

東京 2025

LINUX PLUMBERS CONFERENCE

TOKYO, JAPAN / DECEMBER 11-13, 2025



Build System Analysis for Kernel Development and Customization

Overview – Methodology

- Fedora – Buildroot – Yocto Project
- Initial Build & Test
- “Vendor” vs Vanilla / Local sources
- Customize Code
- Customize Config
- Test

Fedora

Fedora - Setup

```
$ sudo dnf install fedpkg  
  
$ fedpkg clone -a kernel  
    Cloning into 'kernel'...  
    remote: Enumerating objects: 111341, done.  
    remote: Counting objects: 100% (26794/26794), done.  
    remote: Compressing objects: 100% (6136/6136), done.  
  
$ cd kernel && sudo dnf builddep kernel.spec  
  
$ fedpkg --release f43 local
```

Fedora - Setup

```
ls -ln x86_64/

total 5386600

-rw-r--r-- 1 1000 1000      227629 Nov 29 22:24 kernel-6.18.0-0.rc7.251129g19eef1d98eed.63.fc43.x86_64.rpm
-rw-r--r-- 1 1000 1000  20565073 Nov 29 22:24 kernel-core-6.18.0-0.rc7.251129g19eef1d98eed.63.fc43.x86_64.rpm
-rw-r--r-- 1 1000 1000  21027357 Nov 29 22:24 kernel-devel-6.18.0-0.rc7.251129g19eef1d98eed.63.fc43.x86_64.rpm
-rw-r--r-- 1 1000 1000   227497 Nov 29 22:24 kernel-devel-matched-6.18.0-0.rc7.251129g19eef1d98eed.63.fc43.x86_64.rpm
-rw-r--r-- 1 1000 1000 102566873 Nov 29 22:24 kernel-modules-6.18.0-0.rc7.251129g19eef1d98eed.63.fc43.x86_64.rpm
-rw-r--r-- 1 1000 1000   72644045 Nov 29 22:24 kernel-modules-core-6.18.0-0.rc7.251129g19eef1d98eed.63.fc43.x86_64.rpm
-rw-r--r-- 1 1000 1000   4695481 Nov 29 22:24 kernel-modules-extra-6.18.0-0.rc7.251129g19eef1d98eed.63.fc43.x86_64.rpm
```

Fedora – Local Sources / Vanilla

```
$ sudo dnf install rpmdevtools ncurses-devel make gcc bc openssl-devel elfutils-libelf-  
devel bison flex dwarves perl-core rsync  
  
$ git clone https://git.kernel.org/pub/scm/linux/kernel/git/stable/linux.git  
  
$ make olddefconfig  
  
$ make -j$(nproc) rpm-pkg  
  
$ ls -ln rpmbuild/RPMS/x86_64/kernel-*  
  
-rw-r--r-- 1 1000 1000 131165883 Nov 30 00:01 rpmbuild/RPMS/x86_64/kernel-6.17.8_alhe_custom+-3.x86_64.rpm  
  
-rw-r--r-- 1 1000 1000 10416516 Nov 29 23:57 rpmbuild/RPMS/x86_64/kernel-devel-6.17.8_alhe_custom+-3.x86_64.rpm  
  
-rw-r--r-- 1 1000 1000 1606803 Nov 29 23:56 rpmbuild/RPMS/x86_64/kernel-headers-6.17.8_alhe_custom+-3.x86_64.rpm
```

Fedora – Custom Patches

```
Subject: [PATCH] init: Add custom patch for Linux Plumbers

Signed-off-by: Alejandro Hernandez <alhe@linux.microsoft.com>

---
init/Makefile | 2 ++
init/plumbers.c | 10 ++++++++
2 files changed, 12 insertions(+)
create mode 100644 init/plumbers.c

diff --git a/init/Makefile b/init/Makefile
index cbac576c57d6..f7137b00f360 100644
--- a/init/Makefile
+++ b/init/Makefile
@@ -15,6 +15,8 @@ obj-$(CONFIG_GENERIC_CALIBRATE_DELAY) += calibrate.o

obj-y += init_task.o

+obj-y += plumbers.o
+
mounts-y := do_mounts.o
mounts-$(CONFIG_BLK_DEV_RAM) += do_mounts_rd.o
mounts-$(CONFIG_BLK_DEV_INITRD) += do_mounts_initrd.o
diff --git a/init/plumbers.c b/init/plumbers.c
new file mode 100644
index 000000000000..4e8ba834cbb2
--- /dev/null
+++ b/init/plumbers.c
@@ -0,0 +1,10 @@
+#include <linux/init.h>
+#include <linux/kernel.h>
+
+static int __init plumbers_init(void)
+{
+    pr_info("Plumbers init\n");
+    return 0;
+}
+
+early_initcall(plumbers_init);
```



