ELISA
Enabling Linux in Safety Applications

WORKSHOP

NASA Goddard

Real-Time Linux Update

Real-Time Linux Update

IT’S DONE!

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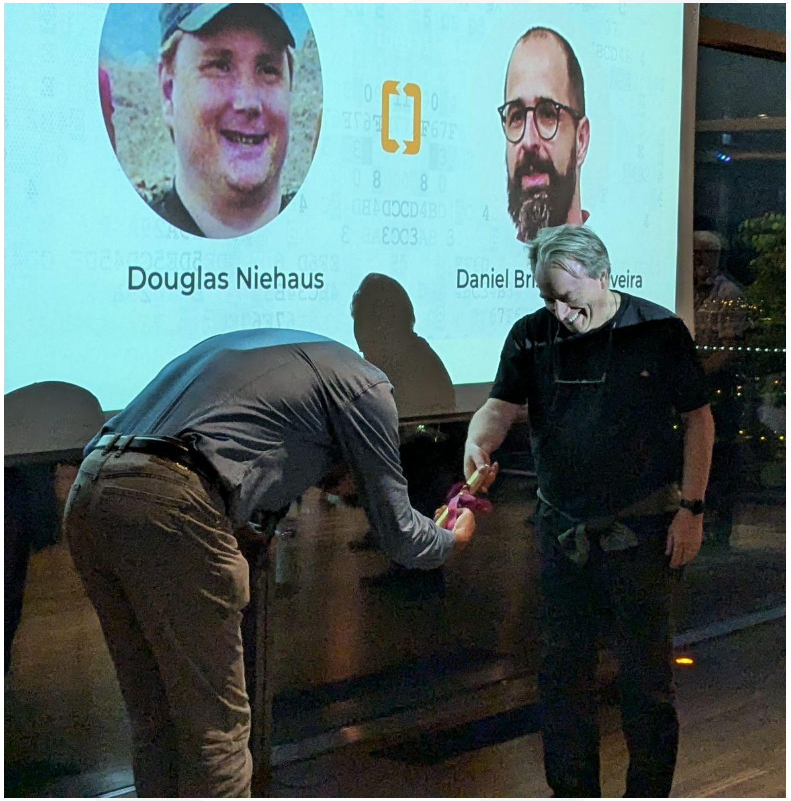
WORKSHOP

September 19, 2024



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  - Fastest worst case scenarios

