

Virtualisation



Learning Outcomes

- Note: this is a bonus lecture, this is not official assessable content
- A quick understanding of hypervisors, and modern extensions to the VM system
- A look at two-level translation



Virtualisation

- A “virtual” system X is a system Y that is different to X but simulates it for some purposes.
 - Virtual memory
 - Virtual machine
 - Virtual terminal
- A common process:
 - Yesterday’s system
 - Today’s compatibility trick
 - Tomorrow’s interface



Virtual Terminals

- A VT100 terminal

Photographed at the Living Computer Museum by Jason Scott

- This was a “terminal”
 - An endpoint
 - Not a computer
- Created standards
 - ANSI
 - Virtual terminals
 - Terminal emulators



Families of Related Processors

- ARM LTD design:
 - Cortex M-0: microprocessor
 - Optional MPU, no MMU
 - Mid-range microprocessors
 - High-end CPUs
 - Google Tensor
 - Mac M-1
 - Instruction sets are somewhat compatible



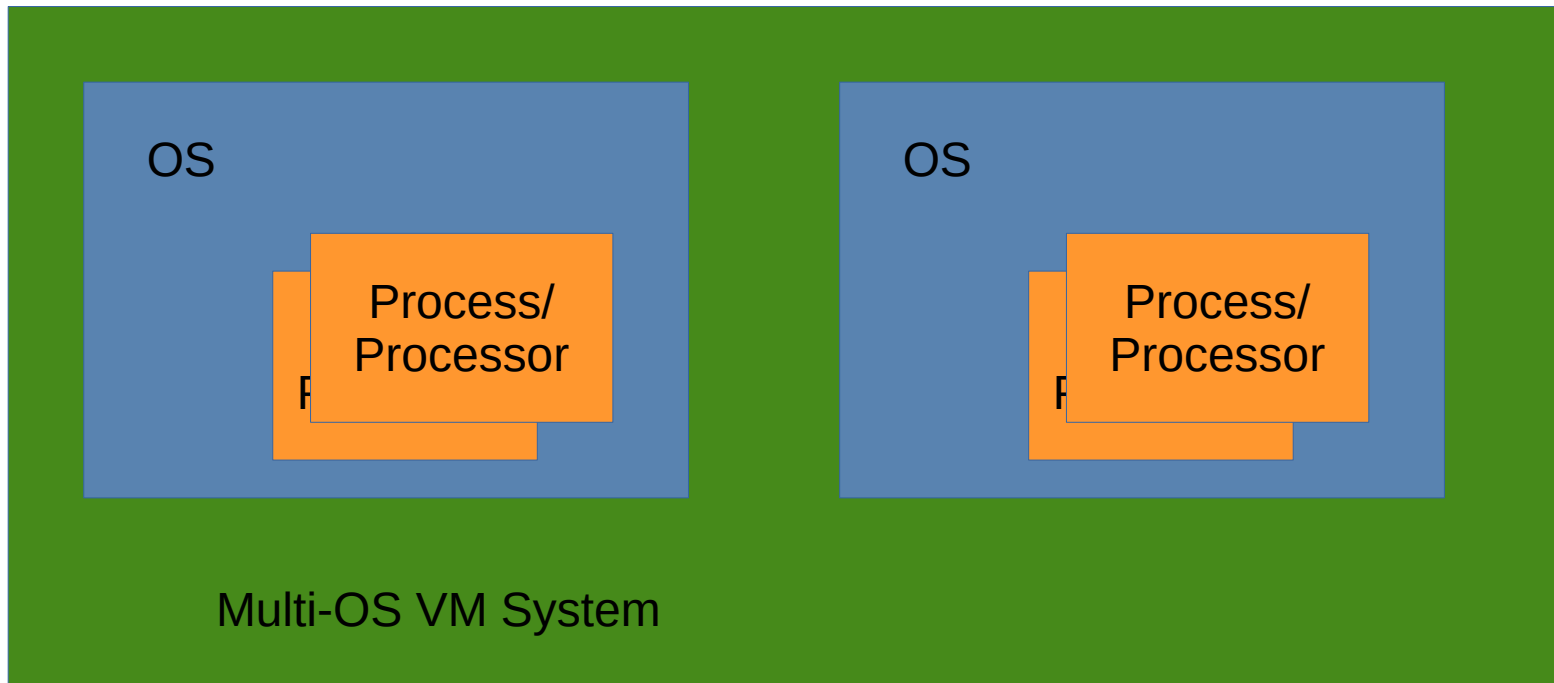
Processes as VMs

- On a simple microprocessor
 - One set of CPU registers
 - One view of memory
- The same program, running in an OS
 - One set of CPU registers per process
 - One view of memory per process
 - “Virtual” microprocessor?