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```
Subject: [PATCH 2/2] misc: Add Plumbers sample module

Signed-off-by: Alejandro Hernandez <alhe@linux.microsoft.com>

---
drivers/misc/Kconfig | 8 ++++++
drivers/misc/Makefile | 1 +
drivers/misc/plumbers_module.c | 21 ++++++++++++++++++++++
3 files changed, 30 insertions(+)
create mode 100644 drivers/misc/plumbers_module.c

diff --git a/drivers/misc/Kconfig b/drivers/misc/Kconfig
index 3fe7e2a9bd29..b8a690defdf5 100644
--- a/drivers/misc/Kconfig
+++ b/drivers/misc/Kconfig
@@ -610,6 +610,14 @@ config MARVELL_CN10K_DPI
    To compile this driver as a module, choose M here: the module
    will be called mrvl_cn10k_dpi.

+
+config PLUMBERS_CFG
+    tristate "Plumbers test module"
+    default n
+    help
+        Say Y/M to build a simple test module that logs messages at
+        init/exit. Choose M to build it as a loadable module (plumbers.ko).
+
source "drivers/misc/c2port/Kconfig"
source "drivers/misc/eeeprom/Kconfig"
source "drivers/misc/cb710/Kconfig"
diff --git a/drivers/misc/Makefile b/drivers/misc/Makefile
index a9f94525e181..208d494955db 100644
--- a/drivers/misc/Makefile
+++ b/drivers/misc/Makefile
@@ -72,3 +72,4 @@ obj-$(CONFIG_TPS6594_PFSM) += tps6594-pfsm.o
obj-$(CONFIG_NSM) += nsm.o
obj-$(CONFIG_MARVELL_CN10K_DPI) += mrvl_cn10k_dpi.o
obj-y += keba/
+obj-$(CONFIG_PLUMBERS_CFG) += plumbers_module.o
diff --git a/drivers/misc/plumbers_module.c b/drivers/misc/plumbers_module.c
```

Fedora – Custom Patches

- Fedora Kernel

```
diff --git a/kernel.spec b/kernel.spec
index cc8c07d19..f64399923 100644
--- a/kernel.spec
+++ b/kernel.spec
@@ -1167,8 +1168,12 @@ Patch1: patch-%{patchversion}-redhat.patch
%endif

# empty final patch to facilitate testing of kernel patches
+Patch999999: 0001-init-Add-custom-patch-for-Linux-Plumbers.patch
+Patch999999: 0002-misc-Add-Plumbers-sample-module.patch
Patch999999: linux-kernel-test.patch
+
# END OF PATCH DEFINITIONS

%description
@@ -2016,6 +2021,8 @@ ApplyOptionalPatch patch-%{patchversion}-redhat.patch
%endif

ApplyOptionalPatch linux-kernel-test.patch
+ApplyOptionalPatch 0001-init-Add-custom-patch-for-Linux-Plumbers.patch
+ApplyOptionalPatch 0002-misc-Add-Plumbers-sample-module.patch
```

Fedora – Custom Configs

```
scripts/config --disable EFI_SBAT_DATAFILE  
scripts/config --disable CONFIG_EFI_SBAT_FILE  
scripts/config --disable CONFIG_EFI_SBAT
```

```
# scripts/kconfig/merge_config.sh .config kernel/configs/plumbers.cfg  
Using .config as base  
Merging kernel/configs/plumbers.cfg  
Value of CONFIG_PLUMBERS_CFG is redefined by fragment kernel/configs/plumbers.cfg:  
Previous value: # CONFIG_PLUMBERS_CFG is not set  
New value: CONFIG_PLUMBERS_CFG=m  
# configuration written to .config
```



Fedora – Custom Configs

```
$ make ARCH=x86_64 plumbers.config olddefconfig  
Using .config as base  
Merging ./kernel/configs/plumbers.config  
Value of CONFIG_PLUMBERS_CFG is redefined by fragment ./kernel/configs/plumbers.config:  
Previous value: # CONFIG_PLUMBERS_CFG is not set  
New value: CONFIG_PLUMBERS_CFG=m  
# merged configuration written to .config (needs make)
```

- Make doesn't need path, but needs .config extension

Fedora – Test

```
$ dnf install kernel-6.17.8_alhe_custom+-3.x86_64.rpm ...
```

- Reboot
- Alternatives:
 - VM
 - QEMU + Rootfs (e.g. docker)

```
qemu-system-x86_64 -kernel vmlinux -append "root=/dev/sda console=ttyS0" -hda rootfs.img -nographic
```