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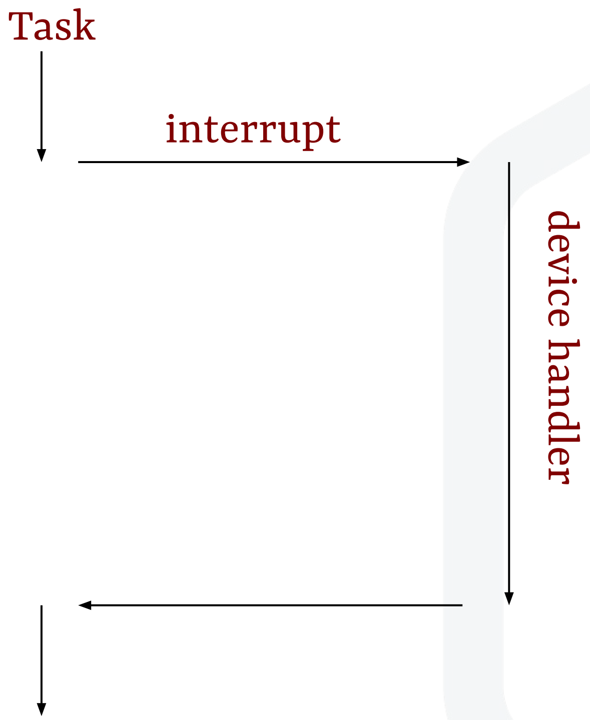
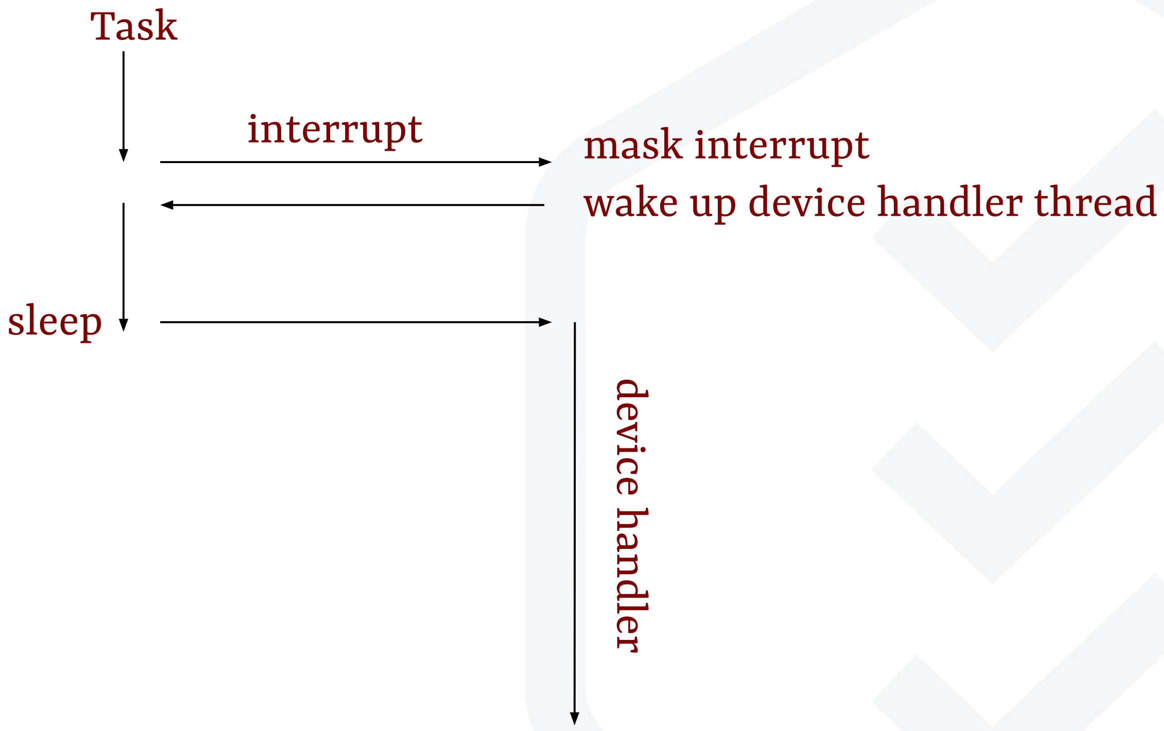
- Added to mainline Linux in v2.6.39 (2011)

Normal hard interrupt handlers



Threaded interrupt handlers



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- Ksoftirqd - runs when too many softirqs are queued on a CPU

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- Ksoftirq can still run (but runs as RT priority 1)

What was made to make Linux Real-Time?

