.1 was just announced in June and should be available by the time you read this. z/VM will include the Linux guest tools and will be able to run in an IFL, replacing VIF.

Note: For the Marist install, once the system is up you will need to format and create your Linux volumes, use SILO to create your boot disk, and configure a network link so you can download and install other packages. The other installs do the DASD set up for you and use FTP, NFS, or SMB to complete the install.

- **VM Reader:** If you have VM, then the IPL is as simple as uploading the kernel, parmfile, and initial RAM disk (lrecl=80 for each) to a VM disk. Then punch these to the reader and IPL the reader.
- **Tape IPL:** This method involves copying the kernel, a parmfile, and the initial RAM disk (initrd) to tape and then IPL'ing the tape. Note that the tape drive will need to be offline to all OS/390 systems when you IPL it (and you may need to vary the CHPID offline as well or you may get Device or Control Unit Busy conditions).
- **AWSTAPE:** If you are using a P/390 or installing under Hercules you will want to use the AWSTAPE installation method. This is a virtual tape using a directory file that points to the three installation files (kernel, parmfile and ramdisk) that reside on the P/390 or PC disk. If you are using this method, be sure to read the documentation available with the distribution.
- **DASD IPL:** This method is experimental and allows you to use ICKDSF to create a boot record on a real OS/390 volume instead of using a tape. You can find information about this method, including the code and sample JCL, at http://pucc.princeton.edu/~rvdheij/linuxipl.html.
- **Load from CD-ROM IPL:** Insert the CD into the CD drive of the hardware management console (HMC) (not the Service Element [SE]), go into "Single Object Operation" and select "Load from CD-ROM or Server." After you configure the network, you will need to access the remainder of the install using the network connection (FTP, NFS or SMB) to complete the install.
- **Load from FTP Server IPL:** For this method the CDs, or just the CD images, need to be available on an FTP Server (note that the OS/2 server [on the HMC] and the Windows FTP servers are not supported for this function for Linux). For this I would recommend that you install Linux on a PC and then copy (or download) the CD image files onto your Linux PC.

Once your PC is booted in Linux, download the CD images for the distribution that you have selected into a unique directory on your system. While still in this directory, issue the following commands to first create the mount points and then to mount the CD images in loopback mode. (Thanks to Mark Post of EDS for this information from a post on the Linux-390 Listserv):

```
mkdir /cd1
mkdir /cd2
mkdir /cd3
mount cd1.iso /cd1 -o loop -r
mount cd2.iso /cd2 -o loop -r
mount cd3.iso /cd3 -o loop -r
```

Next, go to your HMC, get into Single Object Operation, and select "Load from CD-ROM or Server." Click on FTP and enter the appropriate FTP information (including the FTP server IP address, a userid and password that has access to the mount points, and the mount point for the first CD image).

At this point you should switch to the Operating Messages display and follow the prompts to complete the installation.

INSTALLATION HINTS/TIPS

I have gleaned the following hints and tips from various sources:

- When installing the SuSE distribution, which uses the SuSE YaST installation tool, you will need a telnet client that supports a minimum of 25 lines. The telnet client that comes with Windows NT will not work, so you will need to find another client. Check your 3270 emulator package or download one of the following free telnet clients:

  – PuTTY from www.chiark.greenend.org.uk/~sgtatham/putty is also a good choice. Note that you can also find this on the SuSE CD1 in /dosutils/puttytel/puttytel.exe.
  – Tera Term from http://hp.vector.co.jp/authors/VA002416/teraterm.html.

The more I use these telnet clients, the better I like PuTTY. Although Tera Term's defaults are better, you will like PuTTY better overall. The advantage with PuTTY is that there is support for the program function keys when using YaST under SuSE.

- Make sure your LPAR (including an IFL engine) is configured with only the devices that you expect Linux to access. If you are using VM or VIF, this is not an issue, as Linux will only see the devices that VM/VIF has defined for the Linux guest.
- If you are going to download the CD images and wish to burn real CDs, make sure that the CD writing software supports the ISO 9660 image format.
- If you plan to use the "Load from CD-ROM or Server" option for an FTP IPL, make sure the Service Element is properly configured for TCP/IP. The Routing Table information may not have been configured when the level of microcode that supports this feature was installed. If the Routing Table is not properly configured you will not be able to access your FTP server.
- Learn vi. "vi" stands for VIsual editor (some say it stands for very intuitive, which it is not). You can get a copy of GVIM (GUI VI iMproved) to run on your Windows PC from www.vmunix.com/vim/. Click on the download and select a

good mirror site. Get the latest version (gvim57.zip), download it, unzip the program, and use the gvim.exe. Sadly this program does not come with documentation and help, but you can find a copy of the documentation at ftp://ftp.ny.us.vim.org/pub/editors/vim/doc/. Here you can download the vim57html.zip, unzip it, and then open the index.html file for full documentation.

AFTER INSTALLATION: NOW WHAT?

