Debugging Linux Kernel Source with Eclipse & QEMU in Fedora Core 11

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Acknowledgement

- These slides are based on Takis Blog.
 - <u>http://issaris.blogspot.com/2007/12/download-</u> <u>linux-kernel-sourcecode-from.html</u>
- All the credits go to the author of the Blog.

OS & Software Environment

- OS: Fedora Core 11
- Linux Kernel Source: 2.6.30.2
- IDE for Debugging: Eclipse-CDT
- Virtual Machine for Debugging: QEMU
- Compiler: GCC (version 4.4)

1. Install Eclipse/Eclipse-CDT

- Fedora Core 10/11
 - Install Fedora Eclipse packages
 - From CD/DVD or with yum.
- Other distribution
 - Download "Eclipse IDE for C/C++ Developers" from Eclipse site & Install.
 - <u>http://www.eclipse.org/downloads/</u>

2. Download Linux Kernel

- Obtain Linux Kernel source from Linux Kernel website
 - <u>http://www.kernel.org</u>
 - I downloaded 2.6.30.2 version (on 7/20/09)
 - <u>http://kernel.org/pub/linux/kernel/v2.6/linux-</u> 2.6.30.2.tar.bz2

3. Untar Linux Kernel source

- Change to "root" user in a Terminal/Shell \$ su –
- Untar Linux Kernel source:
 - \$ cp linux-2.6.30.2.tar.bz2 /usr/local/src/
 - \$ cd /usr/local/src/
 - \$ tar jxvf linux-2.6.30.2.tar.bz2

- \$ mkdir -p /mnt/build/linux-2.6
- \$ cp /boot/config-2.6.29.4-167.fc11.i686.PAE /mnt/build/linux-2.6/.config
- \$ cd /usr/local/src/linux-2.6.30.2/
- \$ make oldconfig O=/mnt/build/linux-2.6

Kernel compression mode

> 1. Gzip (KERNEL_GZIP) (NEW)

- 2. Bzip2 (KERNEL_BZIP2) (NEW)
- 3. LZMA (KERNEL_LZMA) (NEW)

choice[1-3?]:

. . .

Strip assembler-generated symbols during link (STRIP_ASM_SYMS) [N/y/?] (NEW) Support for extended (non-PC) x86 platforms (X86_EXTENDED_PLATFORM) [Y/n/?]

Support non-standard 32-bit SMP architectures (X86_32_NON_STANDARD) [N/y/?]

Paravirtualization layer for spinlocks (PARAVIRT_SPINLOCKS) [N/y/?]

. . .

// It asked many things. I entered "default" for all the questions.
configuration written to .config

\$ make menuconfig O=/mnt/build/linux-2.6

• Select "Kernel Hacking \rightarrow "

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• Enable "Compile the kernel with debug info"



• Enable "Compile the kernel with frame pointers"



• In a terminal/shell:



• "Select a workspace": /root/workspace

🖨 Workspace Launcher	×
Select a workspace	
Fedora Eclipse stores your projects in a folder called a workspace. Choose a workspace folder to use for this session.	
Workspace: /root/workspace	
Use this as the default and do not ask again OK Cancel	



• "Go to the Workbench"



Select "Window→ Preferences":

	Resource - Fedora	Eclipse	_ + X
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- Select "General→ Workspace"
- Deselect "Build automatically" & "Apply"

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▷ Security	○ <u>A</u> lways ○ <u>N</u> ever ● <u>P</u> rompt			
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Select "C/C++→ Indexer"

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type filter text	Indexer 🗘 🗘	•
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> Workspace	Skip all references (Call Hierarchy and Search will not work)	Indexer" to
▼ C/C++	□ Skip type references (Search for type references will not work)	
Appearance	Skip type references (Search for macro references will not work)	
> Autotcols		
Build Console	Files to index up-nont;	
Build Variables		
> Code Style	Indexing strategy	
> Debug	Automatically update the index	
> Editor	✓ Update index immediately after every file-change	
Environment		
Indexer	Build configuration for the indexer	
Language Mappin	Use active build configuration	
> Make	• Use the build configuration specified in the project's indexer settings	
> New CDT project	Cache limits	
> Property Pages S	Index database cache:	
Task Tags	Limit relative to the maximum heap size: 10 %	
Template Default	Absolute Limit: 64 MB	
▶ Help	Header file cache (used by full indexer and refactoring):	
Install/Update	Absolute Limit: 64 MB	
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· ∢()>	Restore <u>D</u> efaults <u>Apply</u>	
0	OK Cancel	Click "OK"

