

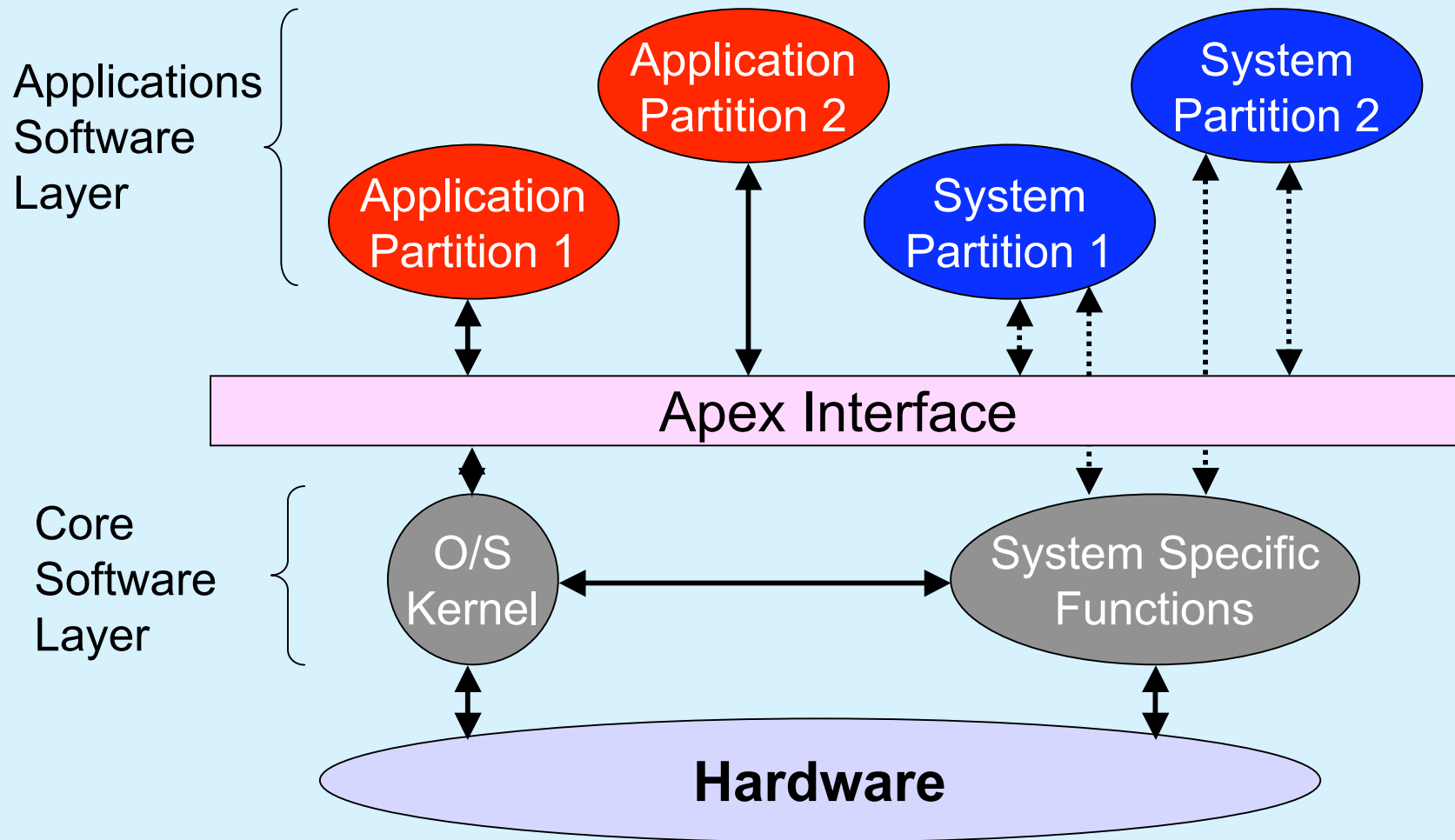


## Ada Programs on the ARINC 653 Platform

