Building Customized Linux Kernels
A live demonstration

Mark Post

August 17, 2004

Session # 9280

Documentation

- The Linux Documentation Project
  http://www.tldp.org/
- Look for the “Kernel HOWTO”
  http://www.tldp.org/HOWTO/Kernel-HOWTO/
  http://www.digitalhermit.com/~kwan/kernel.html
- Practical experience here this week:
  Linux for S/390 Installation Lab, Tue. & Thu.
  9227 and 9230

Basic Process

- Get the source
- Unpack/install the source
- Apply IBM patches (if not already there)
- Generate a kernel configuration
  - make menuconfig
  - make oldconfig
  - make xconfig
  - make config
- Run
  - make dep
  - make image
  - make modules
  - make modules_install

Basic Process (2)

- Put new kernel into place
- Possibly regenerate the initrd
- Possibly update /etc/zipl.conf
- Run zipl
- Take the system down
- Boot from the new kernel
- Back off to the old kernel if necessary

Where to get the source

- "Pristine" source:
  ftp://ftp.kernel.org/pub/linux/kernel/v2.4/
  ftp://ftp.kernel.org/pub/linux/kernel/v2.6/
- Linux distribution-specific source:
  Usually included in your distribution installation media, or...
  https://portal.suse.com/
  ftp://ftp.suse.com/pub/suse/i386/9.1/suse/src/
  ftp://ftp.suse.com/pub/suse/i386/update/9.1/rpm/src/

  ftp://ftp.redhat.com/pub/redhat/linux/enterprise/3/en/os/s390/SRPMS/
  ftp://ftp.redhat.com/pub/redhat/linux/enterprise/3/en/os/s390x/SRPMS/
  ftp://ftp.redhat.com/pub/redhat/linux/updates/enterprise/3AS/en/os/SRPMS/
- IBM patches:
  http://www10.software.ibm.com/developerworks/opensource/linux390/index.shtml

Unpack/Install the Source

- If you get a kernel source RPM, then install the source:
  rpm -ivh kernel-source.rpm
  - Usually puts the source in /usr/src/linux-$VERSION
- If you downloaded source from ftp.kernel.org:
  tar -zxvf linux-2.6.7.tar.gz
  tar -jxvf linux-2.6.7.tar.bz2
- Don't confuse this with a kernel SRPM
  - kernel-source-2.4.20.SuSE-62.i586.rpm
    kernel-source-2.4.20.SuSE-62.src.rpm
    kernel-source-2.4.20-8.i386.rpm
    kernel-2.4.20-8.src.rpm

Unpack/Install the Source

- So what is the difference?
  - SRPM = vanilla source, patches, RPM spec file
    gets installed into /usr/src/rpm/SOURCES
    gets processed with “rpmbuild -bb” command
  - RPM = updated source
    gets installed into /usr/src/linux-$VERSION (usually)
    /usr/src/linux-2.4.19