Switch "Fast C/C++ ndexer" to "No Indexer"

"File→ New→ Project.." on Eclipse menu

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Select "C→C Project" & click "Next"

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Select a wizard	
Create a new C project	
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Select "Makefile project" → "Empty Project"

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C Project Project name must be specified	
<u>Project name:</u> Use <u>d</u> efault location Location: /root/workspace	Browse
Project type:	Toolchains
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Show project types and toolchain	s only if they are supported on the platform
(?) < <u>B</u> ack	Next > Finish Cancel

Uncheck "Use default location" checkbox

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⑦ < <u>B</u> ack	Next > Einish Cancel

- Enter the project name in "Project name"
- Enter "/usr/local/src/linux-2.6.30.2" into "Location"

🖨 C Pro	oject 🛛 🗶
C Project <u>A</u> Directory with specified name already exit	ists.
Project name: kernel-2.6.30.2 Use <u>d</u> efault location Location: /usr/local/src/linux-2.6.30.2	B <u>r</u> owse
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⑦ < <u>B</u> ack Ne	ext > <u>F</u> inish Cancel

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• Click "Finish"

😝 C Project	×
Select Configurations Select platforms and configurations you wish to deploy on	
Project type: Makefile project Toolchains: Configurations:	
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	Advanced settings
Use "Advanced settings" button to edit project's properties. Additional configurations can be added after project creation. Use "Manage configurations" buttons either on toolbar or on pro	operty pages.
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• Answer "Yes"

•	Open Associated Perspective?	×
?	This kind of project is associated with the C/C++ perspective. Do you want to open this perspective now?	
□ <u>R</u> em	nember my decision	
	<u>Y</u> es <u>N</u> o	

• New Project is created.

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7. Configuring Project

• Click the right button (mouse) on the project.

• Select "Properties"

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7. Configuring Project

- Select "C/C++ Builders"
- Uncheck "Use default build command"

\$	Properties for kernel-2.6.30.2	×
type filter text	C/C++ Build	⇔ ~ ⇔~ ◄
Resource Builders C/C++ Build	Configuration: Default	anage Configurations
 C/C++ General Project References Run/Debug Settings 	 Builder Settings Builder Builder type: External builder Use default build command Build command: make CC=gcc O=/mnt/build/linux-2.6 Makefile generation Generate Makefiles automatically Expand Env. Variable Ref Build location 	Variables
	Build <u>d</u> irectory: \${workspace_loc:/kernel-2.6.30.2} Workspace File syst Restore <u>D</u> e	tem Variables efaults <u>A</u> pply Cancel

7. Configuring Project

- Enter "make CC=gcc O=/mnt/build/linux-2.6" in "Build command"
- Enter "/mnt/build/linux-2.6" in "Build directory" by "File system.."

\$	Properties for kernel-2.6.30.2	×
type filter text	C/C++ Build ⇔ <	/ 👻
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C/C++ General Project References Run/Debug Settings	Builder Settings Behaviour Builder Builder External builder	
	Build command: Make CC=gcc O=/mnt/build/linux-2.6 Wariables	
•	□ Generate Makefiles automatically □ Expand Env. Variable Refs in Makefiles Build location Build <u>directory</u> : /mnt/build/linux-2.6	
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0	Click "OK" OK Cancel	

Select "Project→ Build all" on the menu

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Shows the progress for building kernel

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Shows the progress for building kernel

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• Found an error & Building was stopped.

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• "extern" (jffs2-user.h) caused an error.

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	<pre>#undef cpu_to_jemode #undef je16_to_cpu #undef je32_to_cpu #undef jemode_to_cpu extern int target_endian;</pre>		J ^a ₂ 🔌 🖋 ♥ ▽ #FFS2_USER_H_ ■ linux/jffs2.h ■ linux/types.h		
Image: Second	<pre>#define t16(x) ({u16b = (x); (target_endian==BYTE_ORDE #define t32(x) ({u32b = (x); (target_endian==_BYTE_ORDE</pre>	ER) ? ER) ?	 endian.h byteswap.h tarret.ordian.inf 		
	<pre>#define cpu_to_je16(x) ((jint16_t){t15(x)}) #define cpu_to_je32(x) ((jint32_t){t32(x)}) #define cpu_to_jemode(x) ((jmode_t){t32(x)})</pre>		# t16 # t32		
 > Documentation > drivers > Enroware 	<pre>#define je16_to_cpu(x) (t16((x).v16)) #define je32_to_cpu(x) (t32((x).v32)) #define jemode_to_cpu(x) (t32((x).m))</pre>		# cpu_to_je16 # cpu_to_je32 # cpu_to_jemode		
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l> ⊆ lib	Ø /mnt/build/linux-2 6/usr/include/mtd/jffs2-user.h extern's make no ser	kernel-2.	6.30.2		
k 🖻 mm	▷ 🙆 Warnings (95 items)				
D and a second seco					
	K(::::)))		
_ [♦] /mnt/build/linux-2.6/usr/include/mtd/jffs2-user.h extem's make no sense in userspace					

8. Build Modify jffs2-user.h file: remove "extern"

- target_endian is only used in jffs2-user.h.