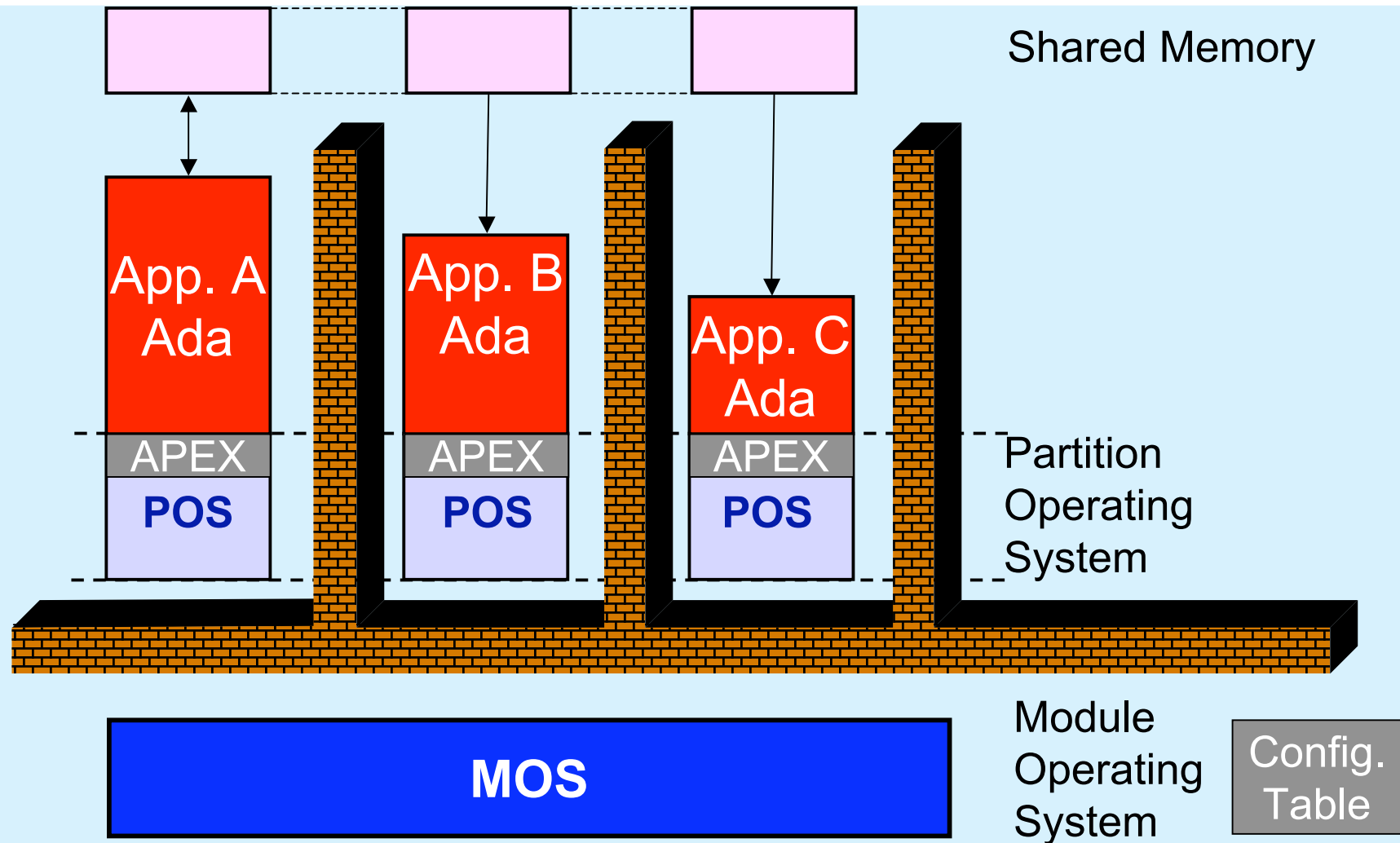
George Romanski

[romanski@verocel.com](mailto:romanski@verocel.com)