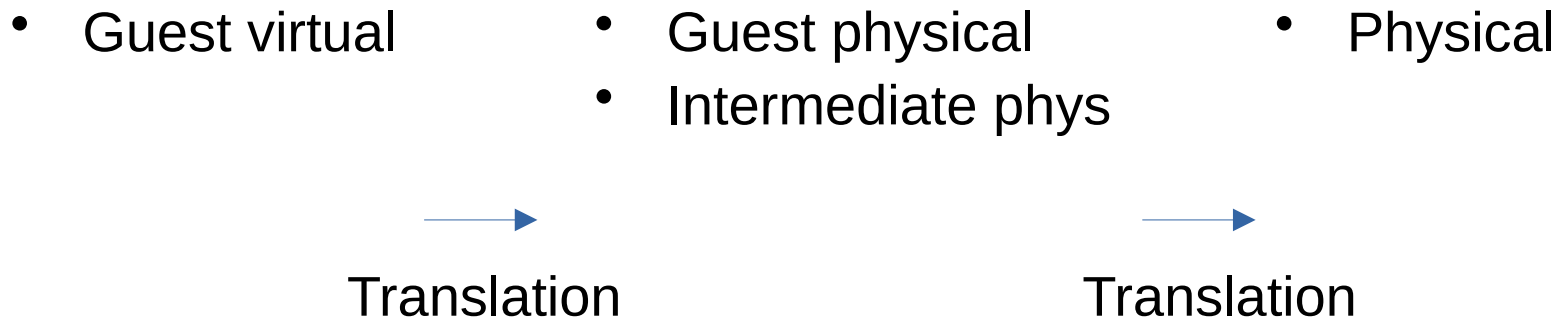


And Repeat...

- What does a “virtual” processor look like?

