Typical mistakes when submitting a new code to Linux kernel

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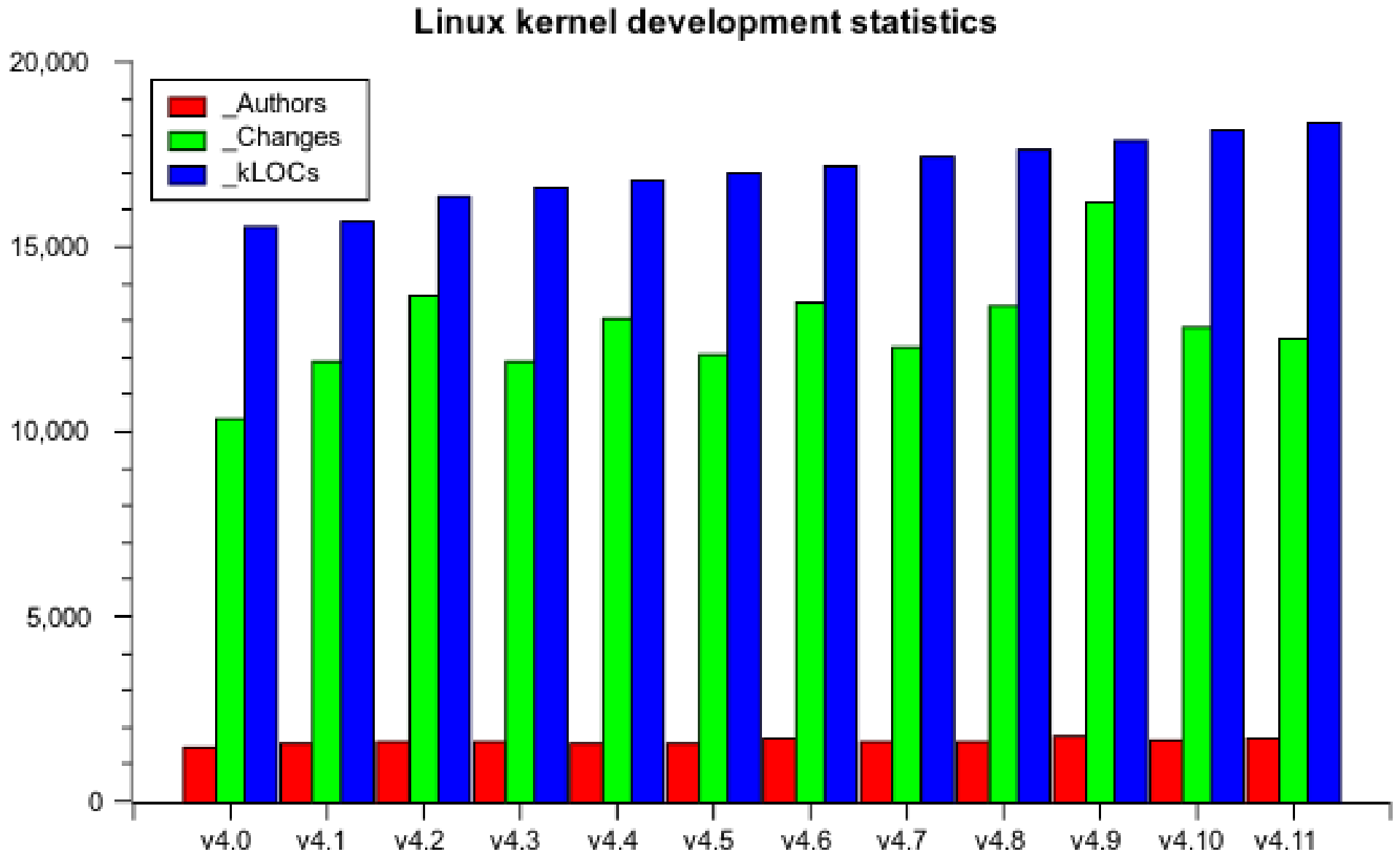
Agenda

- Linux kernel is growing
- Managed Device Resources
- Unified Device Properties
- Special extensions of %p
- Perfect is the enemy of the good enough
- Recommendations how to prepare changes to Linux kernel
- Q&A

Linux is growing

Introduction or Linux is growing


Linux kernel development statistics
20,000
15,000
10,000
5,000
0
_Authors
_Changes
_kLOCs
v4.0
v4.1
v4.2
v4.3
v4.4
v4.5
v4.6
v4.7
v4.8
v4.9
v4.10
v4.11

