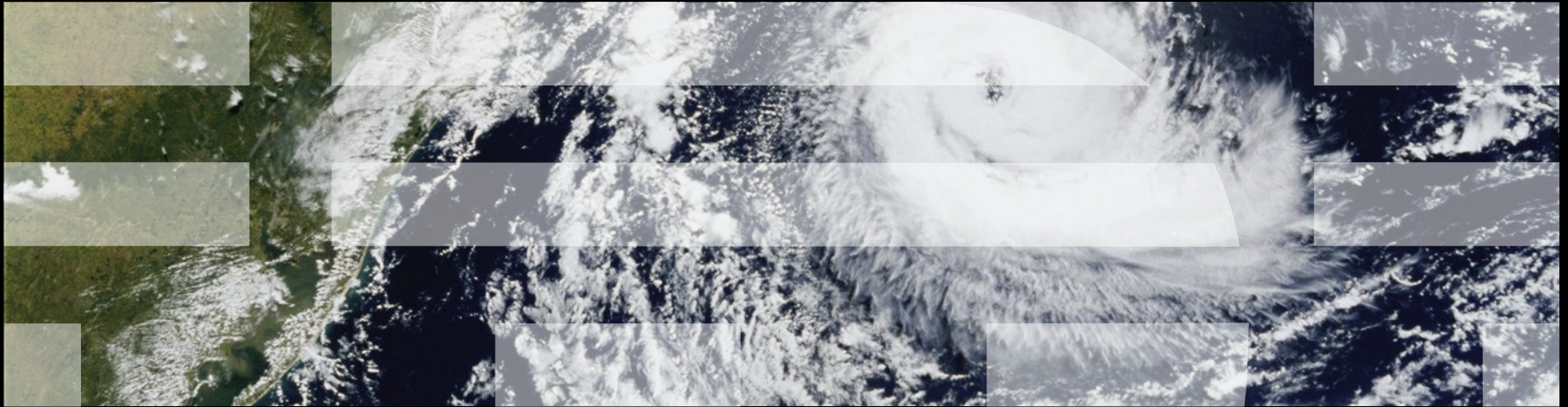


Paul E. McKenney, IBM Distinguished Engineer, Linux Technology Center (Linaro)

29 August 2012



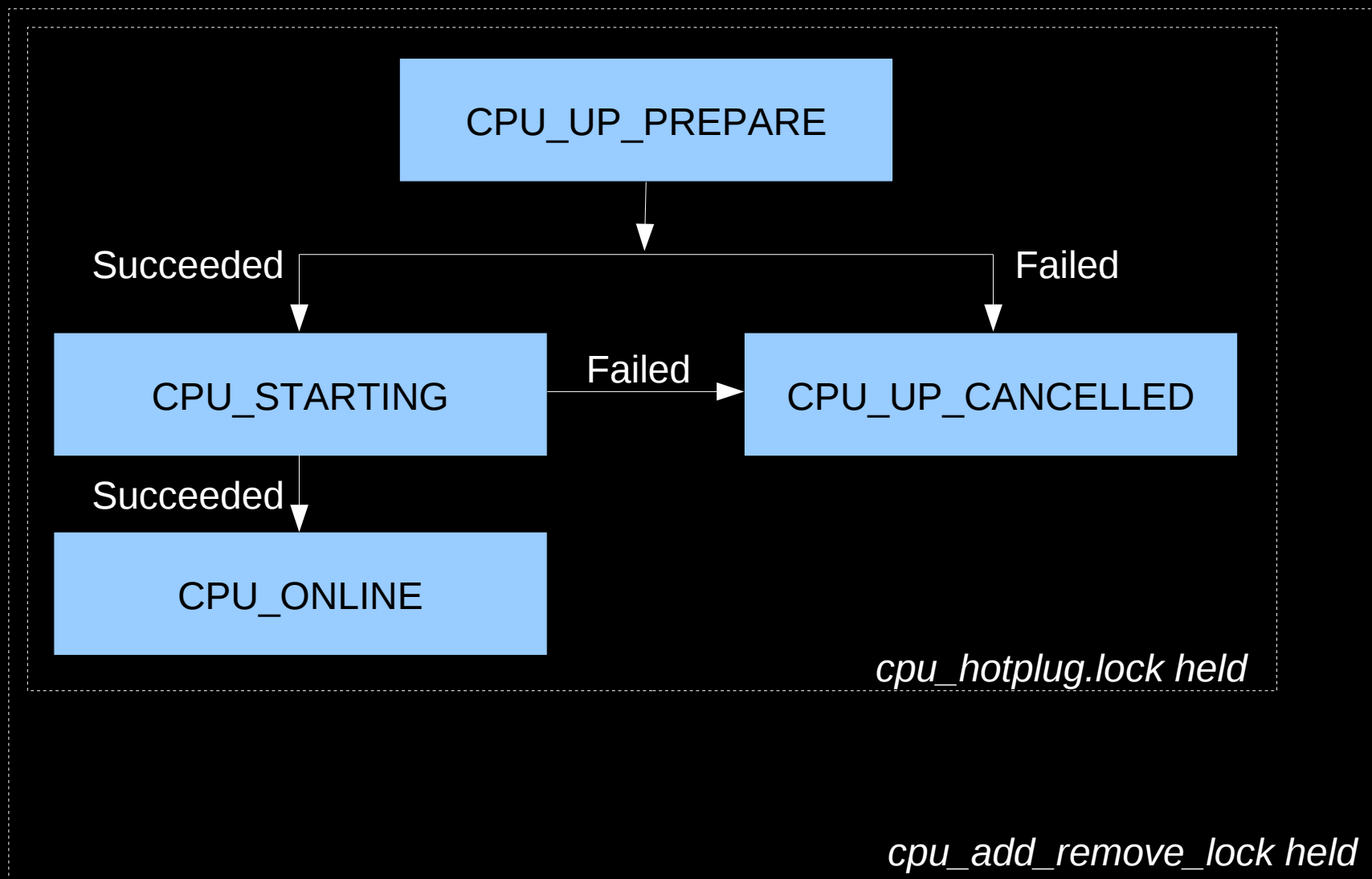
# Scheduling and big.LITTLE Architecture