- Rebuild with "Project → Build all" & created a bzImage
- Kernel: arch/x86/boot/bzImage is ready (#1)



9. QEMU Installation

- Install QEMU & Supporting software
- From Fedora 11 CD/DVD, install in order (or yum):
 - qemu-common-0.10-16.fc11.i586.rpm
 - qemu-img-0.10-16.fc11.i586.rpm
 - bochs-bios-2.3.8-0.6.git04387139e3b.fc11.noarch.rpm
 - etherboot-zroms-kvm-5.4.4-13.fc11.noarch.rpm
 - vgabios-0.6-0.5.b.fc11.noarch.rpm
 - qemu-system-x86-0.10-16.fc11.i586.rpm
 - qemu-kvm-0.10-16.fc11.i586.rpm (*optional*)
- Note: If you already installed, skip this.

10. First Run QEMU

• In a terminal/shell

\$ qemu -s -S -hda /dev/zero -kernel /mnt/build/linux-2.6/arch/x86/boot/bzImage

10. First Run QEMU

- Shows empty (blank) screen
 - Leave this QEMU screen



11. Eclipse Debug Configurations "Run→ Debug Configurations.."



Double click "C/C++ Local Application"



 Put "/mnt/build/linux-2.6/vmlinux" in "C/C++ Application"

👙 Debug Configurations 🛛 🗶						
Create, manage, and run config	gurations	TO.				
Image: Second system Image: Second system <td>Name: kernel-2.6.30.2 Default Main Arguments Environment 梦 Debugger Source Project: kernel-2.6.30.2 C/C++ Application: /mnt/build/linux-2.6/vmlinux Search Project ✓ Connect process input _output to a terminal.</td> <td>rce Common</td>	Name: kernel-2.6.30.2 Default Main Arguments Environment 梦 Debugger Source Project: kernel-2.6.30.2 C/C++ Application: /mnt/build/linux-2.6/vmlinux Search Project ✓ Connect process input _output to a terminal.	rce Common				
Filter matched 4 of 4 items	Appl <u>y</u>	Revert				
0	<u>D</u> ebug	Close				

- In "Debugger" tab
 - "gdbserver Debugger" in "Debugger:"
 - "start_kernel" in "Stop on startup at:"
- "Connection"
 - Select "TCP"
 in "Type:" list
 - Put "1234" in"Port number"
- Click "Debug"

•	Debug Configurations
Create, manage, and run config	Debug Configurations purations Name: kernel-2.6.30.2 Default Main (%- Arguments (%) Environment (%) Debugger Debugger: gdbserver Debugger Image: gdbserver Debugger Image: Stop on startup at: start_kernel Advanced Debugger Options Image: I
Filter matched 4 of 4 items	Apply Revert
	Create, manage, and run config type filter text C/C++ Attach to Local Appl C/C++ Local Application kernel-2.6.30.2 Default C/C++ Postmortem debugg

• Eclipse compiles and links in progress

	C/C++ - Fedora Eclipse	_ + ×	
ile <u>E</u> dit Refac <u>t</u> or <u>N</u> avigate Se	e <u>a</u> rch <u>R</u> un <u>P</u> roject <u>W</u> indow <u>H</u> elp		
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E 🔄 🎽			
🚔 kernel 2.6.30.2		An outline is not available.	
	😰 Problems 🧔 Tasks 🖳 Console 😣 🔲 Properties		Ĩ
	C-Build [kernel-2.6.30.2]		-
	**** Build of configuration Default for project kernel 2.6.30.2 **	**	
	make C(_qcc_0_/mmt/build/linux.2_6_all		
	make -C /usr/local/src/linux-2.6.30.2 0=/mrt/build/linux-2.6/.		
	Using /usr/local/src/linux-2.6.30.2 as source for kernel GEN /mnt/build/linux-2.6/Makefile		
	CHK include/linux/version.h CHK include/linux/utsrelease.h		
	SYMLINK include/asm ·> include/asm-x86		
	CHL /usr/local/src/linux-2.6.30.2/scripts/checksyscalls.sh CHK include/linux/compile.h		
			10

