CPU Scheduler implementation hints for architecture specific code

Nick Piggin, 2005

Context switch

1. Runqueue locking By default, the switch_to arch function is called with the runqueue locked. This is usually not a problem unless switch_to may need to take the runqueue lock. This is usually due to a wake up operation in the context switch. See arch/ia64/include/asm/switch_to.h for an example.

To request the scheduler call switch_to with the runqueue unlocked, you must *#define __ARCH_WANT_UNLOCKED_CTXSW* in a header file (typically the one where switch_to is defined).

Unlocked context switches introduce only a very minor performance penalty to the core scheduler implementation in the CONFIG_SMP case.

CPU idle

Your cpu_idle routines need to obey the following rules:

1. Preempt should now disabled over idle routines. Should only be enabled to call schedule() then disabled again.
2. need_resched/TIF_NEED_RESCHED is only ever set, and will never be cleared until the running task has called schedule(). Idle threads need only ever query need_resched, and may never set or clear it.
3. When cpu_idle finds (need_resched() == 'true'), it should call schedule(). It should not call schedule() otherwise.
4. The only time interrupts need to be disabled when checking need_resched is if we are about to sleep the processor until the next interrupt (this doesn't provide any protection of need_resched, it prevents losing an interrupt):

    4a. Common problem with this type of sleep appears to be:

    ```
    local_irq_disable();
    if (!need_resched()) {
            local_irq_enable();
            *** resched interrupt arrives here ***
            __asm__("sleep until next interrupt");
    }
    ```

5. TIF_POLLING_NRFLAG can be set by idle routines that do not need an interrupt to wake them up when need_resched goes high. In other words, they must be periodically polling need_resched, although it may be reasonable to do some background work or enter a low CPU priority.

    - 5a. If TIF_POLLING_NRFLAG is set, and we do decide to enter an interrupt sleep, it needs to be cleared then a memory barrier issued (followed by a test of need_resched with interrupts disabled, as explained in 3).

arch/x86/kernel/process.c has examples of both polling and sleeping idle functions.

Possible arch/ problems

Possible arch problems I found (and either tried to fix or didn't):

ia64 - is safe_halt call racy vs interrupts? (does it sleep?) (See #4a)

sh64 - Is sleeping racy vs interrupts? (See #4a)

sparc - IRQs on at this point(?), change local_irq_save to _disable.

- TODO: needs secondary CPUs to disable preempt (See #1)