The Case for Cooperative Kernel Threads

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Preemptive Kernel Threads

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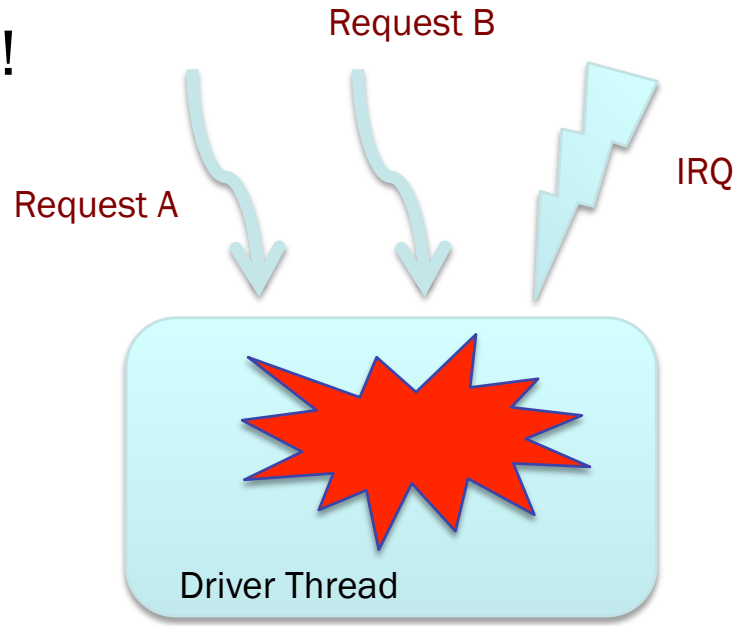
- Most OS kernels are multithreaded
- Drivers run as part of the kernel
  - Need to deal with concurrent invocations
  - Shared state must be maintained
- Synchronisation is hard to get right!
  - Race conditions and deadlocks
  - 20%[1] of bugs in device drivers



[1] RYZHYK, L., CHUBB, P., KUZ, I., AND HEISER, G. Dingo: Taming device drivers. In *Proceedings of the 4th EuroSys Conference (Nuremberg, Germany, Apr. 2009).*

Event-based Device Drivers

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```
probe() {
   ...
   write();
   msleep(10);
   read();
   ...

}
```

'Rip' the stack

```
probe() {
   ...
   write();
   drv->state = 1;
   schedule_timeout(10, drv, timeout);
   return;
}

timeout(drv) {
   switch(drv->state) {
      case 1:
         read();
         break;
      ...
   }
}
```

Cooperative Threading

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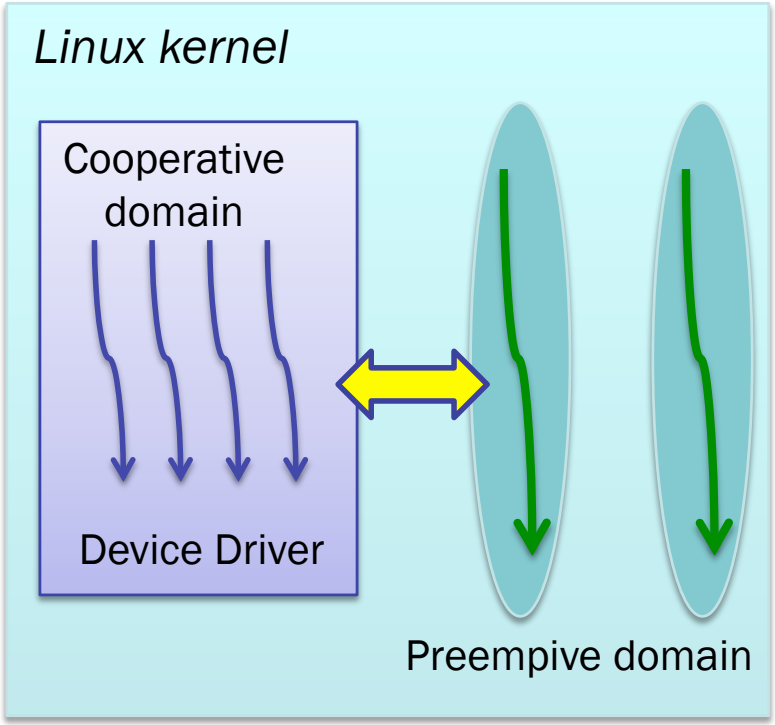
- The best of the two worlds
  - Atomic execution
  - Blocking Allowed
- Not supported in the Linux kernel
- Runtime support for cooperative threads
  - Create cooperative scheduling domains inside the kernel
  - High-performance message passing between preemptive and cooperative threads



Conclusion

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- Research Aim:
  - Dealing with concurrency in device drivers
- Problems:
  - Pre-emptive threading
    - Synchronisation
  - Event-based threading
    - Stack ripping
- Proposed Solution:
  - Cooperative threading
    - Best of both worlds
    - Run-time support in Linux kernel