```
sh-5.3# uname -ar
Linux (none) 6.17.8-alhe-custom+ #3 SMP PREEMPT_DYNAMIC Sat Nov 29 23:49:47
sh-5.3# dmesg | grep Plumbers
[    1.278419] Plumbers init
sh-5.3#
```

Buildroot

Buildroot Initial Build

```
> git clone https://gitlab.com/buildroot.org/buildroot.git
Cloning into 'buildroot'...
remote: Enumerating objects: 605383, done.
remote: Counting objects: 100% (403/403), done.
remote: Compressing objects: 100% (304/304), done.
remote: Total 605383 (delta 177), reused 210 (delta 91), pa
Receiving objects: 100% (605383/605383), 141.86 MiB | 42.09
Resolving deltas: 100% (430262/430262), done.
```

```
/mnt/builds
> cd buildroot
```

```
/mnt/builds/buildroot | master
> git checkout 2025.08.x
Switched to branch '2025.08.x'
Your branch is up to date with 'origin/2025.08.x'.
```

```
/mnt/builds/buildroot | 2025.08.x
> make qemu_aarch64_virt_defconfig
#
# configuration written to /mnt/builds/buildroot/.config
#
```

- [buildroot / buildroot · GitLab](https://gitlab.com/buildroot.org/buildroot)
- Kernel build needs to be enabled
- Set a defconfig
- make

Buildroot Initial Build

```
Buildroot 2025.08.2 Configuration
Target options --->
Toolchain --->
Build options --->
System configuration --->
Kernel --->
Target packages --->
Filesystem images --->
Bootloaders --->
Host utilities --->
Legacy config options --->
```

```
Kernel
[ ] Linux Kernel
```

```
Kernel
[*] Linux Kernel
    Kernel version (Latest version (6.16))
    ( ) Custom kernel patches (NEW)
    Kernel configuration (Using an in-tree d
    ( ) Defconfig name (NEW)
    ( ) Additional configuration fragment fi
    ( ) Custom boot logo file path (NEW)
    Kernel binary format (bzImage) --->
```

Buildroot Initial Build

- make menuconfig
- make linux

```
> make nconfig  
  
/mnt/builds/buildroot | 2025.08.x  
> make  
/usr/bin/make -j1 O=/mnt/builds/buildroot/output HOSTCC="/usr/bin/gcc"
```

```
Creating filesystem with 61440 1k blocks and 15360 inodes  
Filesystem UUID: d49ec582-ae0b-49fb-8c51-1b0220f96269  
Superblock backups stored on blocks:  
    8193, 24577, 40961, 57345  
  
Allocating group tables: done  
Writing inode tables: done  
Creating journal (4096 blocks): done  
Copying files into the device: done  
Writing superblocks and filesystem accounting information: done  
  
ln -sf rootfs.ext2 /mnt/builds/buildroot/output/images/rootfs.ext4  
ln -snf /mnt/builds/buildroot/output/host/aarch64-buildroot-linux-gnu/sysroot  
>>> Executing post-image script board/qemu/post-image.sh
```

```
> ls -lh output/images/  
total 21M  
-rw-r--r-- 1 azureuser azureuser 13M Nov 27 20:17 Image  
-rw-r--r-- 1 azureuser azureuser 60M Nov 27 20:17 rootfs.ext2  
lrwxrwxrwx 1 azureuser azureuser 11 Nov 27 20:17 rootfs.ext4 -> rootfs.ext2  
-rwxr-xr-x 1 azureuser azureuser 822 Nov 27 20:17 start-qemu.sh
```



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Buildroot Initial Build - Test

```
> output/images/start-qemu.sh
Booting Linux on physical CPU 0x000000000000 [0x410fd034]
Linux version 6.12.47 (azureuser@alhe-dev-ub) (aarch64-buildroot-linux-gnu-gcc
random: crng init done
Machine model: linux,dummy-virt
efi: UEFI not found.
OF: reserved mem: Reserved memory: No reserved-memory node in the DT
Zone ranges:
```

```
Starting network: udhcpd: started, v1.37.0
udhcpd: broadcasting discover
udhcpd: broadcasting select for 10.0.2.15, server 10.0.2.2
udhcpd: lease of 10.0.2.15 obtained from 10.0.2.2, lease time 86400
deleting routers
adding dns 10.0.2.3
OK
Starting crond: OK

Welcome to Buildroot
buildroot login: root
# uname -ar
Linux buildroot 6.12.47 #1 SMP Thu Nov 27 20:17:27 UTC 2025 aarch64 GNU/Linux
#
```

- start-qemu.sh is created automatically by buildroot

Buildroot – Custom patches

```
> cat local.mk
BR2_LINUX_KERNEL=y
BR2_GLOBAL_PATCH_DIR="/mnt/builds/buildroot/output/patches"