- Spin locks turned into mutexes (sleeping spin locks)
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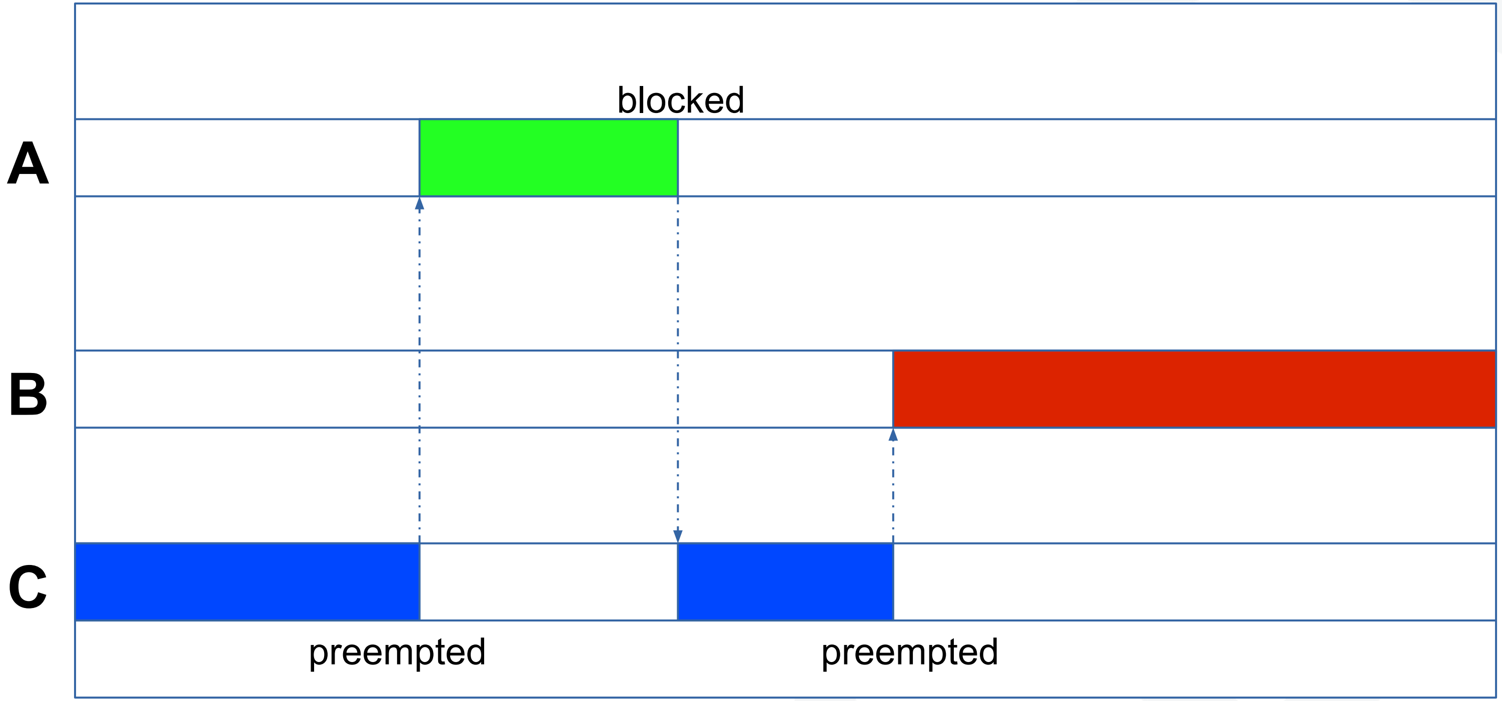
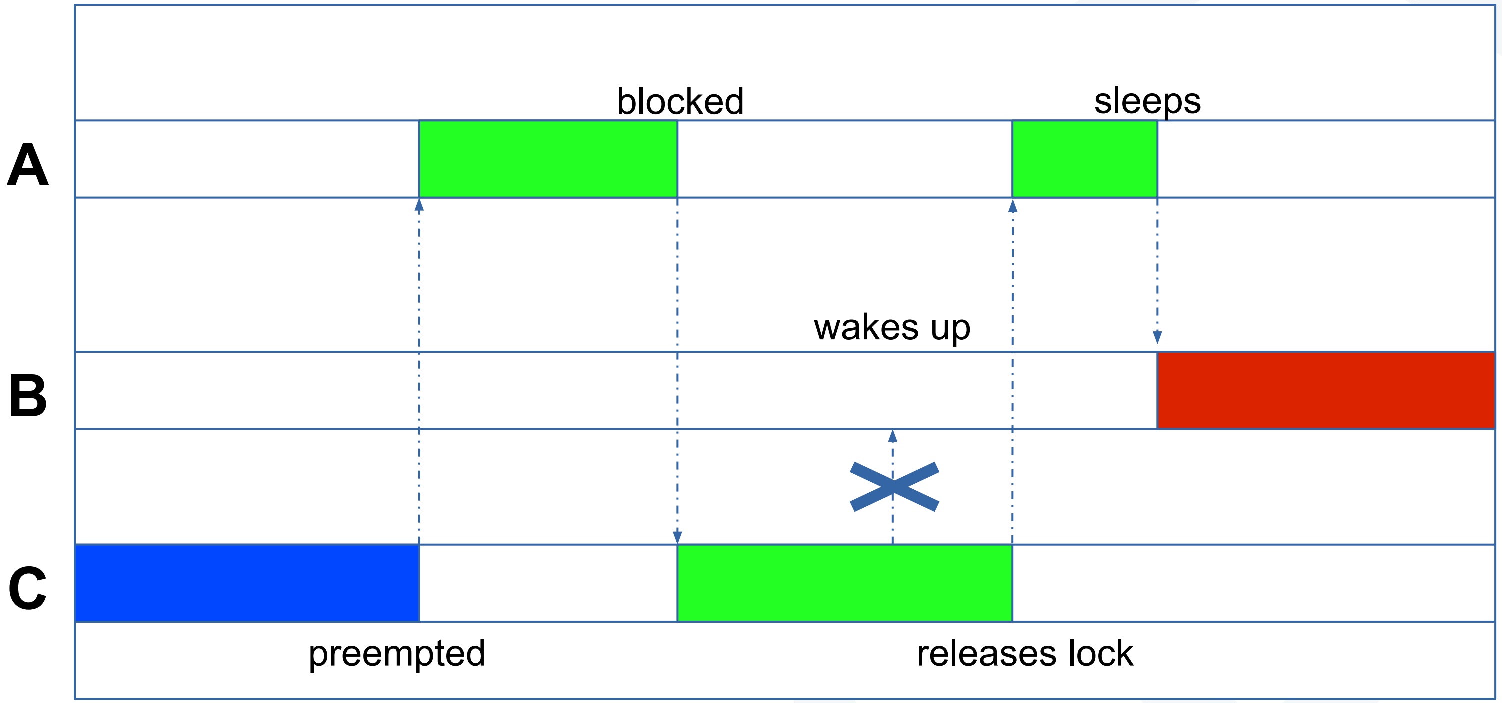
- Added to mainline Linux for user space futex in v2.6.18 (2006)
- Added to mainline Linux for kernel mutex in v6.12 (2024)