Once you have Linux installed and running on your S/390 or zSeries, you will want to try it out. Roughly 2,000 different applications and tools are included with each of the distributions. Here are some of the things you may want to consider using with Linux on your mainframe:

● **Samba:** This open source tool can function as a replacement for your Windows NT server farm(s) in the logon authentication, file serving, and print serving arenas. Samba can also interface with a Windows PDC (primary domain controller) for logon authentication if you want to leave the logon authentication with Windows and move the file and/or print serving to Linux. Samba is included with the distributions and you can find the current level plus documentation at www.samba.org.

● **Apache:** This Web server is running a majority of the world's Web servers and it is also open source. Find it at www.apache.org. Note that you can use the wget command to clone an internal web site onto your Linux/390 system for demonstration purposes.

● **Various IBM Products:** Go to www-1.ibm.com/servers/eserver/zseries/software/ for information on what IBM has currently available.

● **Independent Software Vendors:** ISVs have also jumped on the Linux for S/390 and zSeries bandwagon. IBM maintains at site at www-1.ibm.com/servers/eserver/zseries/solutions/s390da/linuxproduct.html with information on the beta and available software from the ISV community.

● **Sendmail:** The Sendmail application server is open source and is available for Linux. You probably already have a mail server in your installation, but it would be nice to have it on a larger server (with more scalability).

● **Support for Thin Clients:** You can have some fun with Linux by enabling the KDM (KDE Desktop Manager) and then pointing an X-Terminal, or workstation with an X-server installed, to your Linux/390 system. You will be able to run the full KDE environment, including the Koffice suite (or Star Office) on the Linux/390 server with the display on the workstation. Note that you will have to tailor the KDM and other initialization files on your Linux/390 server. Also, depending on your processor, the performance may not be ideal (the processor should have real IEEE Floating Point to perform).

● **vBulletin:** Although the full version of this product is not free, this is a very interesting product. It is a bulletin board application that you can install on your Linux/390 system after you have installed Apache, PHP and MySQL. I set it up in my environment, and my colleagues cannot believe that it is running on a mainframe. You can access this product at www.vbulletin.com. I recommend that you first try the

vBulletin Lite (Version 1.01), which is free, and then move to to the full product (Version 2.01) later.

Before you go into production, you should consider if you want to continue running only one Linux server per LPAR. Chances are you will want to run more than one image. Therefore, you should consider z/VM, which will allow you to run several thousand Linux servers in the same LPAR. This means that you, or someone in your organization, will have to learn z/VM.

You will also want to look into a formal support contract so that you, as a business, have some place to go where you can count on real support. The obvious choices are:

● **IBM:** While IBM does not offer their own distribution, they do offer support services for Linux. The support covers many distributions across all of the IBM hardware platforms (and I suspect other vendors' hardware as well for an additional fee).

● **The Distributors:** Each Linux for S/390 and zSeries distribution vendor offers support services. However, these vendors will only support their own flavor of Linux, so you will need to ensure that you use their distribution on all platforms on which you expect to ask for support.

● **Third-party Consulting Services:** There are several consulting services available that provide excellent support for Linux on the S/390 and zSeries.

OTHER RESOURCES

If you need additional resources, check out the live classes available from IBM at www.ibm.com/services/learning/spotlight/linux. Also, be sure to check out the IBM Redbooks at www.redbooks.ibm.com. (I found 23 books with Linux in the title when I searched the Redbooks site while writing this article.)

Another resource are the many articles written in *Technical Support* by Adam Thornton. These articles are available from the NaSPA Web site in PDF format 60 days after publication. To access, go to www.naspa.com and click on "*Technical Support*."

Do not forget that you can also get excellent information at SHARE (www.share.org). IBM conducted an excellent hands-on Linux for S/390 and zSeries installation lab at the past two SHARE conferences. While at the last SHARE in Long Beach, I attended 16 different sessions on Linux and met many of those who actively participate (answer questions) on the Linux-390 Listserv. You can view some of the handouts for these sessions by going to the SHARE Web site and clicking on the link to the Proceedings.

If you decide to get z/VM, you will need to learn about it as well. Obviously, IBM has many classes you can take to become a z/VM systems programmer. SHARE also offers excellent z/VM education. At the last SHARE there was a track of z/VM sessions designed for the new z/VM systems programmer. Check out the SHARE Web site for the handouts from these sessions as well.

SUMMARY

I realize that this is a lot of information to digest. However, I hope that by now you realize that Linux on the mainframe is something to consider. In a survey I conducted last month on the Linux-390 Listserv, of the 49 worldwide installations polled, only

26 percent are using Linux in production while the remaining sites are experimenting with it. Of these 49 sites, 42 are actively experimenting with Linux on nearly 230 Linux instances (50 of which are production level instances).

Is Linux for the mainframe ready for production in your enterprise? That is something your site needs to determine on its own. However, in my view, Linux is a viable solution. Remember that the current distributions are basically Release 1.0 level for the mainframe (perhaps 1.1) and there are many enhancements coming in the near future. IBM and other vendors have committed a large amount of resources to enhance and improve Linux so that it will be enterprise capable. By the end of the year I expect the question to be, "Why aren't you using Linux on the mainframe?"

Try Linux, even if you only do so on a spare PC under Hercules. Kick the tires and try some of the products. If nothing else, you will be ready when management asks you to install Linux. ⟲

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