BR2_LINUX_KERNEL_PATCH="0001-init-Add-custom-patch-for-Linux-Plumbers.patch \
0002-misc-Add-Plumbers-sample-module.patch"
```

```
> ls -l output/patches
total 8
-rw-rw-r-- 1 azureuser azureuser 1192 Nov 27 20:45 0001-init-Add-custom-patch-for-Linux-Plumbers.patch
-rw-rw-r-- 1 azureuser azureuser 2185 Nov 27 20:45 0002-misc-Add-Plumbers-sample-module.patch
```

- Specify patch directory
- Fails silently if files are not present
- Patches cannot be applied to a local repo

Buildroot – Custom patches

- make linux-dirclean
- make linux-rebuild

```
linux-6.12.47.tar.xz: OK (sha256: e82fe40871743048226987bd349ef107168b15aa
>>> linux-headers 6.12.47 Extracting
xzcat /mnt/builds/buildroot/dl/linux/linux-6.12.47.tar.xz | /mnt/builds/bu
>>> linux-headers 6.12.47 Patching
for p in board/qemu/patches/linux ; do if test -d $p ; then TAR="/mnt/buil
ild/linux-headers-6.12.47 $p \*.patch || exit 1 ; else TAR="/mnt/builds/bu
linux-headers-6.12.47 `dirname $p` `basename $p` || exit 1; fi done

Applying 0001-init-Add-custom-patch-for-Linux-Plumbers.patch using patch:
patching file init/Makefile
patching file init/plumbers.c

Applying 0002-misc-Add-Plumbers-sample-module.patch using patch:
patching file drivers/misc/Kconfig
patching file drivers/misc/Makefile
patching file drivers/misc/plumbers_module.c
>>> linux-headers 6.12.47 Configuring
```

```
Welcome to Buildroot
buildroot login: root
# uname -ar
Linux buildroot 6.12.47 #1 SMP Thu Nov 27 21:28:39 UTC 2025 aarch64 GNU/Linux
# dmesg | grep Plumbers
Plumbers init
# █
```

Buildroot – Kernel Config

```
Linux/arm64 6.12.47 Kernel Configuration
Arrow keys navigate the menu. <Enter> selects submenus --->
(or empty submenus ----). Highlighted letters are hotkeys.
Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help, </> for

General setup --->
Platform selection --->
Kernel Features --->
Boot options --->
Power management options --->
CPU Power Management --->
[*] ACPI (Advanced Configuration and Power Interface) Su
[ ] Virtualization ----
General architecture-dependent options --->
[*] Enable loadable module support --->
-* Enable the block layer --->
Executable file formats --->
↓(+)
```

- make linux-menuconfig

```
Device Drivers → Misc devices --->
Misc devices
Arrow keys navigate the menu. <Enter> selects submenus --->
(or empty submenus ----). Highlighted letters are hotkeys.
Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help, </> for

↑(-)
< > Nitro (Enclaves) Security Module support
<M> Plumbers test module
< > Silicon Labs C2 port support ----
EEPROM support --->
< > ENE CB710/720 Flash memory card reader support
Texas Instruments shared transport line discipline
< > STMicroelectronics LIS2LV02DL three-axis digital accelerometer
```

Buildroot – Kernel Config

```
> cat local.mk  
BR2_LINUX_KERNEL_CONFIG_FRAGMENT_FILES = /mnt/builds/buildroot/output-qemuarm64/kernel-cfg/plumbers.cfg
```

```
> cat kernel-cfg/plumbers.cfg  
CONFIG_PLUMBERS_CFG=m
```

```
> grep PLUMBERS build/linux-custom/.config  
CONFIG_PLUMBERS_CFG=m
```

- Needs absolute path
- make linux-rebuild

Buildroot – Local Sources

```
> cat local.mk
LINUX_OVERRIDE_SRCDIR = /mnt/builds/plumbers/buildroot-kernel
BR2_LINUX_KERNEL_CUSTOM_VERSION_VALUE = $(shell make -sC $(LINUX_OVERRIDE_SRCDIR) kernelversion)
BR2_LINUX_KERNEL_VERSION = $(BR2_LINUX_KERNEL_CUSTOM_VERSION_VALUE)
BR2_KERNEL_HEADERS_AS_KERNEL = y
BR2_TOOLCHAIN_HEADERS_AT_LEAST="6.16"
BR2_LINUX_KERNEL_CONFIG_FRAGMENT_FILES = /mnt/builds/buildroot/output-qemuarm64/kernel-cfg/plumbers.cfg
```

- Does not detect kernel version from repo
- If rebuilding, headers wont match – make **linux-headers-dirclean**