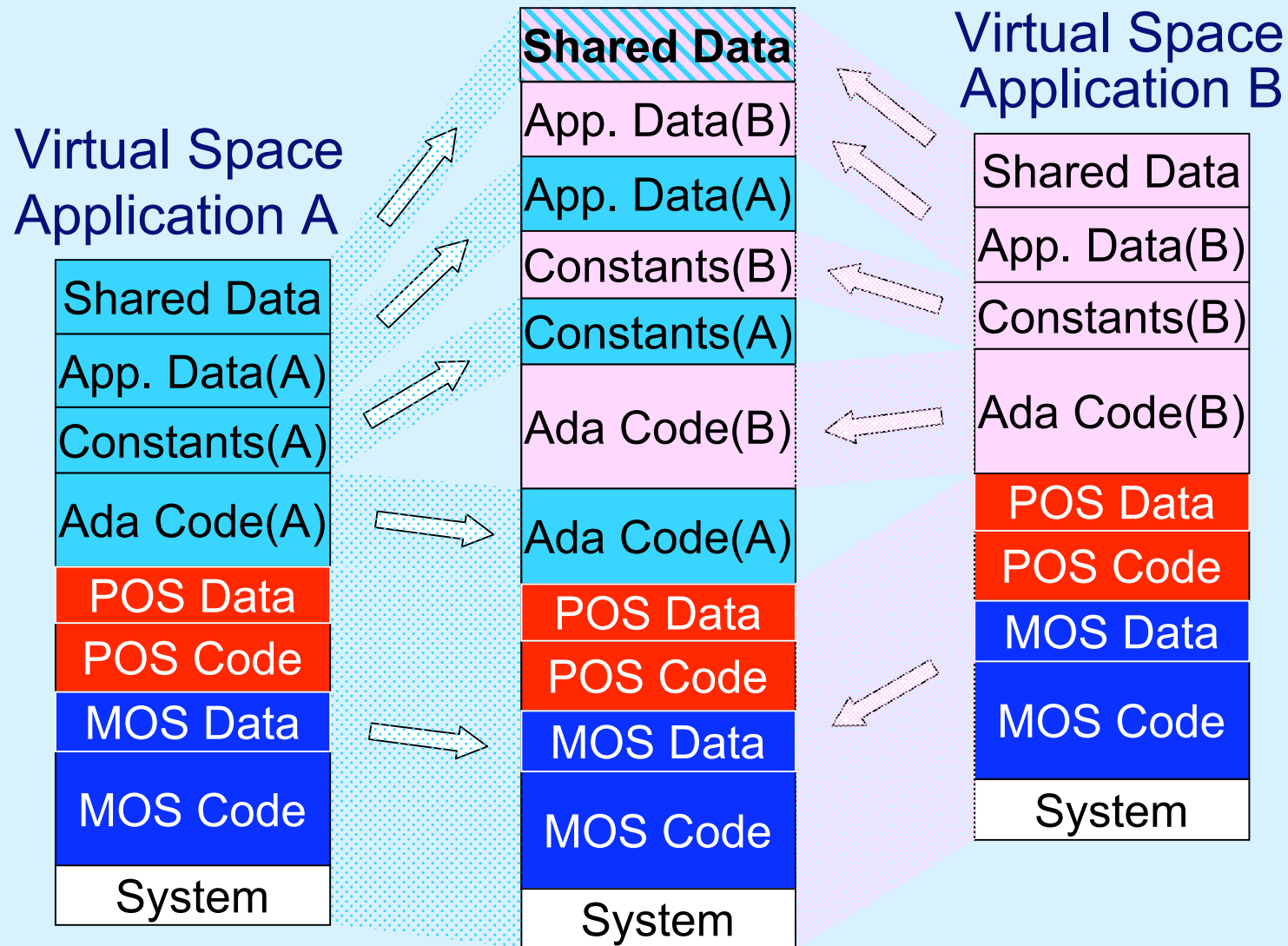
# ARINC-653 Organization



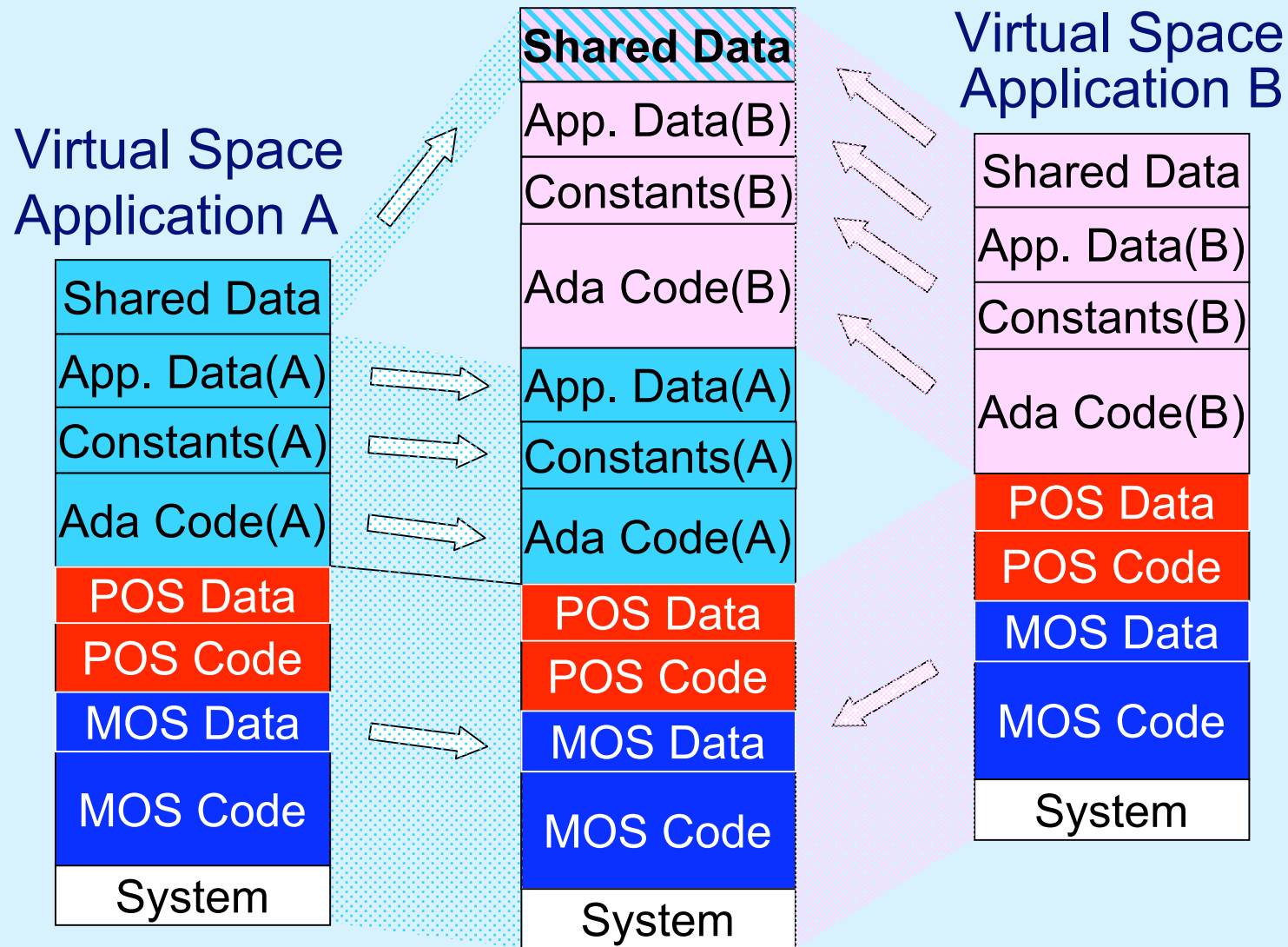