Linux is growing: The most common issues

- Poor knowledge of the existing APIs
  - Internal APIs
  - APIs of the existing frameworks
  - Many small but not least helper functions
- Experience with only single architecture or platform
  - Device Tree is solely for ARM?
  - ACPI is solely for x86?
  - There are no more Big Endian CPUs in use?
- Power management
  - Little understanding how it works
  - Interrupts can be all threaded

Linux is growing: New Developer vs. new helper function

```
> > +
> > +  for (i = 0; i < ARRAY_SIZE(lp_supported); i++) {
> > +          if (strcmp(synth->name, lp_supported[i]) == 0)
> > +                  break;
> > +  }
> > +
> > +  if (i >= ARRAY_SIZE(lp_supported)) {
>
> match_string()
Cool, didn't know about it
```

Managed Device Resources

Few words about Managed Device Resources API

Managed Device Resources: Motivation

- Error path in the ->probe() callback might be twisted up
  - Hard to catch a logic mistake in case of error
  - Possible leak of resources
- Make developers' life easier
  - No need to reinvent a wheel
  - Concentrate on the logic of the driver
  - Bugs, if any, are getting fixed faster and in one place
  - Add code in the middle of ->probe() callback is simple
  - Easy integration into existing code

Managed Device Resources: API

Memory management

- Memory allocation
  - devm_kasprintf()
  - devm_kcalloc(), devm_kmalloc_array()
  - devm_kmalloc(), devm_kzalloc()
  - devm_kmemdup(), devm_kstrdup()
- IO mapping
  - devm_ioport_map()
  - devm_ioremap()
  - devm_ioremap_resource()
- DMA
  - dmam_alloc_coherent(), dmam_alloc_noncoherent()
  - dmam_pool_create()

Other resources

- IRQ
  - devm_request_irq(), devm_request_threaded_irq()
- PCI
  - pcim_enable_device()
  - pcim_iomap(), pcim_iomap_regions()
  - pcim_iomap_table()
- GPIO and pin control:
  - devm_gpiod_get(), devm_pinctrl_get()
- Industrial IO (IIO) bus
  - devm_iio_device_alloc()
  - devm_iio_device_register()
  - devm_iio_trigger_alloc()

Managed Device Resources: Example (19 LOCs)

```
+       ret = of_address_to_resource(np, 0, &res_xbar);
+       if (ret) {
+               dev_err(dev, "Failed to get xbar resources");
+               return ret;
+       }
+
+       if (!devm_request_mem_region(dev, res_xbar.start,
+                                    resource_size(&res_xbar),
+               res_xbar.name)) {
+               dev_err(dev, "Failed to get xbar resources");
+               return -ENODEV;
+       }
+
+       xbar_membase = devm_ioremap_nocache(dev, res_xbar.start,
+                                           resource_size(&res_xbar));
+       if (!xbar_membase) {
+               dev_err(dev, "Failed to remap xbar resources");
+               return -ENODEV;
+       }
```

Managed Device Resources: Example (5 LOCs)

```
+       res_xbar = platform_get_resource(pdev, IORESOURCE_MEM, 0);
+       xbar_membase = devm_ioremap_resource(dev, res_xbar);
+       if (IS_ERR(xbar_membase))
+               return PTR_ERR(xbar_membase);
```

Unified Device Properties

Few words about Unified Device Properties API

Unified Device Properties: Motivation

- Three common resource providers
  - Device Tree
  - ACPI (especially r5.1 and newer)
  - (Legacy) platform data or board files
- Unification
  - Resource provider agnostic API
  - Code deduplication
- Bye, bye, platform data
  - PWM, GPIO provide lookup tables
  - The built-in device properties API

Unified Device Properties: API

Firmware node (Frameworks)

- Boolean
  - fwnode_property_present()
  - fwnode_property_read_bool()
- Integer types
  - fwnode_property_read_uXX()
  - fwnode_property_read_uXX_array()
- Strings
  - fwnode_property_read_string()
  - fwnode_property_read_string_array()
  - fwnode_property_match_string()

Device node (Drivers)

- Boolean
  - device_property_present()
  - device_property_read_bool()
- Integer types
  - device_property_read_uXX()
  - device_property_read_uXX_array()
- Strings
  - device_property_read_string()
  - device_property_read_string_array()
  - device_property_match_string()