Unbounded priority inversion



Bounded priority inversion



Status of Linux Real-Time

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IT'S DONE!

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Not really, but almost!

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Status of Linux Real-Time

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Status of Linux Real-Time

- PREEMPT_RT finally made it into v6.12
  - But don’t use that kernel if you want RT (use at least v6.13)
  - It is missing NEED_RESCHED_LAZY
- NEED_RESCHED_LAZY added in v6.13
  - Does not preempt sleep “spin lock” for non-RT tasks
  - Improves performance of non-RT tasks

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Status of Linux Real-Time

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$ git log --pretty=oneline --abbrev-commit --reverse v6.13-rc1..linux-6.13.y-rt

d16c00faab9a preempt: Move PREEMPT_RT before PREEMPT in vermagic.
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acabbf65e61d serial: 8250: Revert "drop lockdep annotation from serial8250_clear_IER()"
75c8428eb7e9 module: Use complete RCU protection instead a mix of RCU and RCU-sched.
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9a4b05f4abe9 arm: Disable FAST_GUP on PREEMPT_RT if HIGHPTE is also enabled.
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c22fc883cd84 powerpc/pseries/iommu: Use a locallock instead local_irq_save()
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Serial Console

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Basic cleanups

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General i915 Hacks

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General ARM Hacks

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aaff26226481 drm/i915: Don't check for atomic context on PREEMPT_RT
ee6e450fbfc1 drm/i915: Disable tracing points on PREEMPT_RT
7ad03555be9e drm/i915/gt: Use spin_lock_irq() instead of local_irq_disable() + spin_lock()
55bb5062738c drm/i915: Drop the irqs_disabled() check
920f664b8d7b drm/i915/guc: Consider also RCU depth in busy loop.
f92553ce51ee Revert "drm/i915: Depend on !PREEMPT_RT."
aa334412d84f arm: Disable jump-label on PREEMPT_RT.
b80d79ad9c95 ARM: enable irq in translation/section permission fault handlers
9a4b05f4abe9 arm: Disable FAST_GUP on PREEMPT_RT if HIGHPTE is also enabled.
3d9c8e74c1fc ARM: Allow to enable RT
c22fc883cd84 powerpc/pseries/iommu: Use a locallock instead local_ir           )
96edfd863ffa powerpc/pseries: Select the generic memory allocato
d01c57fb0df5 powerpc/kvm: Disable in-kernel MPIC emulation f           T_RT
b35d95e74643 powerpc/stackprotector: work around stack          t from atomic
728e044a97a3 POWERPC: Allow to enable RT
527711180912 sysfs: Add /sys/kernel/realtime entry
```

Is the kernel RT?

Current Stable RT

Version	Maintainer	EOL
6.13	Sebastian A. Siewior	Maintainer
6.6	Clark Williams	Dec 2026
6.1	Clark Williams	Dec 2026
5.15	Joseph Salisbury	Oct 2026
5.10	Luis Claudio R. Goncalves	Dec 2026
5.4	Tom Zanussi	Dec 2025
4.19	Daniel Wagner	Dec 2024

Status of Linux Real-Time

IT'S DONE!

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Not really, but almost!

What’s more to do?

- Growing pains

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- New mailing list: linux-rt-devel@vger.kernel.org
- Documentation, documentation, documentation!!!!

Questions?

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