# Partitioning Applications on LRM



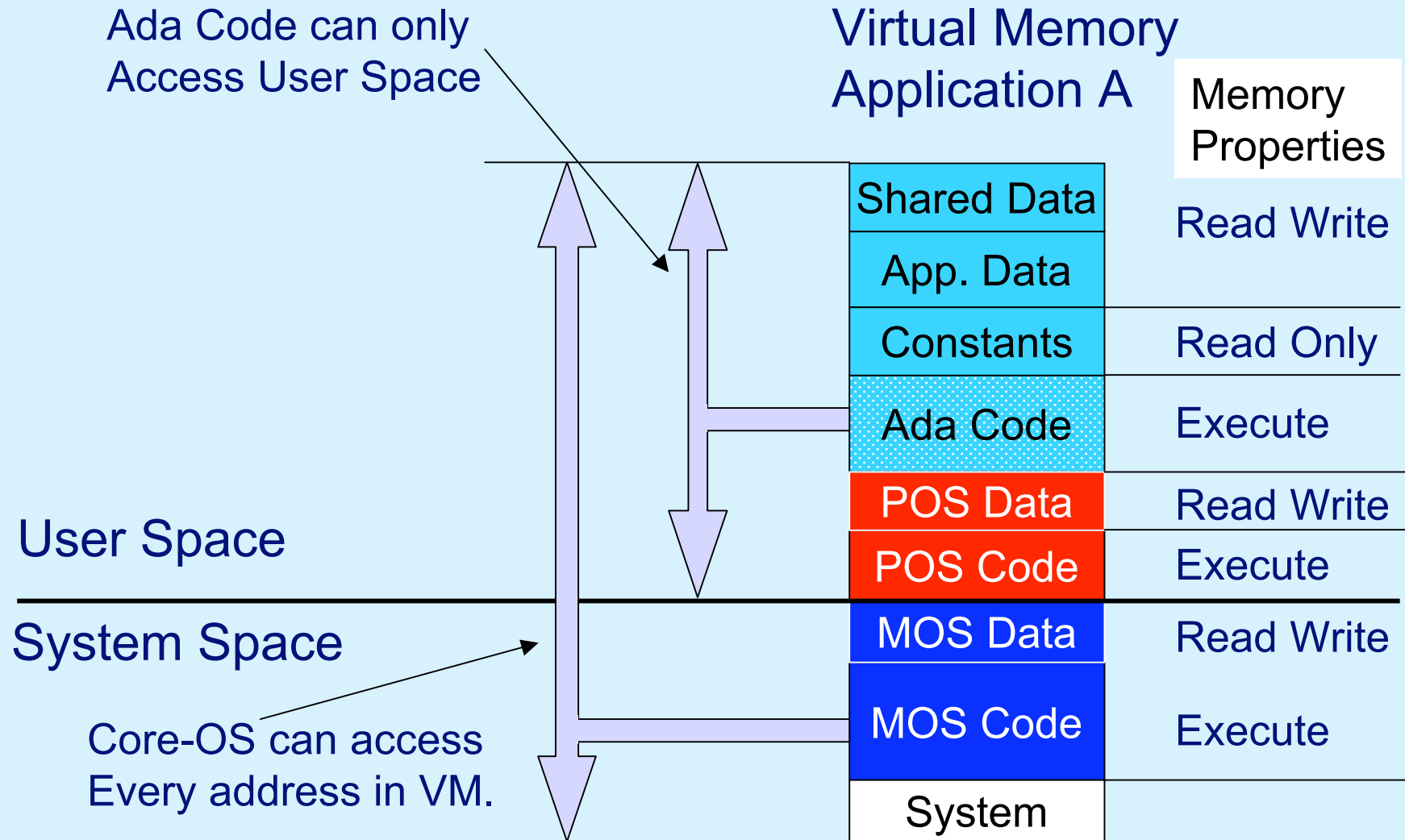
# Virtual to physical mapping - automatic