Unified Device Properties: Conversion example (clean up of NFC pn544 driver: +62 –210 LOCs)

```
e7f6ccaab127 Get rid of platform data
1 file changed, 6 insertions(+), 37 deletions(-)

e2c518c6c998 Convert to use GPIO descriptor
1 file changed, 33 insertions(+), 93 deletions(-)

182d4e860845 Convert to use devm_request_threaded_irq()
1 file changed, 5 insertions(+), 11 deletions(-)

95129b6f0806 Get rid of code duplication in ->probe()
1 file changed, 17 insertions(+), 67 deletions(-)

38d4d2bb7119 Switch to devm_acpi_dev_add_driver_gpios()
1 file changed, 1 insertion(+), 2 deletions(-)
```

Special extensions of %p

Few words about special extensions of %p

Special extensions of %p: The list of (v4.11)

Description	Pattern	Description	Pattern
Symbols/Function Pointers	%p[FfSsB]	**UUID/GUID**	%pU[LlBb]
Kernel Pointers	%pK	**Directory entry names**	%p[Dd][234]
struct resources	%p[Rr]	**Block device names**	%pg
Physical addresses types	%pa[dp]	**struct va_format**	%pV
Raw buffer as an escaped string	%[*0-9]*pE[achnops]	**Content of struct clk**	%pC[nr]
Raw buffer as a hex string	%[*0-9]*ph[CDN]	**Bitmap and its derivatives such as cpumask and nodemask**	%[*0-9]*pb
MAC/FDDI addresses	%p[Mm][FR]	**Flags bitfields such as page flags, GFP flags**	%pG
IP addresses	%p[Ii][46S][pfschnbl]	**Network device features**	%pNF

Special extensions of %p: Least used ones (v4.11)

- 6 Network device features
- 12 Content of struct clk
- 22 Flags bitfields such as page flags, GFP flags
- 28 Block device names
- 67 Raw buffer as an escaped string

Special extensions of %p: Most used ones (v4.11)

- 1789 MAC/FDDI addresses
- 757 IP addresses
- 614 Raw buffer as a hex string
- 381 Symbols/Function Pointers
- 364 Physical addresses types (phys_addr_t, dma_addr_t)

Special extensions of %p: Conversion example (clean up of wireless at76c50x driver -30 LOCs)

```
commit 44afb60f3927c6f732522a477eb77c9db83bd404
Author: Andy Shevchenko <andriy.shevchenko@linux.intel.com>
Date:   Wed Sep 5 11:52:32 2012 +0300

    wireless: at76c50x: eliminate hex2str()

    The hex2str() is substituted by '%*phD' specificator.

    Signed-off-by: Andy Shevchenko <andriy.shevchenko@linux.intel.com>
    Tested-by: Larry Finger <Larry.Finger@lwfinger.net>
    Signed-off-by: John W. Linville <linville@tuxdriver.com>
---
 drivers/net/wireless/at76c50x-usb.c | 54 +++++++++++----------------------
 1 file changed, 12 insertions(+), 42 deletions(-)
```

Perfect is the enemy of the good enough

Few words about special cases when simplification leads to regression

Perfect is the enemy of the good enough: Case study: devm_request_threaded_irq()

- Rule of thumb
  - Don’t use devm_request_irq() or devm_request_threaded_irq() if you are not clear with the details
- Requires special attention to be paid
  - Interrupt handlers can be invoked at any time until they are not explicitly unlinked
- Tasklets are in a race with interrupt handlers
  - There is a race condition when tasklet might be scheduled just enough ahead of the freeing IRQ

Perfect is the enemy of the good enough: Case study: devm_kzalloc() et al.

- Scenario of a crash (character device)
  - User loads a driver
  - Driver registers a device node
  - User opens the device node
  - User unbinds the driver
  - User closes the device node
  - KABOOM!
- Attributes in sysfs
  - Is there a problem?
- What about debugfs?

Bisectability!
Bisectability!
Bisectability!
Bisectability!

Recommendations how to prepare changes to Linux kernel

Few words about changes which are going to be submitted to upstream

Recommendations how to prepare changes to Linux kernel (basic rules):

- Follow the Coding Style and Submitting Patches guidelines
  - They include some common sense rules how to make code clean in the first place
- Use existing code
  - For a new driver it makes sense to look at the existing code from a known author

Recommendations how to prepare changes to Linux kernel (in addition to):

- Check the code against duplications
  - Many helper functions are already implemented as a part of Linux kernel internal API
- Take the material from the above slides into consideration when doing drivers
- Establish internal mailing list for review process if it's not done yet
  - If you are working in a team it is always a good idea to have an internal mailing list dedicated to patch review
- Include a reviewer to the next round if you got some comments
  - Pay a respect to reviewers who volunteered to go through your code
- If in doubt, feel free to ask
  - Public mailing lists, forums, friends – do not hesitate to ask!

Thank you!

Questions and Answers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