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# Hardware Resource Control in L4 $\mu$ -kernels



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## Motivation

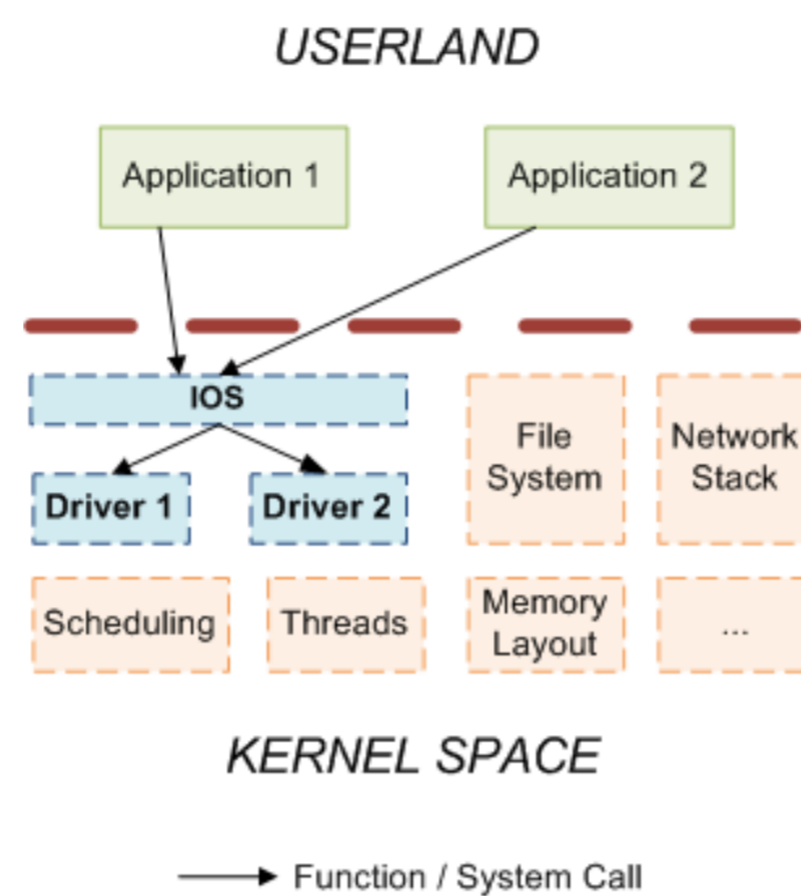
In most operating systems, userland processes have unrestricted access to hardware drivers, by system calls in monolithic kernels or IPCs in  $\mu$ -kernels such as L4. This unrestricted access can often allow **malicious software to force a denial of service on the driver** or strongly impact its quality of service.

To mitigate this safety issue without impacting much drivers code, **our approach is to extend L4 IPCs by adding a control layer to IPCs aimed at drivers.**

This would allow admission control to the driver, as well as **accounting and managing the driver's occupation by user processes.**