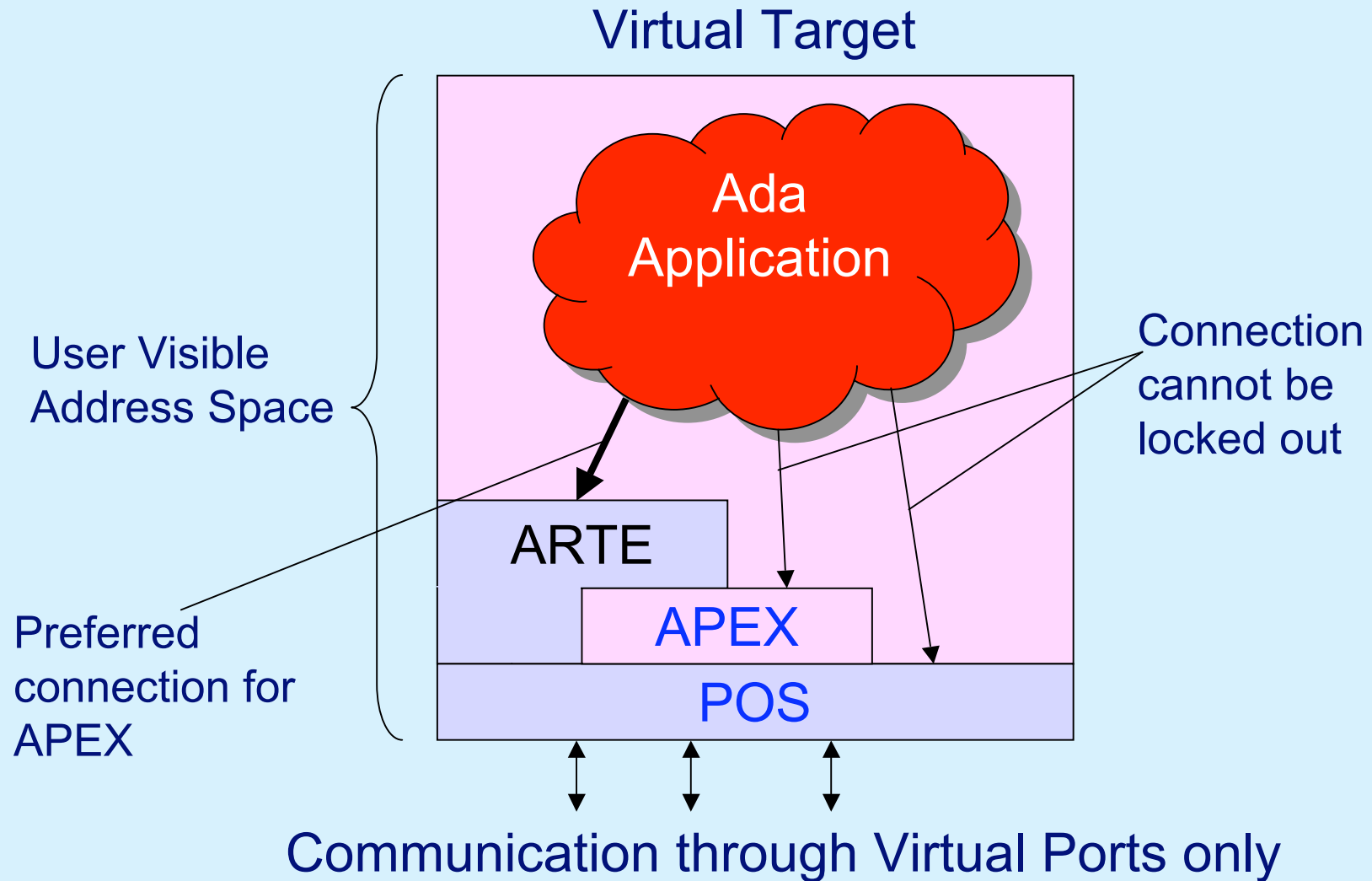
# Virtual to physical mapping-Black Box



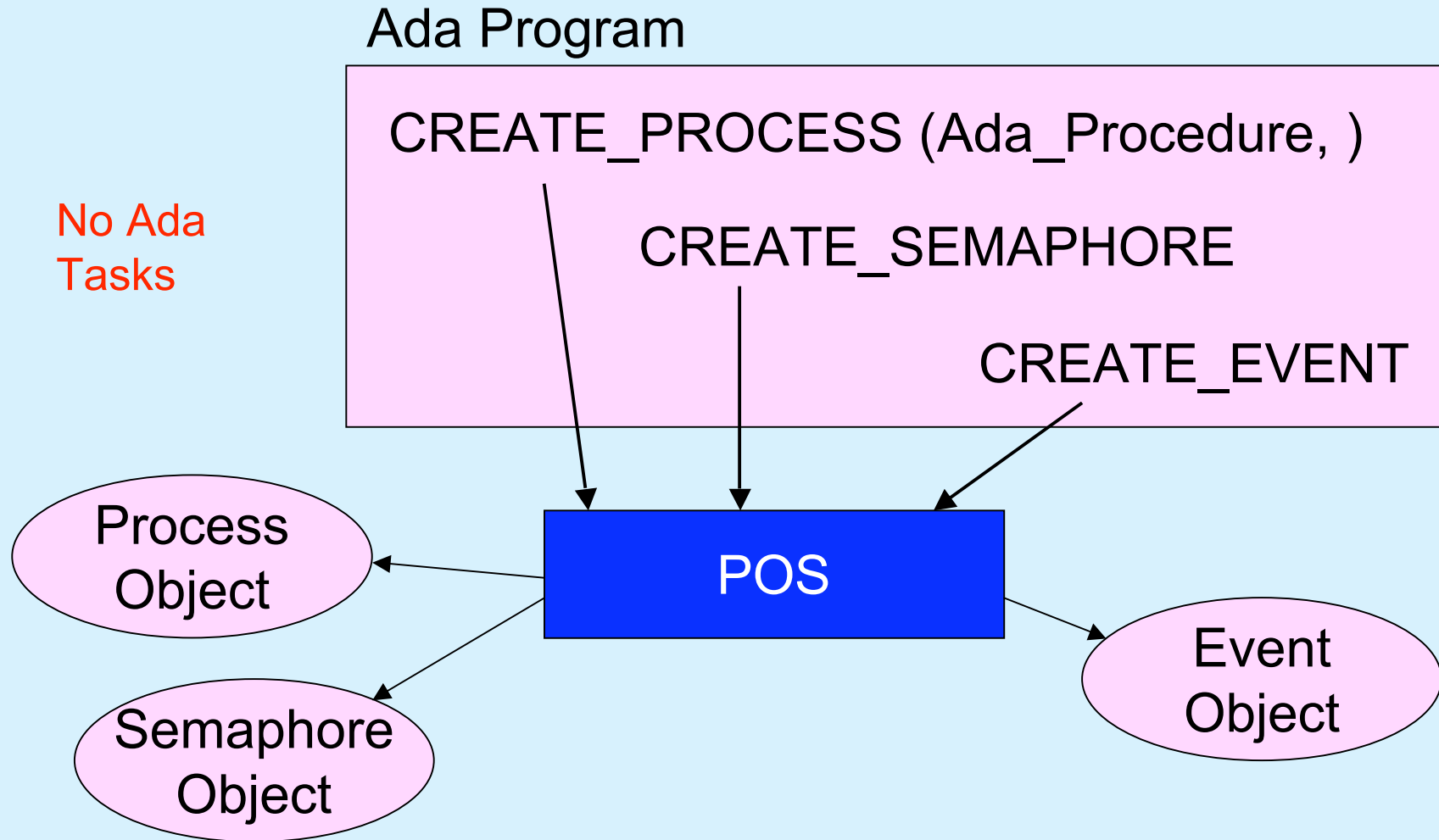
# Virtual memory properties



# IMA Model for an Ada application



# Ada Objects Created not Declared (APEX)

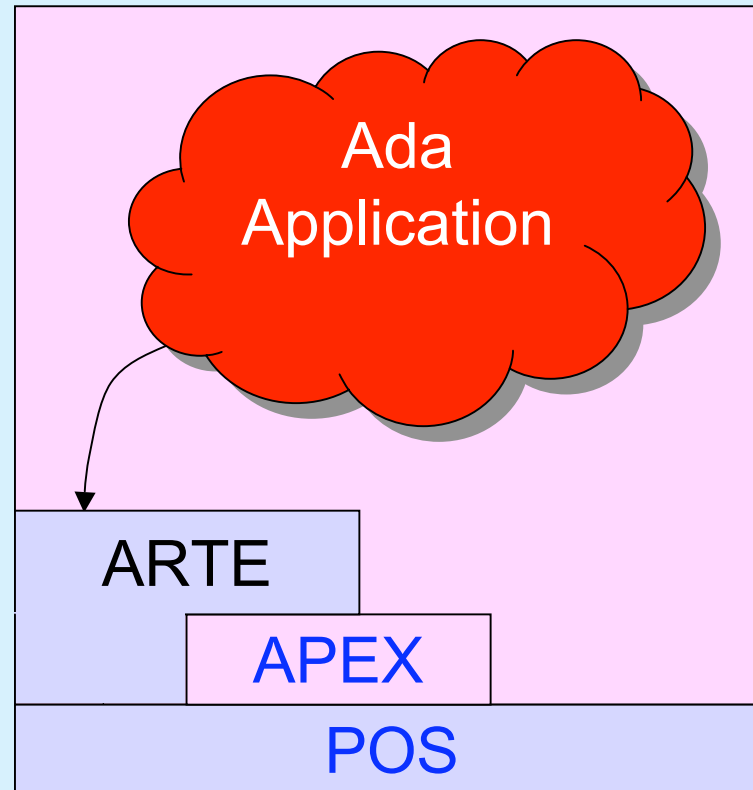


# Ada application needs memory

Code requests memory

ARTE obtains memory  
from POS\*

Heap, Stack, Auxiliary stack

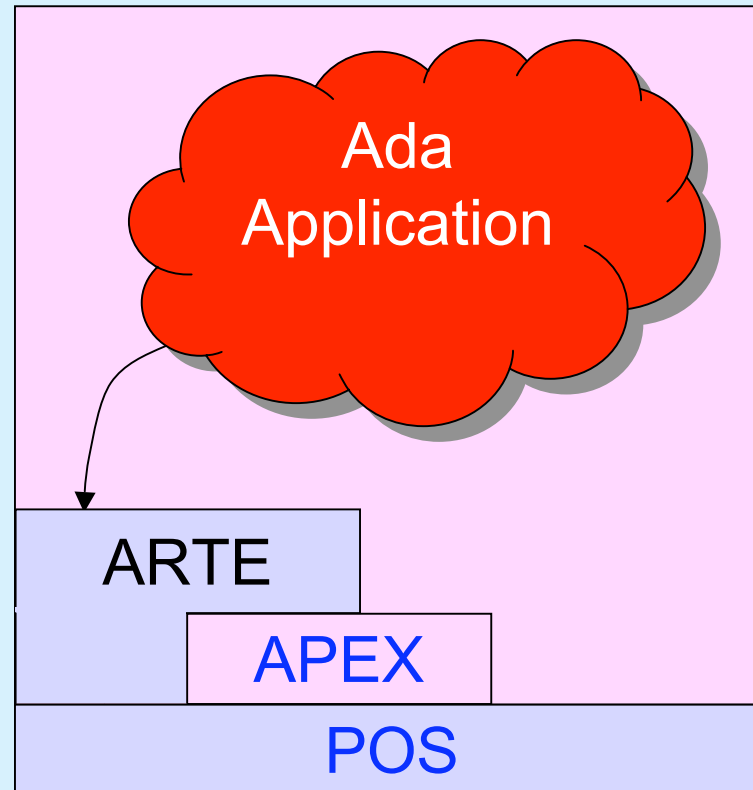