• After a while, it opens "Confirm Perspective Switch"



Shows the changed perspective

Debug - kernel-2.6.30.2/init/main.c - Fedora E	clipse – + ×			
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▼	Value			
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▽ 🧬 Thread [1] (Suspended: Breakpoint hit.)				
😑 3 start_kernel() /usr/loca/src/linux-2.6.30.2/init/main.cl537 (🐸				
= 2 i386_start_kernel() /usr/local/src/linux-2.6.30.2/arch/x86/k	X			
i main.c ♡	P D E Outline 🕱 🛛 🗖			
<u></u>				
£	linux/types.h			
asmlinkage void init start kernel(void)				
char * command line:				
extern struct kernel param start param[], stop param[];				
smp setup processor id():	🖉 linux/syscalls.h			
* Need to run as early as possible, to initialize the				
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console 26 30 2 Default [C/C++ Local Application] /mnt/build/inux-2 6/minux (10/12/09 5:45 PM)				
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12. Back to QEMU screen

• Shows some outputs.



13. Line-by-line run in Eclipse In Eclipse, "Run→ Step over" (or F6)

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<u>F</u> ile <u>E</u> dit Refac <u>t</u> or <u>N</u> avigate Se <u>a</u> rch	<u>Run</u> Project <u>W</u> indow <u>H</u> elp			
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🥳 🏟 🕩 💷 🛯	. 🥙 Toggle <u>W</u> atchpoint			
▽ 💽 kernel-2.6.30.2 Default [C/C++ Local	□ S <u>k</u> ip All Breakpoints		Value	
	💥 Remo <u>v</u> e All Breakpoints		line 0x00020800	
マ 🔊 Thread [1] (Suspended: Breakpo	o 🏟 Restart			
= 3 start_kernel() /usr/local/src	/ 👼 Resume Without Signal			
= 2 i386_start_kernel() /usr/loc	🔊 🕄 Resume At Li <u>n</u> e (C/C++)			
- • ···································	, I▶ Resu <u>m</u> e	F8		
🗟 main.c ន	00 <u>S</u> uspend		n 🗖 📴 Outline 🛿	- 8
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🛿 asmlinkage void init start kern	Step Over	F7	linux/modul	e.h
<pre>char * command line;</pre>	⇒Ĩ Run to Line	Ctrl+R	🗧 📕 linux/proc_f	s.h
extern struct kernel param	Use Step <u>F</u> ilters	Shift+F5	linux/kernel	.h
<pre>smp setup processor id();</pre>	0. Dum	Chall F11	🛃 linux/syscal	ls.h
	wo <u>n</u> un ™a Debug	CUN+F11 F11	📙 🛃 linux/stack	protector.h
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kernel-2.6.30.2 Default [C/C++ Local Annli	Ru <u>n</u> Configurations			
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In Eclipse, "Run→ Step over" (or F6) – Several "Run→ Step over"s (or F6)

Debug - kernel-2.6.30.2/init/main.c - Fedora Eclipse _ + X <u>File Edit Refactor Navigate Search Run Project Window Help</u> 📑~ 🕞 🔠 🔜 🐅 📭 💁 🌝 🤌 🧶 🌗 🕼 영 🌾 🌤 🖧 😭 🎋 Debug 🔤 🤇 🦉 □ □ (>> Variables 🛛 <u>- п</u> 🅸 Debug 🛛 💁 Breakpoints 🔐 Registers 🛋 Modules 🍇 🚸 🕪 III 🔳 M 🔍 🐼 🖄 i+ 😿 Image: Second Science of Content in the second s Value Name command line 0xc07ffc12 = 3 start kernel() /usr/local/src/linux-2.6.30.2/init/main.c:541 = 2 i386 start kernel() /usr/local/src/linux-2.6 30.2/arch/x86/ke - n 🗄 Outline 🕄 💽 main.c 🔀 la, linux/types.h asmlinkage void init start kernel(void) 🛃 linux/module.h 🛃 linux/proc fs.h char * command line: extern struct kernel param start param[], stop param[]; Iinux/kernel.h 🛃 linux/syscalls.h smp setup processor id(); 🛃 linux/stackprotector.h Iinux/string.h * Need to run as early as possible, to initialize the * lockden hash. 📮 Console 🗱 🤄 Tasks 🚼 Problems 🚺 Executables 📋 Memory 🔳 🛪 छ 🛛 Outputs on kernel-2.6.30.2 Default [C/C++ Local Application] /mnt/build/linux-2.6/vmlinux (10/12/09 5:45 PM) **QEMU** screen 51/63,∎≎,