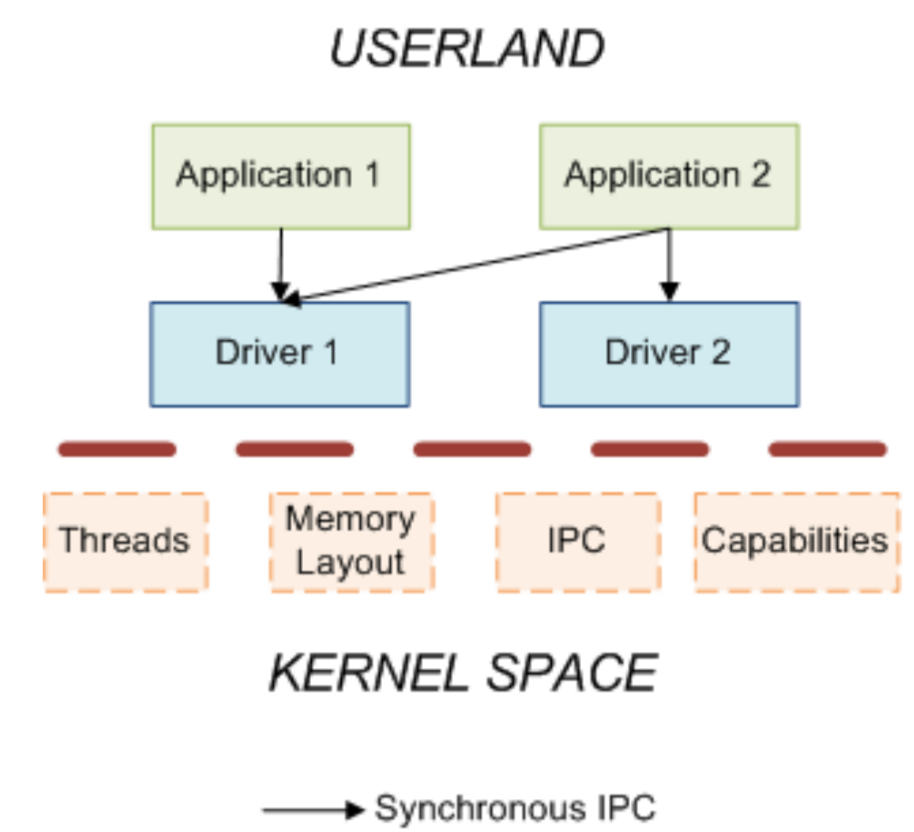
## Context: Operating System Kernels

### Monolithic Kernels



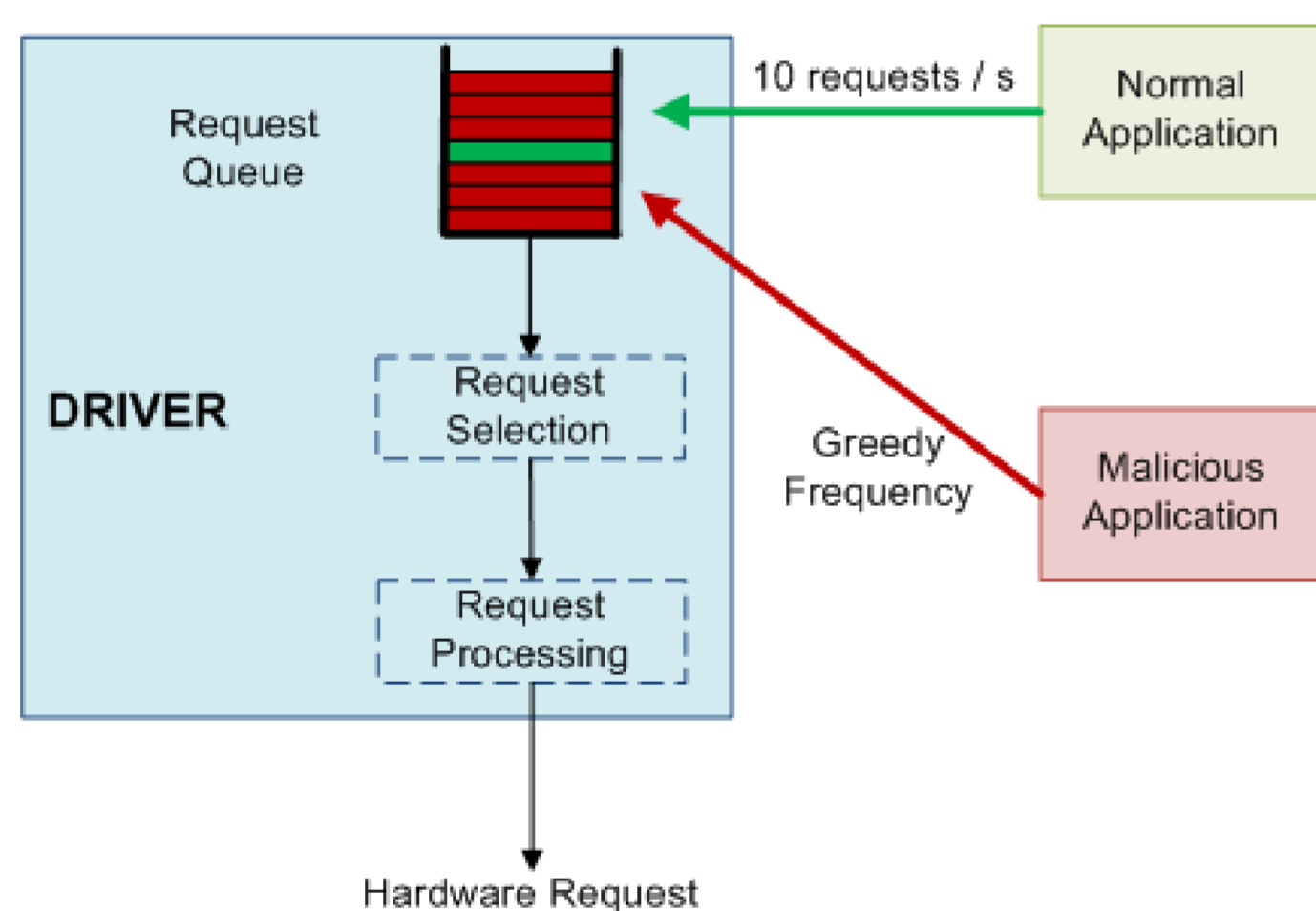
- All privileged code in kernel
- Communication via method calls
- Unified drivers interface (IOS)