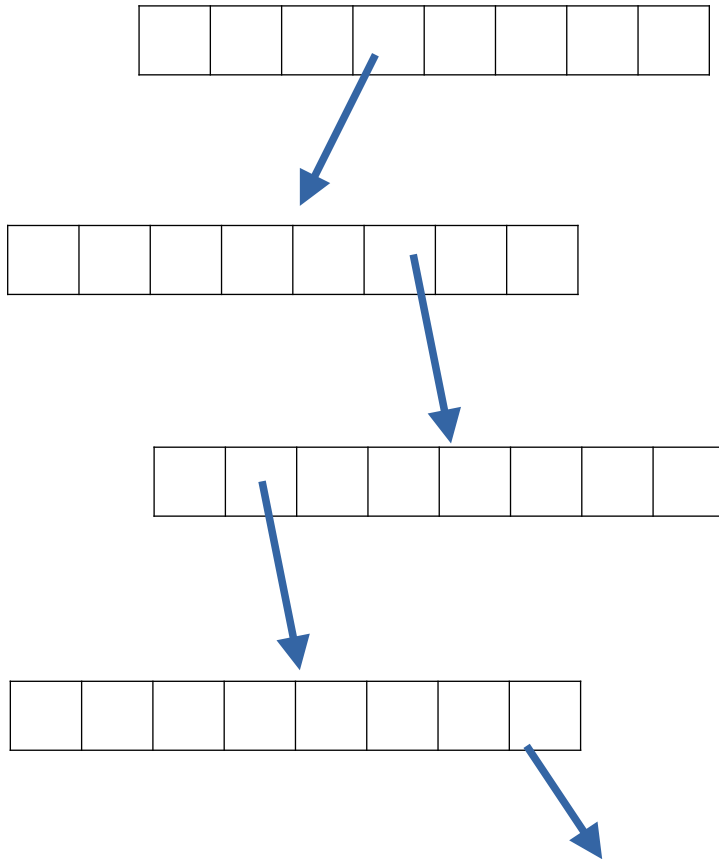


Second Level Translation

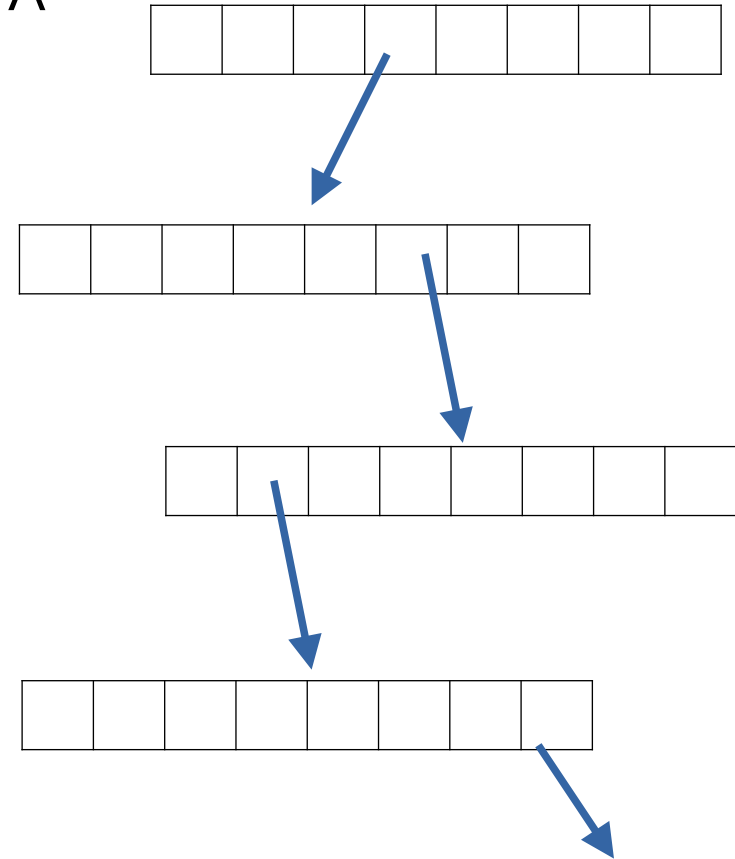


Second Level Translation

VA



IPA



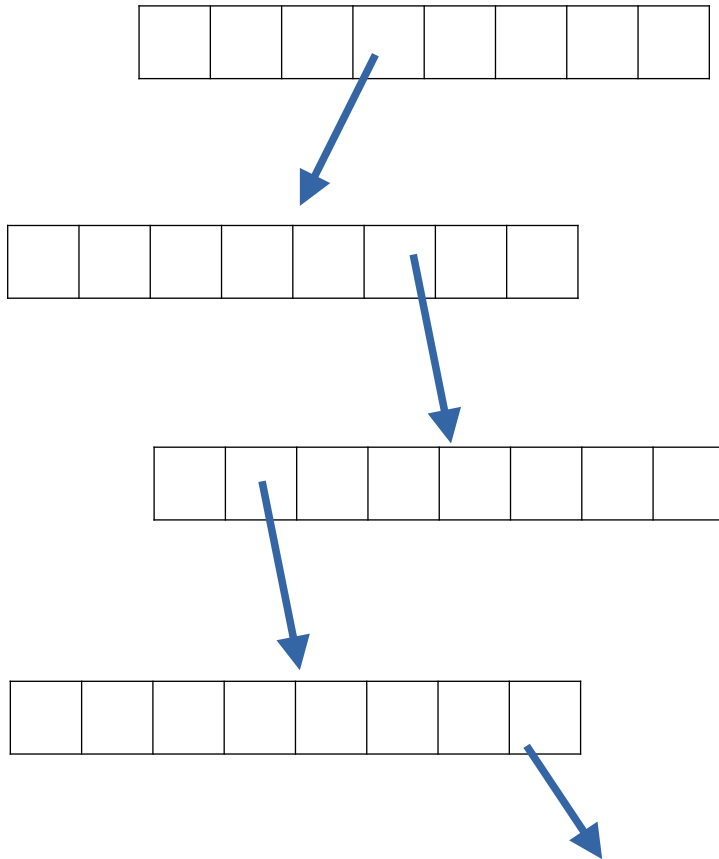
PA

4K frame

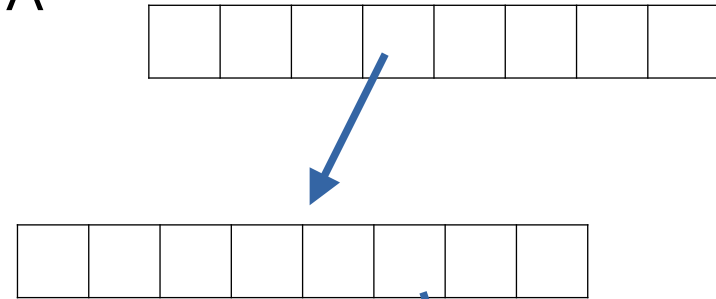


Large Mappings

VA



IPA



PA

1G frame



Hypervisor Support

- OS is “supervisor” of regular system
- Add a super-supervisor = hypervisor
- Hardware adds more of the same:
 - Additional page tables
 - Additional exception levels
 - EL0 - EL3 replace User/Kernel
 - Additional exception/interrupt entry paths
 - VMEnter: activate a VM system
 - VMEExit: exception back to hypervisor level



Summary

- Common evolution:
 - Yesterday's obsolete system
 - Today's compatibility trick
 - Tomorrow's interface
- Virtual Machines
 - Guest virtual OSs
- Modern setup gives good uses for large pages and additional page-table features