```
>>> linux custom Installing to target
# Install modules and remove symbolic links pointing to build
# directories, not relevant on the target
INSTALL /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/modules.order
INSTALL /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/modules.builtin
INSTALL /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/modules.builtin.modinfo
SYMLINK /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/build
INSTALL /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/kernel/fs/efivarfs/efivarfs.ko
STRIP /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/kernel/fs/efivarfs/efivarfs.ko
INSTALL /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/kernel/drivers/misc/plumbers_module.ko
STRIP /mnt/builds/buildroot/output-qemuarm64/target/lib/modules/6.16.12/kernel/drivers/misc/plumbers_module.ko
```



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Buildroot – Test

- `start-qemu.sh`

```
Welcome to Buildroot
buildroot login: root
# uname -ar
Linux buildroot 6.16.12 #1 SMP Fri Nov 28 05:31:58 UTC 2025 aarch64 GNU/Linux
# dmesg | grep Plumbers
Plumbers init
# modprobe plumbers_module
Plumbers module: plumbers_init
# rmmod plumbers_module
Plumbers module: plumbers_exit
# dmesg | grep Plumbers
Plumbers init
Plumbers module: plumbers_init
Plumbers module: plumbers_exit
```

Yocto Project / OpenEmbedded

Yocto Project - Setup

```
/mnt/builds
> git clone https://git.yoctoproject.org/poky
Cloning into 'poky'...
remote: Enumerating objects: 709198, done.
remote: Counting objects: 100% (662/662), done.
remote: Compressing objects: 100% (391/391), done.
remote: Total 709198 (delta 421), reused 379 (delta 271), pack-reused 708536
Receiving objects: 100% (709198/709198), 221.64 MiB | 43.91 MiB/s, done.
Resolving deltas: 100% (516111/516111), done.

/mnt/builds
> cd poky

/mnt/builds/poky | master
> git checkout scarthgap
branch 'scarthgap' set up to track 'origin/scarthgap'.
Switched to a new branch 'scarthgap'
```

- Scarthgap = LTS (2024)

Yocto Project - Setup

```
/mnt/builds/poky | scarthgap ?1
> source oe-init-build-env build
This is the default build configuration for the Poky reference distribution.

### Shell environment set up for builds. ###

You can now run 'bitbake <target>'

Common targets are:
  core-image-minimal
  core-image-full-cmdline
```

```
/mnt/builds/poky/build | scarthgap ?1
> bitbake core-image-minimal
Loading cache: 100% |#####
Loaded 1879 entries from dependency cache.
Parsing recipes: 100% |#####
Parsing of 922 .bb files complete (921 cached, 1 parsed). 1880 targets, 59 skipped
Removing 2 recipes from the x86_64 sysroot: 100% |#####
NOTE: Resolving any missing task queue dependencies

Build Configuration:
BB_VERSION           = "2.8.1"
BUILD_SYS            = "x86_64-linux"
NATIVELSBSTRING      = "universal"
TARGET_SYS           = "aarch64-poky-linux"
MACHINE              = "qemuarm64"
DISTRO               = "poky"
```

- bitbake linux-yocto

Yocto Project – Test

```
> runqemu nographic
runqemu - INFO - Running bitbake -e ...
runqemu - INFO - Continuing with the following parameters:
KERNEL: [/mnt/builds/poky/build/tmp/deploy/images/qemuarm64/Image]
MACHINE: [qemuarm64]
FSTYPE: [ext4]
ROOTFS: [/mnt/builds/poky/build/tmp/deploy/images/qemuarm64/core-image-minimal-qemuarm64.rootfs]
CONFFILE: [/mnt/builds/poky/build/tmp/deploy/images/qemuarm64/core-image-minimal-qemuarm64.conf]

runqemu - INFO - Using preconfigured tap device tap0
runqemu - INFO - If this is not intended, touch /tmp/qemu-tap-locks/tap0.skip to make runqemu
runqemu - INFO - Network configuration: ip=192.168.7.2::192.168.7.1:255.255.255.0::eth0:off:8.8.8.8
runqemu - INFO - Running /mnt/builds/poky/build/tmp/work/x86_64-linux/qemu-helper-native/1.0/recipe-sources/
=no -object rng-random,filename=/dev/urandom,id=rng0 -device virtio-rng-pci,rng=rng0 -drive id=
ci,drive=disk0 -device qemu-xhci -device usb-tablet -device usb-kbd -machine virt -cpu cortex
root=/dev/vda rw mem=256M ip=192.168.7.2::192.168.7.1:255.255.255.0::eth0:off:8.8.8.8 net.ifn

runqemu - INFO - Host uptime: 15418627.88

[ 0.000000] Booting Linux on physical CPU 0x000000000000 [0x411fd070]
[ 0.000000] Linux version 6.6.111-yocto-standard (oe-user@oe-host) (aarch64-poky-linux-gcc
[ 0.000000] random: crng init done
```

- runqemu grabs correct values automatically