In Eclipse, "Run→ Step over" (or F6)

- Several "Run \rightarrow Step over"s (or F6) Debug - kernel-2.6.30.2/init/main.c - Fedora Eclipse _ + X <u>File Edit Refactor Navigate Search Run Project Window Help</u> | 📸~ 🔚 🔠 🐘 | 🐅~ 🔾~ 💁 🖉 - 💷 / 셋 - 셋 - 책~ 🏷 🗘~ ↔ 🔛 🎋 Debug 🔤 🤇 🎬 □ □ (>> Variables 🛛 <u>- п</u> 🅸 Debug 🛛 💁 Breakpoints 🔐 Registers 📥 Modules 🍇 🔕 🕪 III 🔳 M 🔍 🐼 🛝 🗮 i> 😿 Site Name Value command line 0xc07ffc12 = 3 start kernel() /usr/local/src/linux-2.6.30.2/init/main.c:555 = 2 i386 start kernel() /usr/local/src/linux-2.6 30.2/arch/x86/ke - n 🚺 main.c 🖾 🗄 Outline 🕄 la . boot init stack canary(); linux/types.h cgroup init early(); 🛃 linux/module.h local irc disable(): 🛃 linux/proc fs.h early boot irgs off(); Iinux/kernel.h early init irg lock class(); 🛃 linux/syscalls.h Iinux/stackprotector.h * Interrupts are still disabled. Do necessary setups, then linux/string.h * enable them 📮 Console 🗱 🧟 Tasks 🚼 Problems 🚺 Executables 🚺 Memory 📕 🛪 छ 🛛 kernel-2.6.30.2 Default [C/C++ Local Application] /mnt/build/linux-2.6/vmlinux (10/12/09 5:45 PM)

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Outputs on QEMU screen

In Eclipse, "Run→ Step over" (or F6) – Several "Run→ Step over"s (or F6)

Debug - kernel-2.6.30.2/init/main.c - Fedora Eclipse _ + × <u>File Edit Refactor Navigate Search Run Project Window Help</u> | 📸~ 🕞 💩 🏧 🖉~ 🧟 🖉 🖉 🖉 🖉 🖉 🖓 😓 🖓 En (» 😭 🔅 Debug □ □ (>> Variables 🛛 <u>- п</u> 🕸 Debug 🛛 💁 Breakpoints 🔐 Registers 🛋 Modules 🍇 🚸 🕩 💷 M R. O. . C. Image: Second State (C/C++ Local Application) Name Value command line 0xc0951804 = 3 start kernel() /usr/local/src/linux-2.6.30.2/init/main.c:590 = 2 i386 start kernel() /usr/local/src/linux-2.6 30.2/arch/x86/ke - -🗄 Outline 🗟 Disassembly 🛛 💽 main.c 🔀 * timer interrupt). Full topology setup happens at smp init() setup per cpu areas(); * time - but meanwhile we still have a functioning scheduler. 0xc091f5e2 <start kernel+223>: sched init(); */ 0xc091f602 <start kernel+255>: sched init(); build all zonelists(); * Disable preemption - early bootup scheduling is extremely 0xc091f607 <start kernel+260>: * fracile until we cpu idle() for the first time. page alloc init(); 0xc091f60c <start kernel+265>: */ preempt disable(); printk(KERN_NOTICE "Kernel_com build all zonelists(): 0xc091f611 <start kernel+270>: pace alloc init(): 0xc091f616 <start kernel+275>: printk(KERN_NOTICE "Kernel command line: %s\n", boot command line); 0xc091f61b <start kernel+280>: narse early naram(). narse early naram(). 12 📮 Console 🔅 🔪 🧟 Tasks 🚼 Problems 🚺 Executables 🚺 Memory 🔲 🗶 🔆 🕞 🕞 🚱 📑 🖻 🗸 📑 🗸 🗖 🗖 Outputs on kernel-2.6.30.2 Default [C/C++ Local Application] /mnt/build/linux-2.6/vmlinux (10/12/09 5:45 PM) **QEMU** screen 53/63

In Eclipse, "Run→ Step over" (or F6) – Several "Run→ Step over"s (or F6)