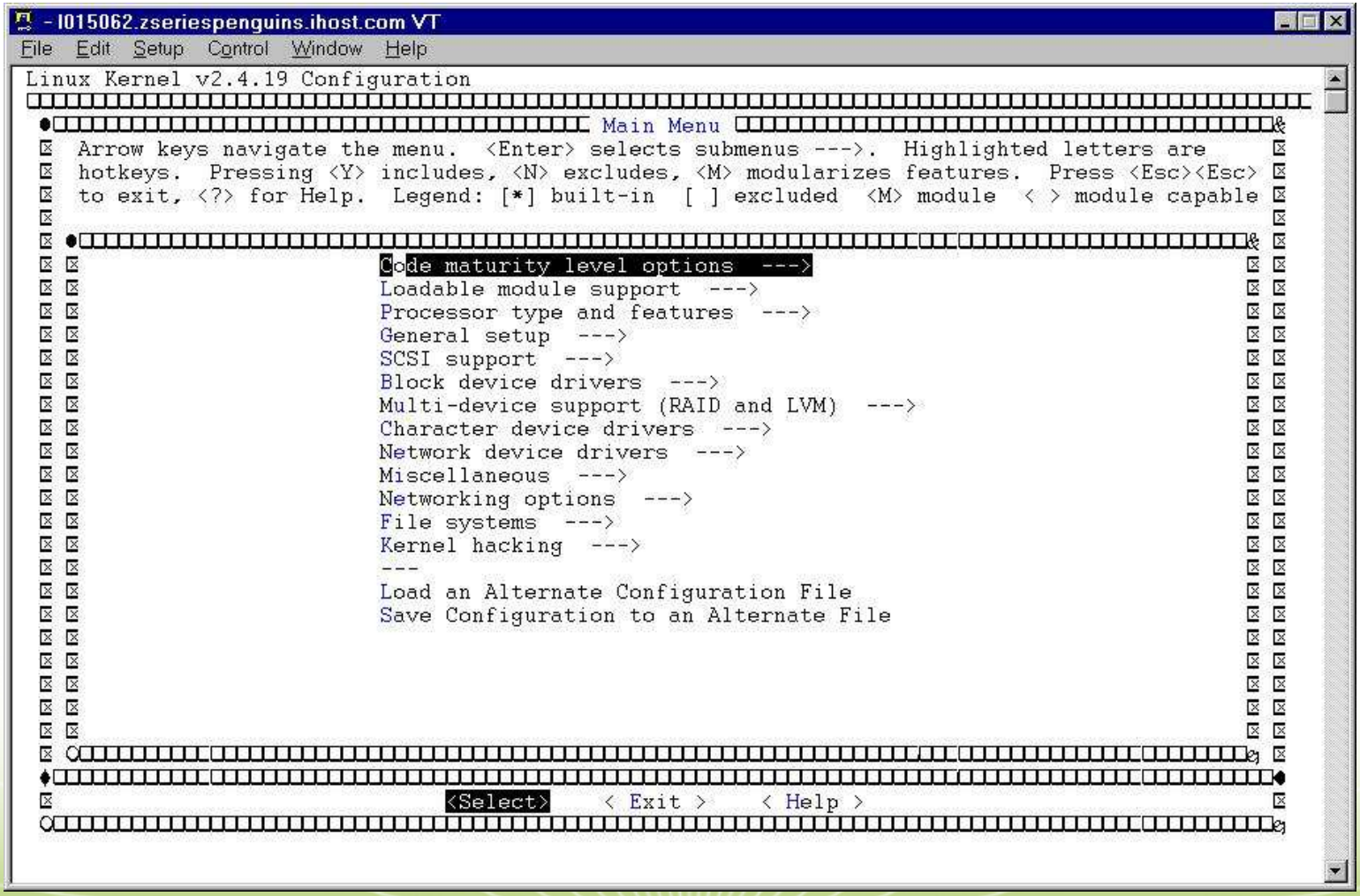
Apply IBM patches

- Patches come in .tar.gz files.
- Contain a
  - LICENSE file (GPL)
  - .readme file
  - .diff file
- Read the .readme file(s) for patching order.
- cd to top-level directory and use patch command:
  cat /path/to/diff.file | patch -p1 [---dry-run]
- Repeat for each .diff file.

