Scheduling and big.LITTLE Architecture
Scheduling Topics

- Target CPU Selection (Vincent Guittot)
- Sharing Scheduler Information (Vincent Guittot)
- Task Placement for Asymmetric Cores (Morten Rasmussen)
- Scheduling and the big.LITTLE Architecture *(you are here!)*
- Dynamic CPU Core Management (Peter De Schrijver and Antti Miettinen)
- Application of Deadline Scheduling for Power-Saving Strategies (Juri Lelli)

- Main focus of this talk is progress on CPU hotplug
  - See Peter's and Antti's talk for alternatives
CPU Hotplug Primer: Online Process

- **CPU_UP_PREPARE**
  - **Succeeded** → **CPU_STARTING**
  - **Failed** → **CPU_UP_CANCELLED**

- **CPU_STARTING**
  - **Failed** → **CPU_UP_CANCELLED**
  - **Succeeded** → **CPU_ONLINE**

- Variables used:
  - `cpu_hotplug.lock held`
  - `cpu_add_remove_lock held`
CPU Hotplug Primer: Offline Process

CPU_DOWN_PREPARE

- Succeeded
- Failed

CPU_DYING

- Succeeded
- Failed

CPU_DEAD

- Succeeded

CPU_POST_DEAD

All other CPUs spinning with interrupts off while outgoing CPU is in CPU_DYING notifiers

- cpu_hotplug_lock held

- cpu_add_remove_lock held
CPU Hotplug Is Not Atomic

Valid notifier order for online:
- IPIs
- RCU
- Scheduler
Must reverse order for offline

Reality will intrude…
- RCU depends on scheduler
- Circular dependency!
Must further decompose RCU and scheduler interaction
Scheduling and big.LITTLE Architecture

CPU Hotplug: Valid Online Order (1/3)

Valid notifier order for online:
• IPIs
• RCU
• Scheduler
Must reverse order for offline

Reality will intrude...
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Valid notifier order for online:
- IPIs
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Must reverse order for offline

Reality will intrude...
- RCU depends on scheduler
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Must further decompose RCU and scheduler interaction
CPU Hotplug: Valid Online Order (3/3)

Valid notifier order for online:
- IPIs
- RCU
- Scheduler
Must reverse order for offline

Reality will intrude...
- RCU depends on scheduler
- Circular dependency!
Must further decompose RCU and scheduler interaction
Suppose We Offline In The Same Order...

Valid notifier order for online:
- IPIs
- RCU
- Scheduler

Must reverse order for offline

Reality will intrude...
- RCU depends on scheduler
- Circular dependency!

Must further decompose RCU and scheduler interaction
CPU Hotplug: Invalid Offline Order

Valid notifier order for online:
- IPIs
- RCU
- Scheduler

Must reverse order for offline

Reality will intrude...
- RCU depends on scheduler
- Circular dependency!

Must further decompose RCU and scheduler interaction
CPU Hotplug: Valid Offline Order (1/3)

Valid notifier order for online:
- IPIs
- RCU
- Scheduler
Must reverse order for offline

Reality will intrude...
- RCU depends on scheduler
- Circular dependency!
Must further decompose RCU and scheduler interaction
CPU Hotplug: Valid Online Order (2/3)

Valid notifier order for online:
- IPIs
- RCU
- Scheduler
Must reverse order for offline

Reality will intrude...
- RCU depends on scheduler
- Circular dependency!
Must further decompose RCU and scheduler interaction
Valid notifier order for online:
- IPIs
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Must reverse order for offline

Reality will intrude...
- RCU depends on scheduler
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CPU Hotplug: Work In Progress

- Reduce task creation/destruction overhead
  - Thomas Gleixner's generic-idle (mainline) and park/unpark (-tip)
  - Tejum Heo's fix for workqueues
- Numerous fixes from Srivatsa Bhat (3.4-3.6)
- Disturbance-free SRCU (Lai Jiangshan, 3.4)
- Wean RCU from __stop_machine() (PEM, 3.5-3.7)
- Wean scheduler from __stop_machine() (in progress)
- Guard for_each_online_cpu() (Silas Boyd-Wickizer, 3.7-3.8)
- Switch hotplug from __stop_machine() (PEM experimental)
- Reverse notifier order, reworking notifier concepts (TBD)
- Apply park/unpark everywhere (TBD)
Other Topics

- Synthetic Mobile Workloads
  - Progress, but no nice solution yet

- Emulating big.LITTLE on commodity systems
  - An embarrassment of riches: http://lwn.net/Articles/501501/
Summary

- Excellent progress on many fronts
- But much work still to be done!
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Questions?