Debug - kernel-2.6.30.2/init/main.c - Fedora Eclipse _ + X <u>Fle Edit Refactor Navigate Search Run Project Window Help</u> 🍅 🔗 🗸 🕺 월 🖓 福 🌾 🖓 🗸 😭 🐝 Debug 🔤 🤇 👋 🕸 Debug 🖾 - -□ 🗱 Variables 💥 🗣 Breakpoints 🔐 Registers 🛋 Modules 🋬 🍪 🕪 3 03 P ক্ষ ⇒te, Value Name v
 gdbserver Debugger (10/12/09 5:45 PM) (Suspended) I command line 0xc0951804 3 start kernel() /usr/local/src/linux-2.6.30.2/init/main.c:649 (= 2 i386 start kernel() /usr/local/src/linux-2.6.30.2/arch/x86/ke - H 🗄 Outline 🗟 Disassembly 🛛 🚺 main.c 🛛 initrd start = 0; 0xc091f73a <start kernel+567>: cal 0xc091f73f <start kernel+572>: cal #endif 0xc091f744 <start kernel+577>: cal 0xc091f749 <start kernel+582>: cal vmalloc init(); vfs caches init early(); 0xc091f74e <start_kernel+587>: cal 0xc091f753 <start kernel+592>: cal cpuset init early(); page cgrcup init(); 0xc091f758 <start kernel+597>: cal 0xc091f75d <start kernel+602>: mcv mem init(); 0xc091f762 <start kernel+607>: tes enable debug pagealloc(); cpu hotplug init(); 0xc091f764 <start kernel+609>: je kmem cache init(); 0xc091f766 <start kernel+611>: cal kmemtrace init(); 0xc091f768 <start kernel+613>: cal debug chiects mem init(). 0xc091f76d_cstart_kernel+618>+ cal 🗹 📕 🗶 🛬 🖳 📇 💭 🛃 🖃 🖉 🗉 Console 🛿 🔪 🧟 Tasks 🔝 Problems 🚺 Executables 📋 Memory Outputs on kernel-2.6.30.2 Default [C/C++ Local Application] /mnt/build/linux-2.6/vmlinux (10/12/09 5:45 PM) **QEMU** screen 54/63

In Eclipse, "Run→ Step over" (or F6)
 – Several "Run→ Step over"s (or F6)

QEMU [Stopped]

ACPI: INT_SRC_OVR (bus 0 bus_irg 9 global_irg 9 high level) ACPI: INT_SRC_OVR (bus 0 bus_irq 10 global_irq 10 high level) ACPI: INT_SRC_OVR (bus 0 bus_irg 11 global_irg 11 high level) Enabling APIC mode: Flat. Using 1 I/O APICs Using ACPI (MADT) for SMP configuration information SMP: Allowing 16 CPUs, 15 hotplug CPUs PM: Registered nosave memoru: 00000000009f000 – 00000000000000000 PM: Registered nosave memory: 0000000000000000 - 000000000008000 PM: Registered nosave memory: 0000000000008000 - 0000000000100000 Allocating PCI resources starting at 10000000 (gap: 8000000:f7fbc000) NR_CPUS:32 nr_cpumask_bits:32 nr_cpu_ids:16 nr_node_ids:1 PERCPU: Embedded 12 pages at c1101000, static data 27836 bytes Built 1 zonelists in Zone order, mobility grouping on. Total pages: 32399 Kernel command line: Enabling fast FPU save and restore... done. Enabling unmasked SIMD FPU exception support... done. Initializing CPU#0 NR IRQS:1280 PID hash table entries: 512 (order: 9, 2048 bytes) Fast TSC calibration failed TSC: PIT calibration matches PMTIMER, 2 loops Detected 2193.136 MHz processor. Console: colour VGA+ 80x25 console [tty0] enabled

_ X

In Eclipse, "Run→ Step over" (or F6) – Several "Run→ Step over"s (or F6)

