Kernel Memory Management in Verified Small Kernels

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Department of Communications, Information Technology and the Arts
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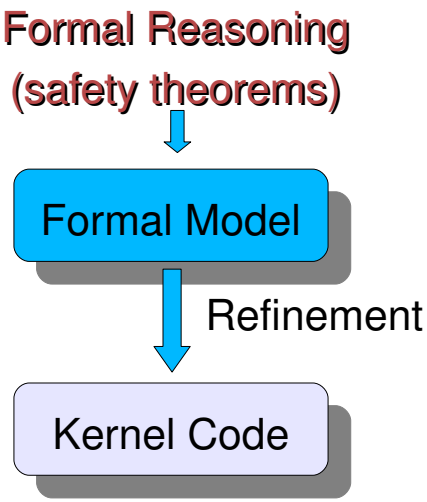
Formally assured microkernel for systems requiring strong security guarantees

- Formally assured
  - Abstract model → Kernel code
  - Abstract model facilitate reasoning
  - Kernel code must be rigid
- Deployable in variety of system
  - Diverse requirements
  - Example
    - Partitioning
    - Temporal guarantees
    - Share resources ...
  - Kernel should support and enforce the appropriate policy



Kernel Memory Management

- **How to manage kernels physical memory?**
  - Cache [*EROS, Cache kernel*] – No temporal predictability
  - Static allocation – Not suitable for dynamic systems
  - Quota – Underutilisation

  } No single policy

  - Modifying the kernel – breaks refinement

- **seL4 Model:** Exports all memory allocation/deallocation decisions to user
  - No implicit allocations within the kernel
  - Kernel memory is represented as first class objects
    - Capabilities are used to confer authority
  - Inspired by early capability machines [*Cap system*]
  - Allocation takes place only on explicit user request

seL4 Model

Advantages

- Supports diverse policies by modifying user-level code
- Supports co-existing policies
- Confinement of authority guarantees confinement of physical memory

Status:

- Formal proof of spatial partitioning
- Haskell prototype & C/C++ version of the kernel
- Performance evaluation/refinement – on going research

Thanks

– Travel fundings: **InfoSys Technologies Ltd.**

Thanks!