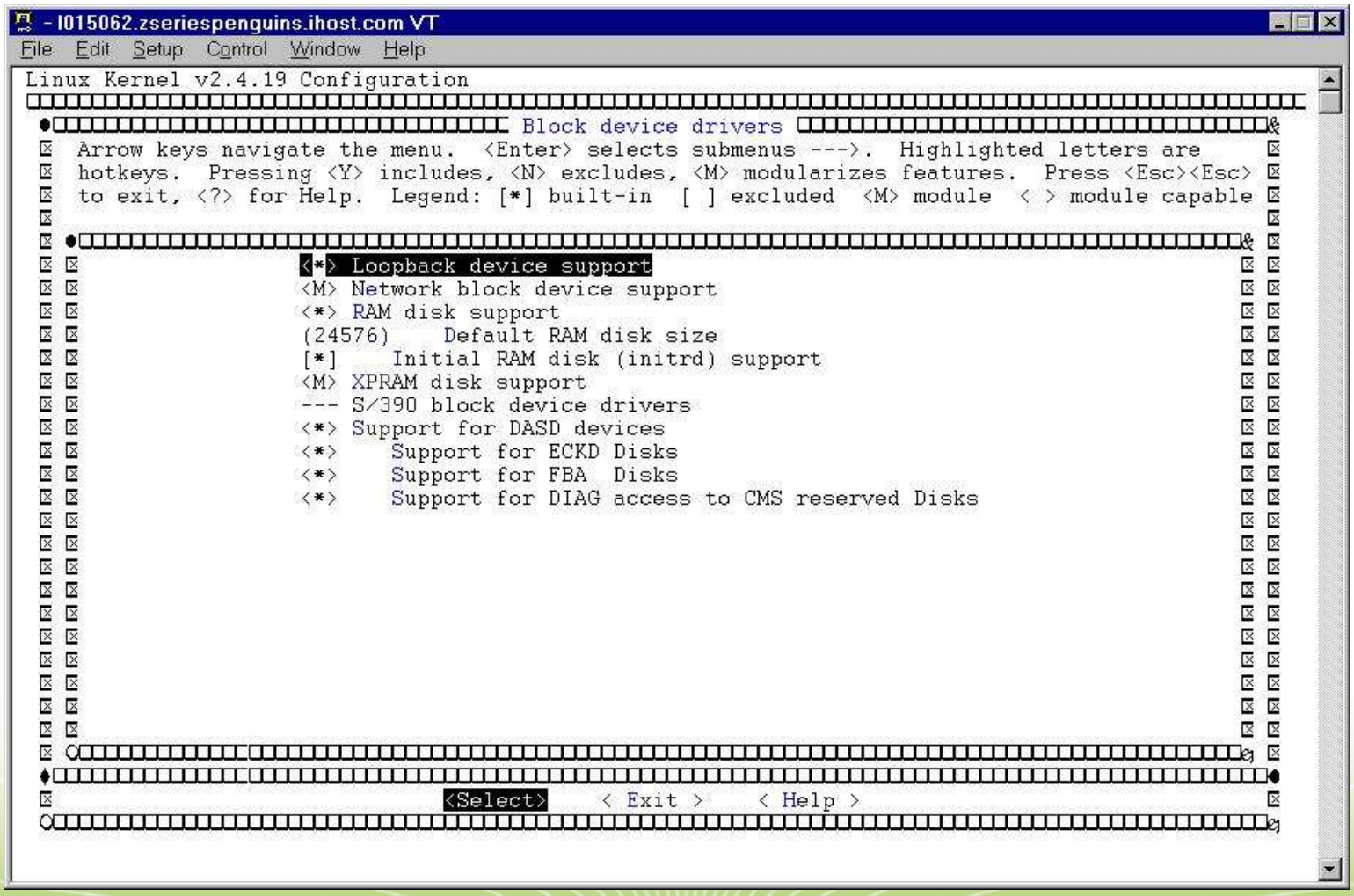
Generate a kernel configuration

- Many ways to specify a particular kernel configuration:
  - make config (**don't** do this)
  - make oldconfig (used to start from a known configuration)
  - make menuconfig
  - make xconfig (**don’t** do this on Linux/390)