Debug - kernel-2.6.30.2/init/main.c - Fedora Ecliose _ + X <u>File Edit Refactor Navigate Search Run Project Window Help</u> | 🗂 🖉 🔝 🐘 🔹 🔊 🖓 🖉 🥙 🥔 🖉 🖉 🖓 👘 🖉 🖓 👘 🖓 🖓 😭 🎋 Debug 🔤 🤇 🖹 □ □ (🛛 Variables 🛛 <u>- п</u> 🕸 Debug 🛛 💁 Breakpoints 🔐 Registers 🛋 Modules 🍇 🔕 🕪 🖽 2 0 0 Image: Second Science of Content in the second s Name Value command line 0xc0951804 = 3 start kernel() /usr/local/src/linux-2.6.30.2/init/main.c:654 = 2 i386 start kernel() /usr/local/src/linux-2.6 30.2/arch/x86/ke - -🗄 Outline 🗟 Disassembly 🛛 💽 main.c 🔀 0xc091f73a <start kernel+567>: cal initrd start = 0; 0xc091f73f <start kernel+572>: cal #end1f 0xc091f744 <start kernel+577>: cal 0xc091f749 <start kernel+582>: cal vmalloc init(); vfs caches init early(); 0xc091t74e <start kernel+587>: cal 0xc091f753 <start kernel+592>: cal cpuset init early(); page corcup init(); 0xc091f758 <start kernel+597>: cal 0xc091f75d <start kernel+602>: mcv mem init(); enable debug pagealloc(); 0xc091f762 <start kernel+607>: tes cpu hotpluc init(): 0xc091f764 <start kernel+609>: ie 0xc091f766 <start kernel+611>: cal kmem cache init(); kmemtrace init(); 0xc091f768 <start kernel+613>: cal debug objects mem init(). 0xc091f76d <start kernel+618> cal 🗹 📮 Console 🔅 🔪 🧟 Tasks 🚼 Problems 🚺 Executables 🚺 Memory 🔳 🗶 🔆 🕞 🕞 🚱 📑 🖻 🗸 📑 🗸 🗖 🗖 Outputs on kernel-2.6.30.2 Default [C/C++ Local Application] /mnt/build/linux-2.6/vmlinux (10/12/09 5:45 PM) **QEMU** screen 56/63

In Eclipse, "Run→ Step over" (or F6)
 – Several "Run→ Step over"s (or F6)

QEMU [Stopped] _ X Initializing CPU#0 NR IRQS:1280 PID hash table entries: 512 (order: 9, 2048 bytes) Fast TSC calibration failed TSC: PIT calibration matches PMTIMER. 2 loops Detected 2193.136 MHz processor. Console: colour VGA+ 80x25 console [tty0] enabled Dentry cache hash table entries: 16384 (order: 4, 65536 bytes) Inode-cache hash table entries: 8192 (order: 3, 32768 bytes) allocated 655040 bytes of page_cgroup please try cgroup_disable=memory option if you don't want Initializing HighMem for node O (00000000:0000000) Memoru: 121284k/131008k available (3240k kernel code, 9184k reserved, 1966k data 404k init, Ok highmem) virtual kernel memory layout: fixmap : 0xffc56000 - 0xfffff000 (3748 kB) $: 0 \times ff 800000 - 0 \times ff a00000$ pkmap (2048 kB) vmalloc : 0xc87f0000 - 0xff7fe000 (880 MB) (127 MB) lowmem : 0xc0000000 - 0xc7ff0000 .init : 0xc091f000 - 0xc0984000 (404 kB).data : 0xc072a27e - 0xc0915bb8 (1966 kB) .text : 0xc0400000 - 0xc072a27e (3240 kB) Checking if this processor honours the WP bit even in supervisor mode...Ok.

In Eclipse, "Run→ Step over" (or F6) - Several "Run \rightarrow Step over"s (or F6)

Debug - kernel-2.6.30.2/init/main.c - Fedora Eclipse <u>File Edit Refactor Navigate Search Run Project Window Help</u> 🔝 🚺 🍫 🕢 🌜 🥭 🥠 🌙 🖓 🌾 🏷 🖓 **⊳**≁ 🛛 🗠 🍄 🏇 Debua 💁 Breakpoints 🚟 Registers 🛋 Modules 参 Debug 🕄 🕪= Variables 🕴 5= A. 6 5 14 🔳 🍇 🤣 🕪 💷 kernel-2.6.30.2 Default [C/C++ Local Application] Name Value I + command line 0xc0951804 = 3 start kerneli) /usr/local/src/inux-2.6.30.2/init/main.c:690 -= 2 i386 start kernel() /usr/local/src/linux-2.6.30.2/arch/x86/ke - 8 🗈 main.c 🖾 🗄 Outline 🗟 Disassembly 🛛 0xc091f7cb <start kernel+712>: cal /* rootfs populating might need page-writeback */ page writeback init(); 0xc091f7d0 <start_kernel+717>: cal #ifdef CONFIG PROC FS 0xc091f7d5 <start kernel+722>: cal proc rcot init(); 0xc091f7da <start kernel+727>: cal 0xc091f7df <start kernel+732>: cal #endif cgroup init(); 0xc091f7e4 <start kernel+737>: cal cpuset init(); 0xc091f7e9 <start kernel+742>: cal taskstats init early(); 0xc091f7ee <start kernel+747>: cal delayacct init(); 0xc091f7f3 <start kernel+752>: cal 0xc091f7f8 <start kernel+757>: mov 0xc091f7fb <start kernel+760>: lea check bugs(); 0xc091f7fc <start kernel+761>: ret achi early init(). /* before LAPIC and SMP init */ Zasks Problems Executables Memory 🛃 🖻 v 📸 v 📑 😑 Console 🖾 Outputs on kernel-2.6.30.2 Default [C/C++ Local Application] /mnt/build/linux-2.6/vmlinux (10/12/09 5:45 PM) **QEMU** screen ₽Ŷ