```
Poky (Yocto Project Reference Distro) 5.0.14 qemuarm64 /dev/ttyAMA0
```

```
qemuarm64 login: root
```

```
WARNING: Poky is a reference Yocto Project distribution that should be used for
testing and development purposes only. It is recommended that you create your
own distribution for production use.
```

```
root@qemuarm64:~# uname -ar
Linux qemuarm64 6.6.111-yocto-standard #1 SMP PREEMPT Wed Nov 26 08:35:00 UTC 2025 aarch64
root@qemuarm64:~#
```



Yocto Project – Local Sources

- `PREFERRED_PROVIDER_linux-yocto = "linux-yocto-upstream"`

```
commit 655054d2c3c184875f95646abd828b5dfc027d5e (HEAD -> v6.6/base, tag: v6.6.111)
Author: Greg Kroah-Hartman <gregkh@linuxfoundation.org>
Date:   Sun Oct 12 12:56:23 2025 +0200

    Linux 6.6.111

    Link: https://lore.kernel.org/r/20251010131330.355311487@linuxfoundation.org
    Tested-by: Jon Hunter <jonathanh@nvidia.com>
    Tested-by: Shuah Khan <skhan@linuxfoundation.org>
    Tested-by: Linux Kernel Functional Testing <lkft@linaro.org>
    Tested-by: Mark Brown <broonie@kernel.org>
    Tested-by: Ron Economos <re@w6rz.net>
    Tested-by: Brett A C Sheffield <bacs@librecast.net>
    Tested-by: Peter Schneider <pschneider1968@gmail.com>
    Tested-by: Miguel Ojeda <ojeda@kernel.org>
    Signed-off-by: Greg Kroah-Hartman <gregkh@linuxfoundation.org>
```

- Vanilla -stable
- Same version as linux-yocto
- Yocto Kernel-meta enabled

Yocto Project – Local Sources

- devtool modify linux-yocto

```
INFO: Copying kernel config to src tree
INFO: Source tree extracted to /mnt/builds/poky/build/workspace/sources/linux-yocto
INFO: Recipe linux-yocto now set up to build from /mnt/builds/poky/build/workspace/sources/linux-yocto
```

```
/mnt/builds/poky/build | scarthgap ?1
> ls -l workspace/sources/linux-yocto
total 1004
drwxr-xr-x 24 azureuser azureuser 4096 Nov 28 07:06 arch
drwxr-xr-x 3 azureuser azureuser 4096 Nov 28 07:06 block
drwxr-xr-x 2 azureuser azureuser 4096 Nov 28 07:06 certs
-rw-r--r-- 2 azureuser azureuser 496 Nov 28 07:06 COPYING
-rw-r--r-- 2 azureuser azureuser 102435 Nov 28 07:06 CREDITS
drwxr-xr-x 4 azureuser azureuser 4096 Nov 28 07:06 crypto
drwxr-xr-x 76 azureuser azureuser 4096 Nov 28 07:06 Documentation
drwxr-xr-x 143 azureuser azureuser 4096 Nov 28 07:07 drivers
```

```
/mnt/builds/poky/build | scarthgap ?1
> ls -l workspace/append
total 4
-rw-rw-r-- 1 azureuser azureuser 1104 Nov 28 07:14 linux-yocto_6.6.bbappend
```

- devtool is one supported flow, but there are more

Yocto Project – Custom Patches

```
> cd workspace/sources/linux-yocto  
/mnt/builds/poky/build/workspace/sources/linux-yocto | v6.6/standard/qemuarm64
```

```
commit febe90b324e198ebfb57fdcafe371c5fcbd80ec (HEAD -> plumbers-yocto)  
Author: Alejandro Hernandez <alhe@linux.microsoft.com>  
Date:   Wed Nov 26 08:35:00 2025 +0000  
  
    misc: Add Plumbers sample module  
  
Signed-off-by: Alejandro Hernandez <alhe@linux.microsoft.com>  
  
commit 084c128999a7c9a506c43cb57e6b9238d97c7aa8  
Author: Alejandro Hernandez <alhe@linux.microsoft.com>  
Date:   Sat Nov 22 19:14:17 2025 +0000  
  
    init: Add custom patch for Linux Plumbers  
  
Signed-off-by: Alejandro Hernandez <alhe@linux.microsoft.com>  
  
commit cdd229fbaaa25d5d9eb055477af8c2b82238763b (tag: devtool-patched, tag: devtool-base)  
Merge: 0974351ebdd7 2a17dc587afe  
Author: Bruce Ashfield <bruce.ashfield@gmail.com>
```

Yocto Project – Kernel Config

- devtool menuconfig linux-yocto