### L4 $\mu$ -kernel

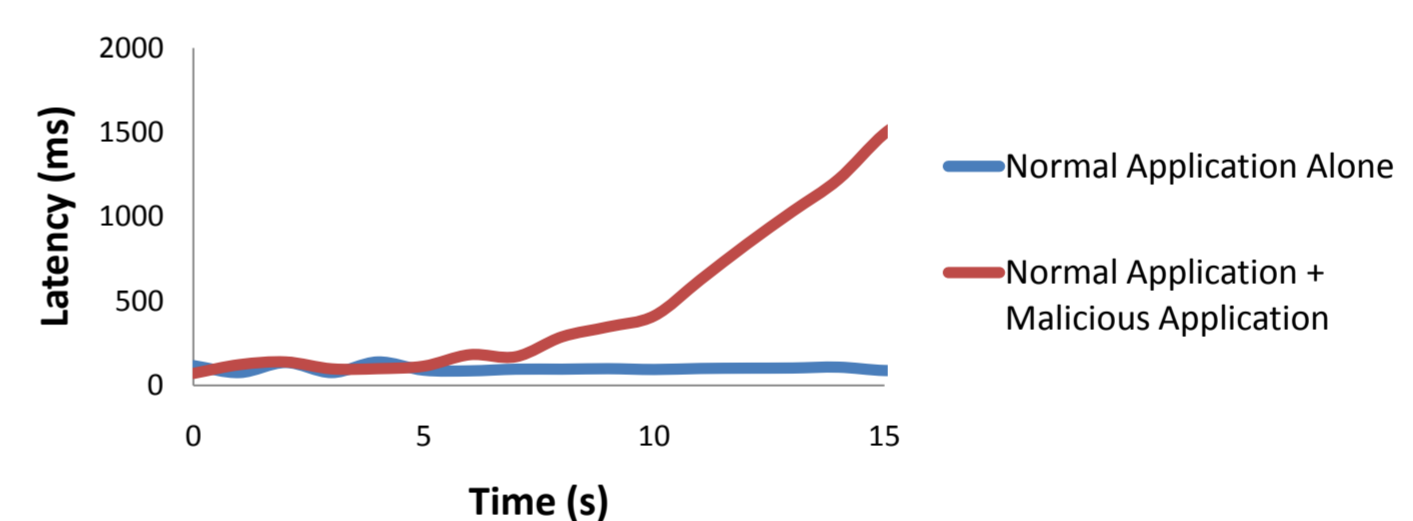


- Minimal kernel
- Communication via synchronous IPCs
- Userland privileges managed by capabilities