In Eclipse, "Run→ Step over" (or F6)
 – Several "Run→ Step over"s (or F6)

QEMU [Stopped]						
Initializing HighMem for node 0 (00000000:0000000)						
Memory: 121284k/131008k available (3240k kernel code, 9184k reserved, 1966k data						
, 404k init, 0k highmem)						
virtual kernel memory layout:						
fixmap : 0xffc56000 - 0xfffff000 (3748 kB)						
pkmap : 0xff800000 - 0xffa00000 (2048 kB)						
vmalloc : 0xc87f0000 - 0xff7fe000 (880 MB)						
$lowmem$: $0 \times c 0000000 - 0 \times c 7 f f 0000$ (127 MB)						
$.init : 0 \times c091f 000 - 0 \times c0984000$ (404 kB)						
.data : 0xc072a27e - 0xc0915bb8 (1966 kB)						
.text : 0xc0400000 - 0xc072a27e (3240 kB)						
Checking if this processor homours the WP bit even in supervisor modeOk.						
SLUB: Genslabs=13, HWalign=32, Order=0-3, MinObjects=0, CPUs=16, Nodes=1						
Calibrating delay loop (skipped), value calculated using timer frequency 4386.						
27 BogoMIPS (1pj=2193136)						
Security Framework initialized						
SELinux: Initializing.						
Mount-cache hash table entries: 512						
Initializing cgroup subsys ns						
Initializing cgroup subsys cpuacct						
Initializing cgroup subsys memory						
Initializing cgroup subsys devices						
Initializing cgroup subsys freezer						
Initializing cgroup subsys net_cls						

14. Final QEMU screen

 After *rest_init()* run, QEMU console shows kernel panic.

- Since it doesn't have a rootfile system

/dev/zero was assigned in the initial run.

• Can add a rootfile system later.

14. Final QEMU screen

😝 Debug · kernel-2.6.30.2/init/main.c - Fedora Eclipse 📃 🔹							
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▼ 🗊 kernel-2.6.30.2 Default [C/C++ Local Application]	Name Value						
	▶						
▽ 🔊 Thread [1] (Stepping)							
🚍 3 start_kernel() /usr/local/src/inux-2.6.30.2/init/main.c:699 0							
Z i386 start kernel() /usr/local/src/linux-2.6.30.2/arch/x86/ke							
check_bugs();	excourr/co <start_kernel+ 1=""></start_kernel+> : cal						
acri carly init(), (* bafara LADIC and SMD init */	<pre>0xc091f7d5 <start_kernel+722>: cal 0xc001f7d5 <start_kernel+722>: cal</start_kernel+722></start_kernel+722></pre>						
acpi earcy init(); /* before LAPIC and SMP init */	0xc091f7df <start_kernel+732>: cat</start_kernel+732>						
<u>ftrace_init();</u>	<pre>0xc091f7e4 <start_kernel+737>: cal 0xc001f7e9 <ctart_kernel+747>: cal</ctart_kernel+747></start_kernel+737></pre>						
/* Do the rest noninit'ed, we're now alive */	0xc091f7ee <start_kernel+742>; cat</start_kernel+742>						
<pre>rest_init();</pre>	P 0xc001f7f3 <start_kernel+752>: cal 0xc001f7f9 <start_kernel+757>: mov 0xc001f7f0 <start_kernel+757>: mov 0xc001f7</start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+757></start_kernel+752>						
*	0xc091f7fb <start_kernel+760>: lea</start_kernel+760>						
int initcall_debug;	0xc091f7fc <start_kernel+761>: ret</start_kernel+761>						
⊑ Console 🛿 🖉 Tasks 🗜 Problems 🚺 Executables 🔋 Memory 🛛 🗧 🗶 📓 🚛 🚛 🖅 🖆 😭 🛃 🖉							
kernel-2 6.30.2 Default [C/C++ Local Application] /mrt/build/linux-2.6/vmlinux (10/12/09 5:45 PM)							
] П*							

14. Final QEMU screen



15. End

- Now, you have an environment to debug Linux Kernel source code.
- All the credits go to Takis Blog.
 - <u>http://issaris.blogspot.com/2007/12/download-</u> <u>linux-kernel-sourcecode-from.html</u>

Thank you.