```
Linux/arm64 6.6.111 Kernel Configuration
Arrow keys navigate the menu. <Enter> selects submenus --->
(or empty submenus ----). Highlighted letters are hotkeys.
Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help, </> for

General setup --->
Platform selection --->
Kernel Features --->
Boot options --->
Power management options --->
CPU Power Management --->
```

```
Misc devices
Arrow keys navigate the menu. <Enter> selects submenus --->
(or empty submenus ----). Highlighted letters are hotkeys.
Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help, </> for

<M> Plumbers test module
< > Analog Devices Digital Potentiometers
< > Dummy IRQ handler
< > Sensable PHANToM (PCI)
```

- bitbake linux-yocto -c menuconfig

Yocto Project – Kernel Config

- `devtool menuconfig linux-yocto`

```
Changed configuration saved at:  
/mnt/builds/poky/build/tmp/work/qemuarm64-poky-linux/linux-yocto/6.6.111+git/linux-yocto-6.6.111+git/.config  
Recompile will be forced  
NOTE: Tasks Summary: Attempted 748 tasks of which 747 didn't need to be rerun and all succeeded.  
INFO: Updating config fragment /mnt/builds/poky/build/workspace/sources/linux-yocto/oe-local-files/devtool-fragment.cfg
```

```
> cat /mnt/builds/poky/build/workspace/sources/linux-yocto/oe-local-files/devtool-fragment.cfg  
CONFIG_PLUMBERS_CFG=m
```

- `devtool-fragment.cfg` is automatically created

Yocto Project – Kernel Meta

- SCCs
 - BSP
 - KTYPE e.g. tiny, standard, preempt-rt
 - Patches
- cfg fragments
- Dependencies on features
- KERNEL_FEATURES:qemuall += "cfg/virtio.scc"
- SRC_URI += "fragment.cfg"

```
> cat features/i2c/i2cdev.scc
# SPDX-License-Identifier: MIT
define KFEATURE_DESCRIPTION "Enable userspace I2C access"
define KFEATURE_COMPATIBILITY board

include i2c.scc
kconf hardware i2cdev.cfg
```

<https://git.yoctoproject.org/yocto-kernel-cache>

Yocto Project – Iterate

- `devtool build-image core-image-minimal || devtool build linux-yocto`

```
NOTE: linux-yocto: compiling from external source tree /mnt/builds/poky/build/workspace/sources/linux-yocto
NOTE: Tasks Summary: Attempted 4044 tasks of which 4013 didn't need to be rerun and all succeeded.

Summary: There was 1 WARNING message.
INFO: Successfully built core-image-minimal. You can find output files in /mnt/builds/poky/build/tmp/deploym
/mnt/builds/poky/build | scarthgap ?1
> ls -l tmp/deploym/images/qemuarm64/Image
lrwxrwxrwx 2 azureuser azureuser 62 Nov 28 08:10 tmp/deploym/images/qemuarm64/Image -> Image--6.6.111+git0+5053
```

- `runqemu`

```
Poky (Yocto Project Reference Distro) 5.0.14 qemuarm64 /dev/ttyAMA0

qemuarm64 login: root

WARNING: Poky is a reference Yocto Project distribution that should be used for
testing and development purposes only. It is recommended that you create your
own distribution for production use.

root@qemuarm64:~# uname -ar
Linux qemuarm64 6.6.111-yocto-standard #1 SMP PREEMPT Fri Nov 28 07:46:54 UTC 2025 aarch64 GNU/Linux
root@qemuarm64:~# dmesg | grep Plumbers
[ 0.071033] Plumbers init
root@qemuarm64:~# modprobe plumbers_module
[ 27.774129] Plumbers module: plumbers_init
root@qemuarm64:~# rmmod plumbers_module
[ 34.576696] Plumbers module: plumbers_exit
root@qemuarm64:~# dmesg | grep Plumbers
[ 0.071033] Plumbers init
[ 27.774129] Plumbers module: plumbers_init
[ 34.576696] Plumbers module: plumbers_exit
```



Yocto Project – Devtool finish

- devtool finish meta-plumbers