## An Example of Resource Monopolization



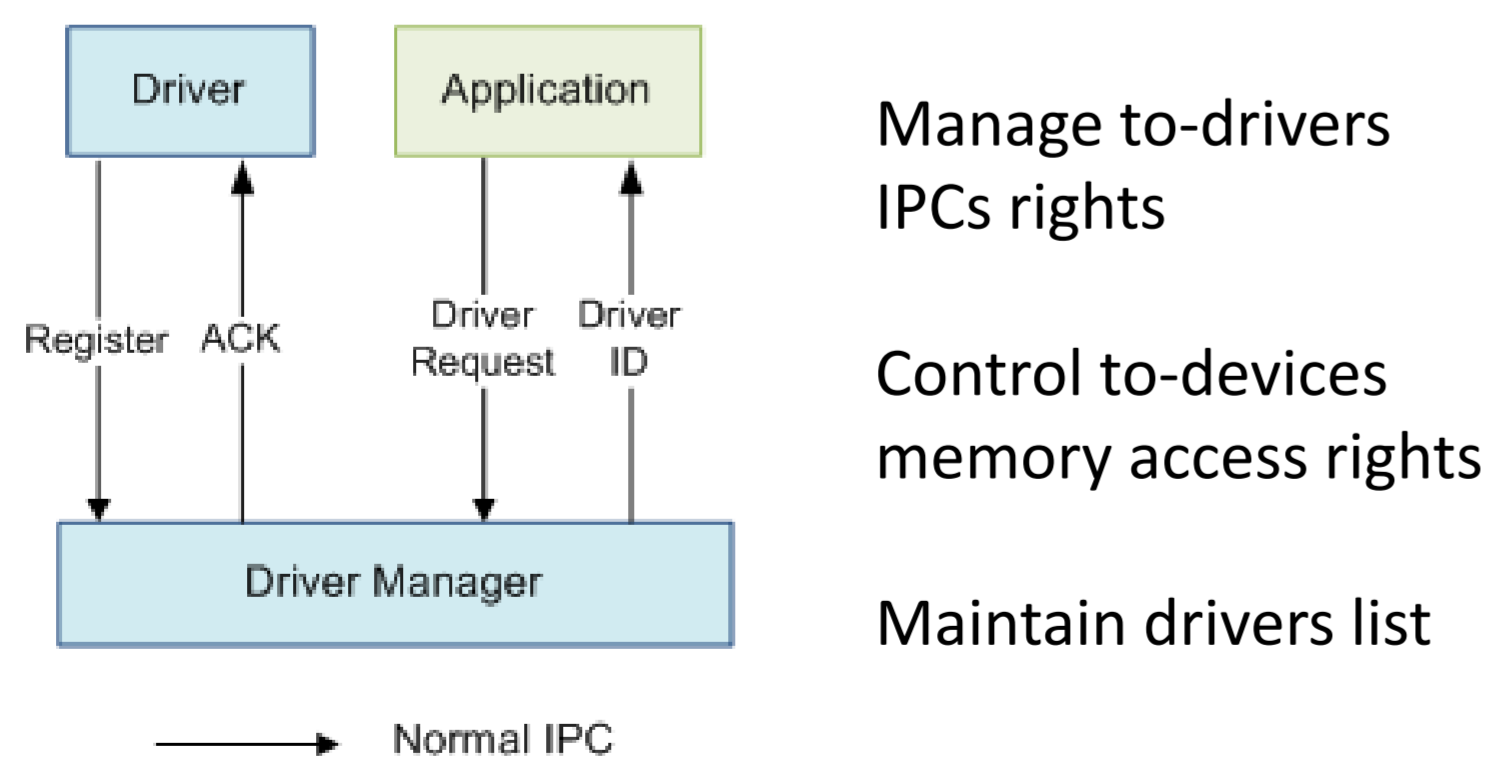
### Delay between application deadlines and actual processing



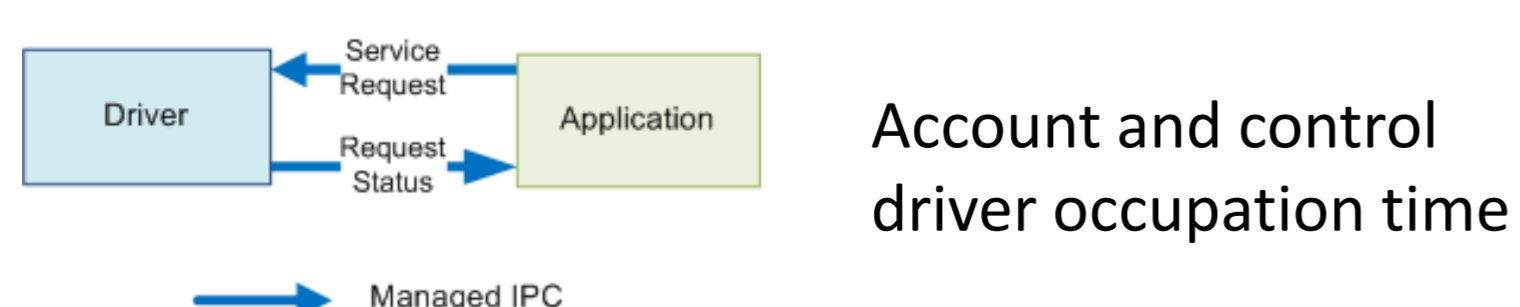
➔ The quality of service provided by the driver to the normal application is severely impacted

## Proposition: Extend L4 IPCs

### Admission Control



### IPC Extension for Resource Control



## Expected Benefits

- **Safety:** Prevent malicious threads from monopolizing drivers
- **QoS Management:** Accounting and admission control would allow resource reservation and real-time guarantees

## Open Questions

- How about resource control in higher layers?
- Which uniform resource reservation model?
- Robustness of managed IPCs to malicious users?