\*Depending on configuration settings –  
this is only available until Partition set to NORMAL

# Ada application is constrained

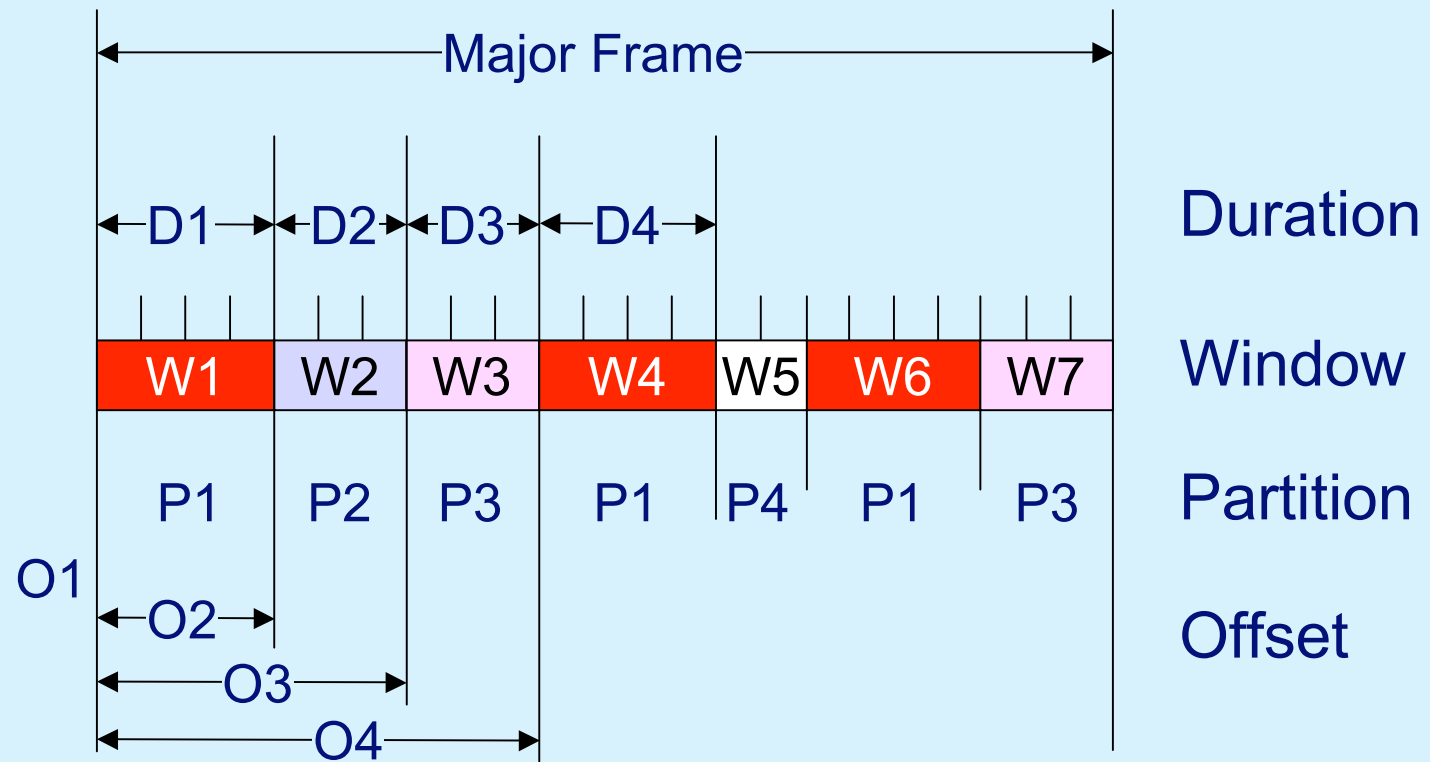
ARTE may provide needed functionality directly or by mapping to POS