```
INFO: Would remove config fragment /tmp/devtooljgri4wqw/tmp1edbjq0s/devtool-fragment.cfg
INFO: Removing config fragment /tmp/devtooljgri4wqw/tmp1edbjq0s/devtool-fragment.cfg
NOTE: Writing append file /mnt/builds/poky/meta-plumbers/recipes-kernel/linux/linux-yocto_%.bbappend
NOTE: Copying 0001-init-Add-custom-patch-for-Linux-Plumbers.patch to /mnt/builds/poky/meta-plumbers/recipes-kernel/linux/linux-yocto_%.bbappend
NOTE: Copying 0002-misc-Add-Plumbers-sample-module.patch to /mnt/builds/poky/meta-plumbers/recipes-kernel/linux/linux-yocto_%.bbappend
INFO: Cleaning sysroot for recipe linux-yocto...
WARNING: Preserving 0002-misc-Add-Plumbers-sample-module.patch in /mnt/builds/poky/build/workspace/attic/linux-yocto/0002-misc-Add-Plumbers-sample-module.patch
WARNING: Preserving 0001-init-Add-custom-patch-for-Linux-Plumbers.patch in /mnt/builds/poky/build/workspace/attic/linux-yocto/0001-init-Add-custom-patch-for-Linux-Plumbers.patch
WARNING: Preserving plumbers.cfg in /mnt/builds/poky/build/workspace/attic/linux-yocto/linux-yocto-plumbers.cfg
INFO: Preserving source tree in /mnt/builds/poky/build/workspace/attic/sources/linux-yocto.20251128065054
If you no longer need it then please delete it manually.
It is also possible to reuse it via devtool source tree argument.
```

Yocto Project – Devtool finish

```
/mnt/builds/poky/build | scarthgap ?1
> ls -l ../meta-plumbers/recipes-kernel/linux
total 8
drwxrwxr-x 2 azureuser azureuser 4096 Nov 28 06:50 linux-yocto
-rw-rw-r-- 1 azureuser azureuser 179 Nov 28 06:53 linux-yocto_%.bbappend

/mnt/builds/poky/build | scarthgap ?1
> ls -l ../meta-plumbers/recipes-kernel/linux/linux-yocto
total 8
-rw-rw-r-- 1 azureuser azureuser 1176 Nov 28 06:50 0001-init-Add-custom-patch-for-Linux-Plumbers.patch
-rw-rw-r-- 1 azureuser azureuser 2039 Nov 28 06:50 0002-misc-Add-Plumbers-sample-module.patch

/mnt/builds/poky/build | scarthgap ?1
> batcat ../meta-plumbers/recipes-kernel/linux/linux-yocto_%.bbappend -l python
```

	File: ../meta-plumbers/recipes-kernel/linux/linux-yocto_%.bbappend
1	FILESEXTRAPATHS:prepend := "\${THISDIR}/\${PN}:"
2	
3	SRC_URI += " \
4	file://0001-init-Add-custom-patch-for-Linux-Plumbers.patch \
5	file://0002-misc-Add-Plumbers-sample-module.patch \
6	"
7	

- Patches applied
- No longer building from workspace

Yocto Project – Out-of-tree Modules

```
File: ../meta-skeleton/recipes-kernel/hello-mod/hello-mod_0.1.bb

SUMMARY = "Example of how to build an external Linux kernel module"
DESCRIPTION = "${SUMMARY}"
LICENSE = "GPL-2.0-only"
LIC_FILES_CHKSUM = "file://COPYING;md5=12f884d2ae1ff87c09e5b7ccc2c4ca7e"

inherit module

SRC_URI = "file://Makefile \
          file://hello.c \
          file://COPYING \
          "

S = "${WORKDIR}"

# The inherit of module.bbclass will automatically name module packages with
# "kernel-module-" prefix as required by the oe-core build environment.

RPROVIDES:${PN} += "kernel-module-hello"
```

```
File: ../meta-skeleton/recipes-kernel/hello-mod/files/Makefile

obj-m := hello.o

SRC := $(shell pwd)

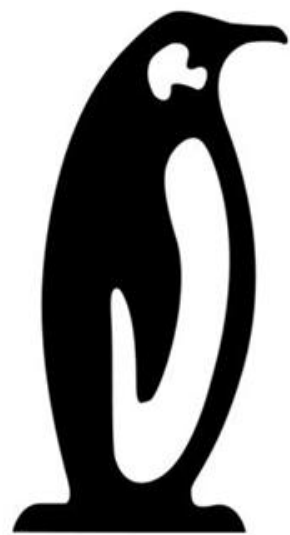
all:
    $(MAKE) -C $(KERNEL_SRC) M=$(SRC)

modules_install:
    $(MAKE) -C $(KERNEL_SRC) M=$(SRC) modules_install
```

Which kernel dev flow is most useful to you?

- Vanilla is widely used
- Buildroot migration is simple due to make/kconf familiarity
- Yocto Project has more features





東京 2025

LINUX PLUMBERS CONFERENCE

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