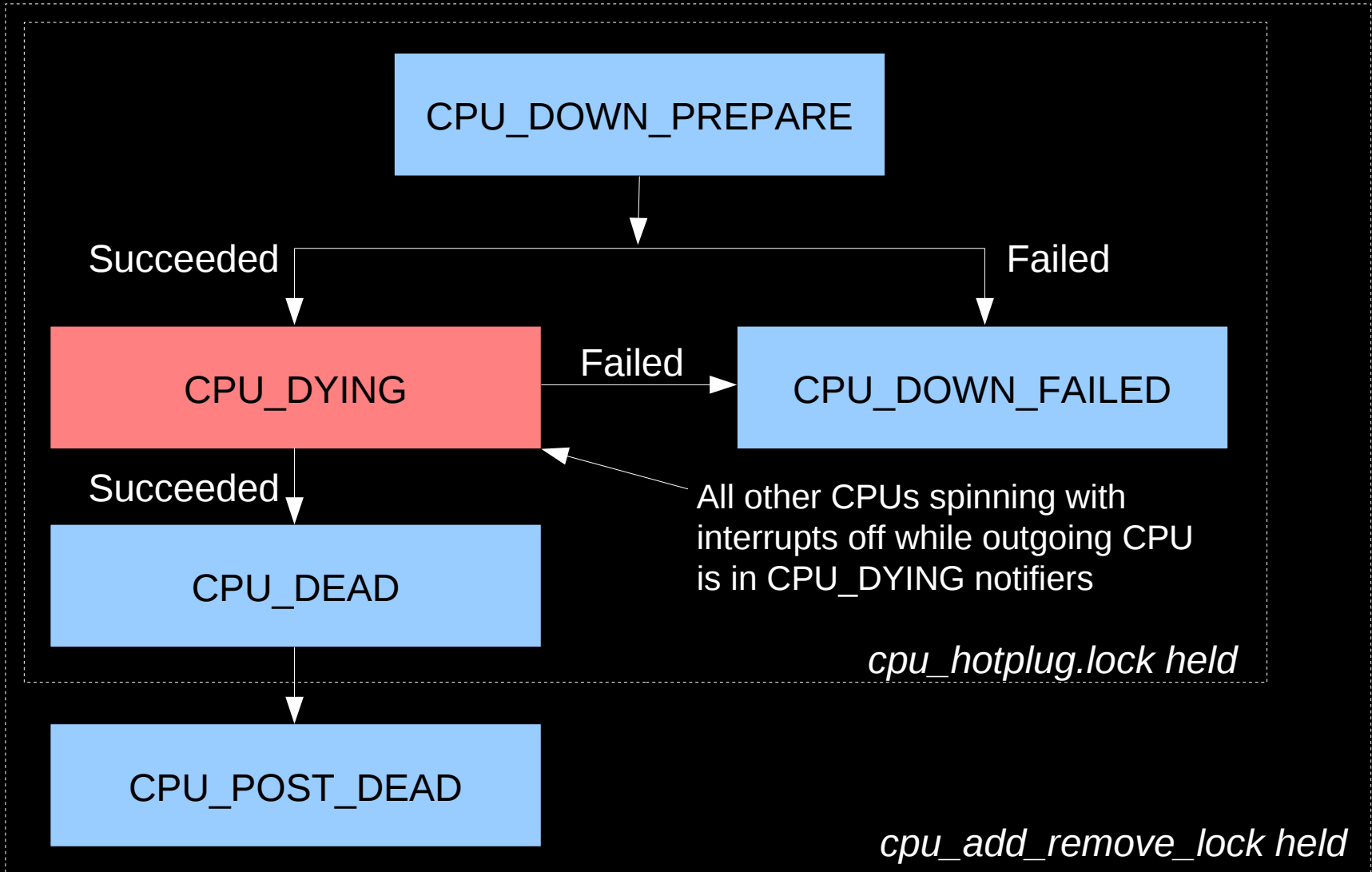
## Scheduling Topics

- 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

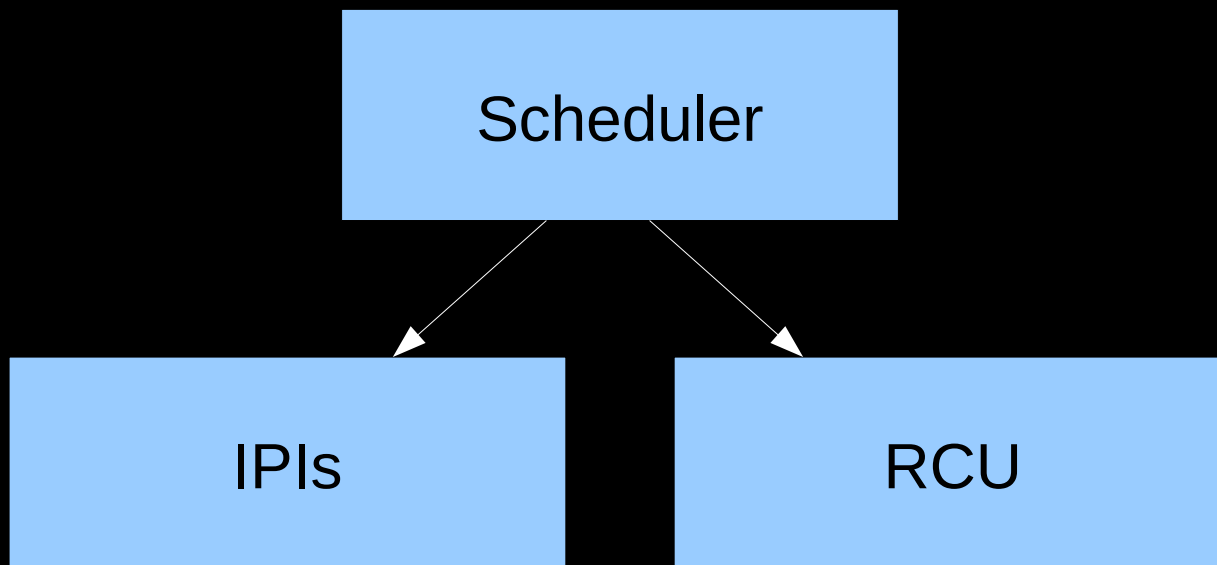
# CPU Hotplug Primer: Online Process



# CPU Hotplug Primer: Offline Process



# 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

## CPU Hotplug: Valid Online Order (1/3)



IPIs

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)



IPIs

RCU

Valid notifier order for online:

- IPIs
- RCU
- Scheduler

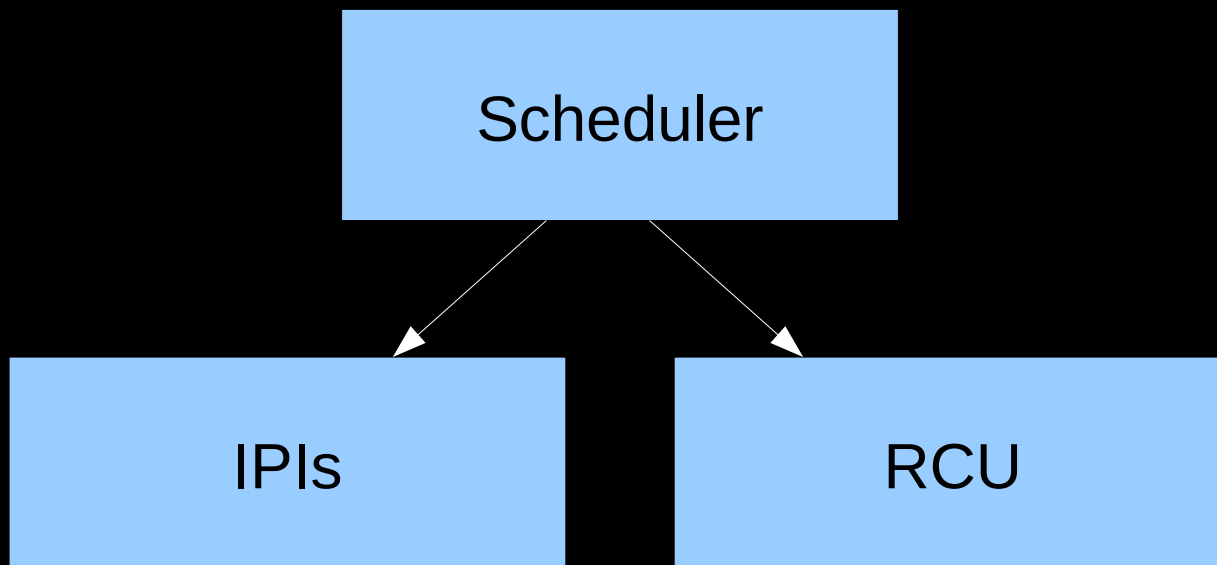
Must reverse order for offline

Reality will intrude...

- RCU depends on scheduler
- Circular dependency!

Must further decompose RCU and scheduler interaction

## CPU Hotplug: Valid Online Order (3/3)



Valid notifier order for online:

- IPIs
- RCU
- Scheduler

Must reverse order for offline

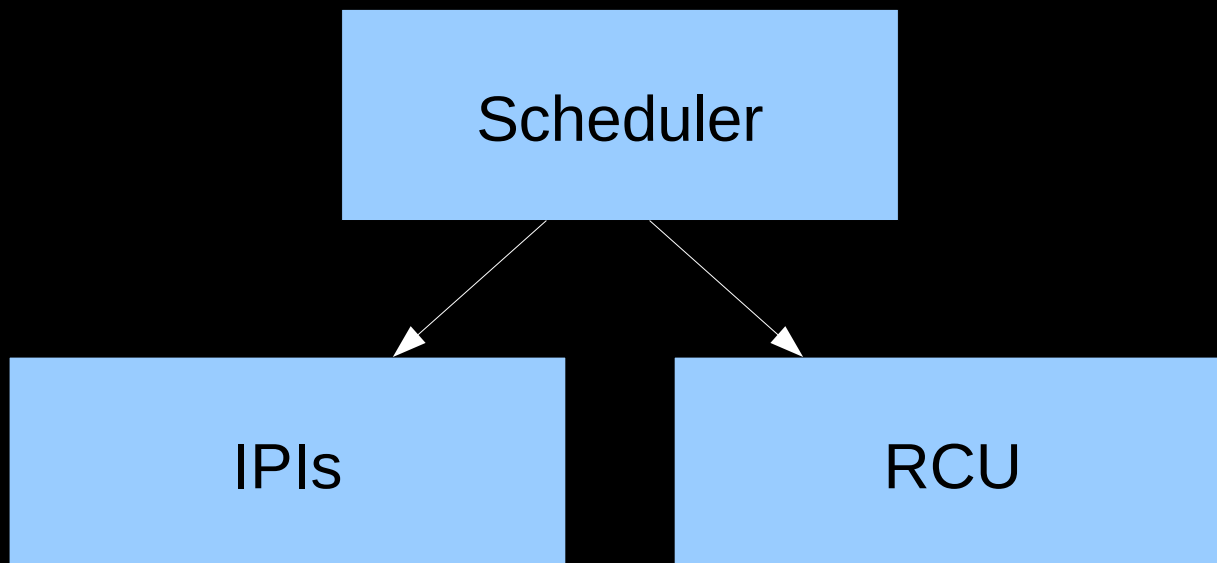
Reality will intrude...