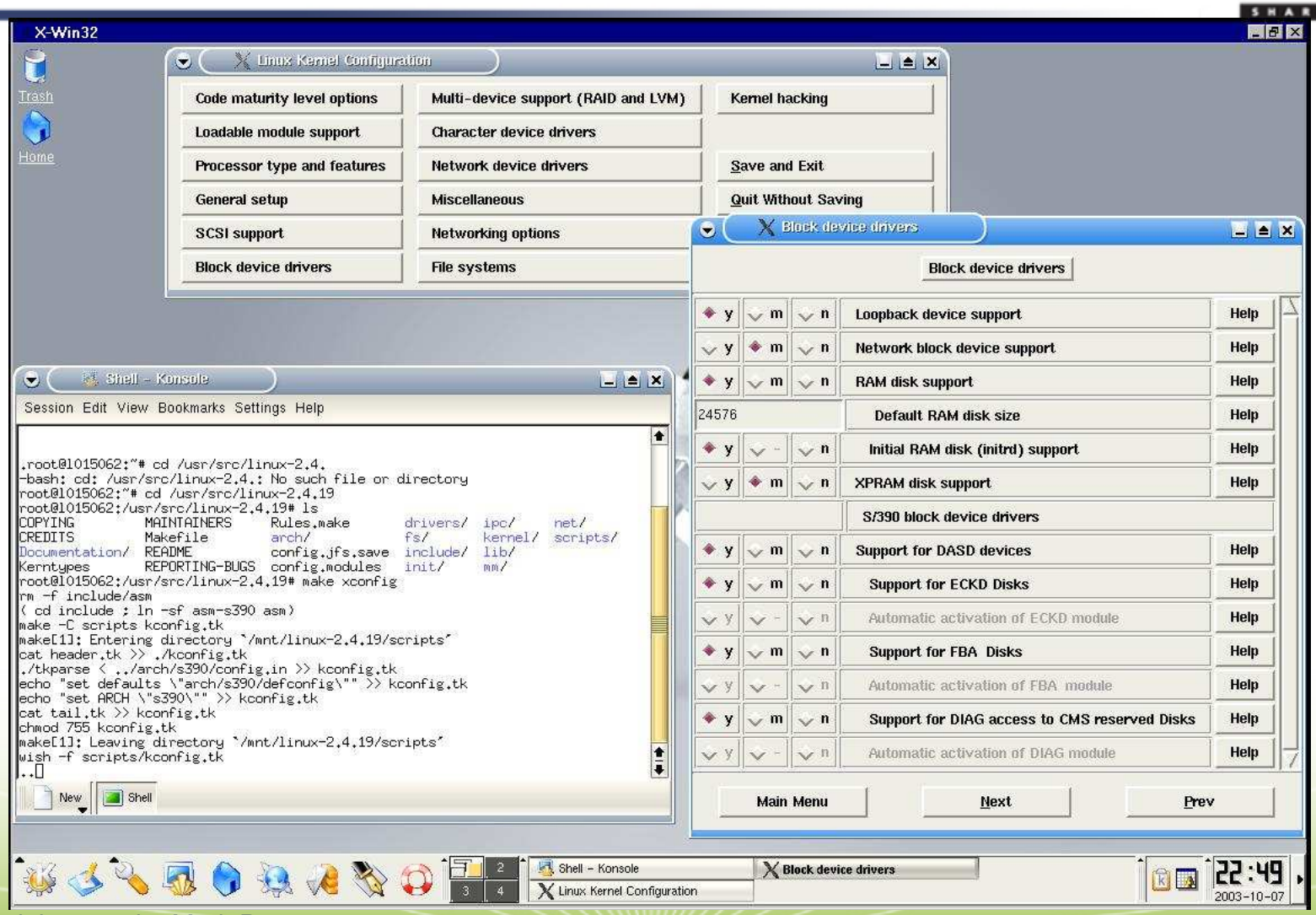
Make menuconfig



Make menuconfig (2)



Don’t do this at home



Usual order of commands:

- Save configuration file
- make mrproper
  (this wipes out .config!)
- copy saved configuration file to .config
- make menuconfig
  (or oldconfig)
- make dep
  (no longer needed in 2.6.x kernels)
- make image
  (on Intel, will likely be bzImage)
- make install
  (make sure you know what this does)
- make modules
- make modules_install
- depmod -a version-of-kernel-just-built
  - depmod -a 2.4.19-xfs

Put new kernel into place

- The generated kernel is going to be:
  /path/to/linux/source/arch/s390/boot/image
  AKA
  arch/s390/boot/image
- Copy the image file to /boot/
- Copy the System.map file to /boot/
  (located in the top-level source directory)
- Copy the .config file to /boot/
  (give it a name like config-2.4.26[-something])

Regenerate the initrd

- Newer versions of SUSE and Red Hat use an initial ramdisk to hold driver modules
- Updating the kernel and/or kernel modules requires that the initrd be re-created
- The command that does this is “mkinitrd.”
  - Read the man page for this to understand what it does.
  - Look inside the initrd to see what’s in the old one, versus the new one.
  - Look at http://linuxvm.org/Info/HOWTOs/mkinitrd-notes.html

Update /etc/zipl.conf

- Review the contents of /etc/zipl.conf
- If you need to make a change, do so
  - Correct kernel
  - Correct default kernel
  - Correct DASD volume to write the kernel
  - Correct kernel parameters specified

Re-run zipl

- If you use /etc/zipl.conf, just type in “zipl”
- If you don’t use /etc/zipl.conf, then you’ll have to specify all the parameters:
  - zipl -t /boot -i /boot/image-2.4.26 -p /boot/parmfile -r /boot/ramdisk
- Make sure you get messages similar to this:

```
Building bootmap './bootmap'
Adding IPL section
  kernel image.....: image at 0x10000
  kernel parmline...: 'dasd=300-305,400 root=/dev/dasda1 ro noinitrd' at 0x1000
Preparing boot device: dasda (0300).
Done.
```

Take the system down

- shutdown -h now
- shutdown -h 23:59
- Whatever your site's change management dictates.

Boot from the new kernel

- In an LPAR - from the HMC
- From z/VM - ipl devno clear
- How do you know what to specify for the boot device number?
  - From the /boot directory:
    df -h .
    grep dasd? /proc/dasd/devices
    First number is the device number

Back off to the old kernel

- How do you do that, when you just over-wrote your old kernel information?
  - You need multiple DASD volumes/minidisks (**not** LVM or RAID)
  - Create a boot directory (or some other name) in each file system
  - Copy the files from /boot, and your new kernel, etc.
  - Re-run zipl from that directory or add entries to /etc/zipl.conf and change your default

```
# df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/dasda1           2.3G  348M  1.8G  17% /
/dev/dasdb1           2.3G  1.3G  848M  61% /usr
```