- 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

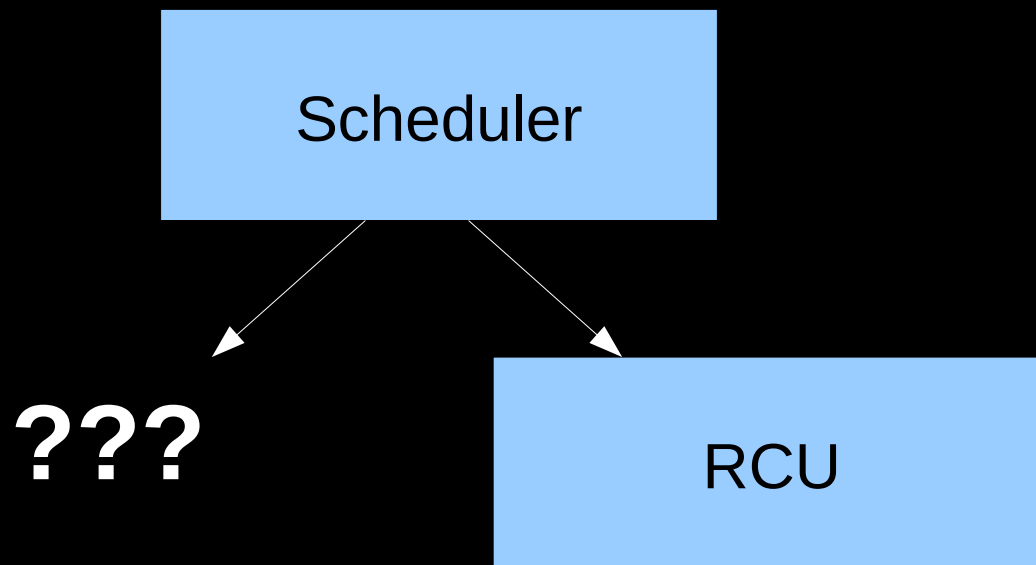
Must reverse order for offline

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

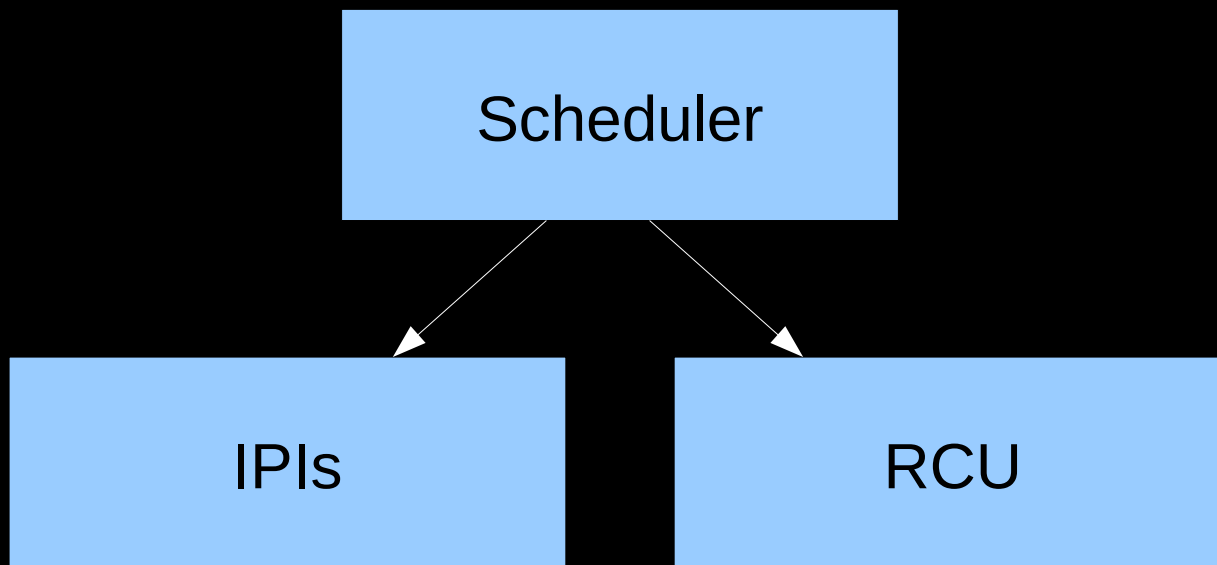
Must reverse order for offline

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)



IPIs

RCU

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 (3/3)



IPIs

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: Work In Progress

- Reduce task creation/destruction overhead
  - Thomas Gleixner's generic-idle (mainline) and park/unpark (-tip)
  - Tejun 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?