- Mathematical functions
- I/O formatting
- Extra long operations



Certain operations and machine code insertions that produce privileged instructions are prohibited

# Allocating Time to Partitions



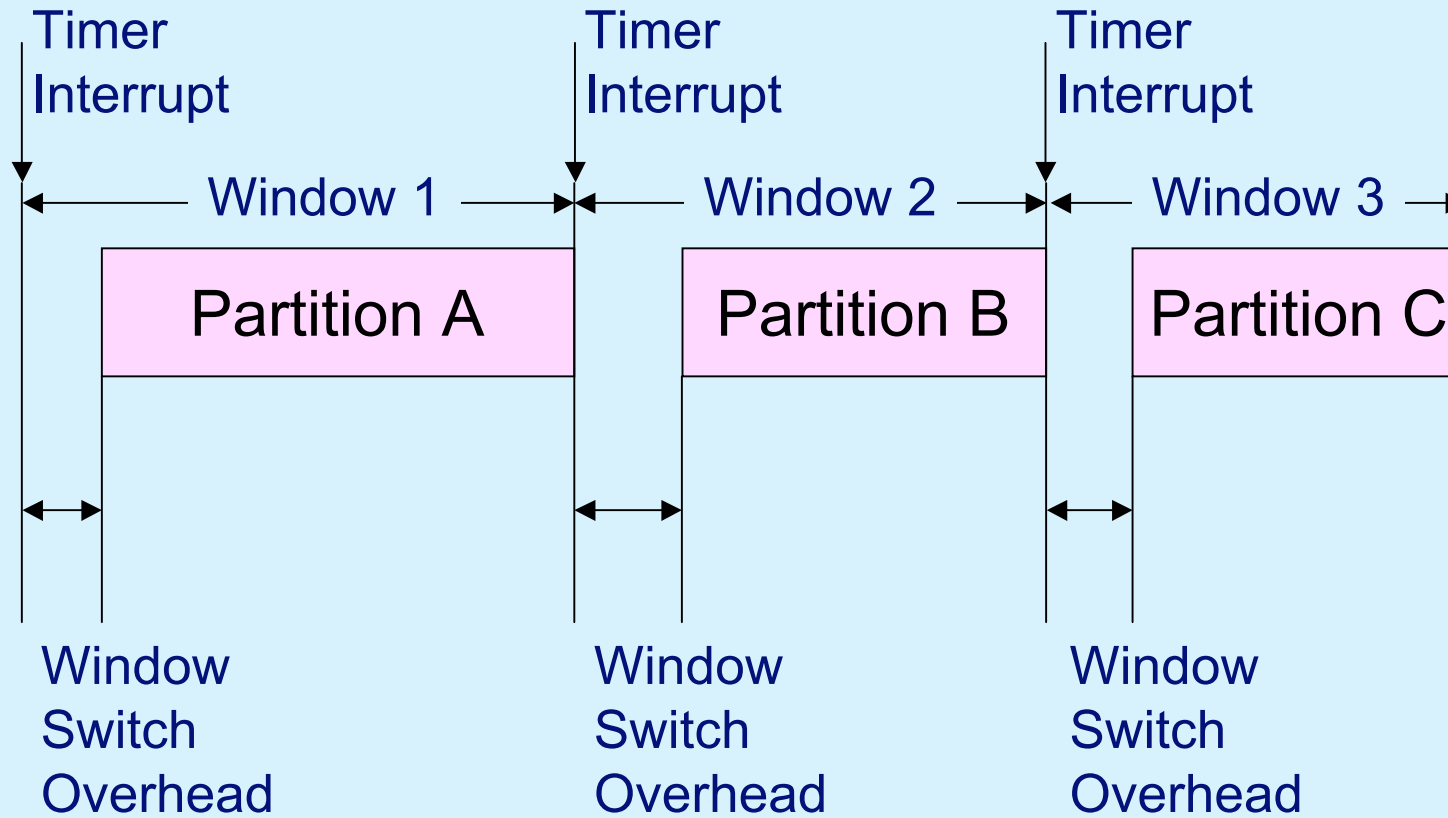
## Multiple Schedules (ARINC 653 Supplement 2)

- ≡ Multiple Partition schedules may be supported
- ≡ Each schedule selects: partitions, durations, offsets
- ≡ Partitions may be replaced, removed or added
- ≡ Schedule switch may be invoked by
  - ≡ MOS
  - ≡ System level Partition (special privilege)

Multiple Schedules

- Particularly important at start-up
- Mode switching
- Debugging/Testing

# Time Between Partitions



# Window Switch Overhead

- ≡ Fixed Overhead
  - ≡ Context switch
- ≡ Variable Overhead
  - ≡ Page Table Entries
  - ≡ Cached Data (L1, L2)
  - ≡ Cached Instructions (L1, L2)
- ≡ Timing Jitter
  - ≡ Ignore on partition boundaries
  - ≡ Cache flush
  - ≡ Cache Invalidate

Caching policy may  
be configured  
Write-through,  
Copy-back

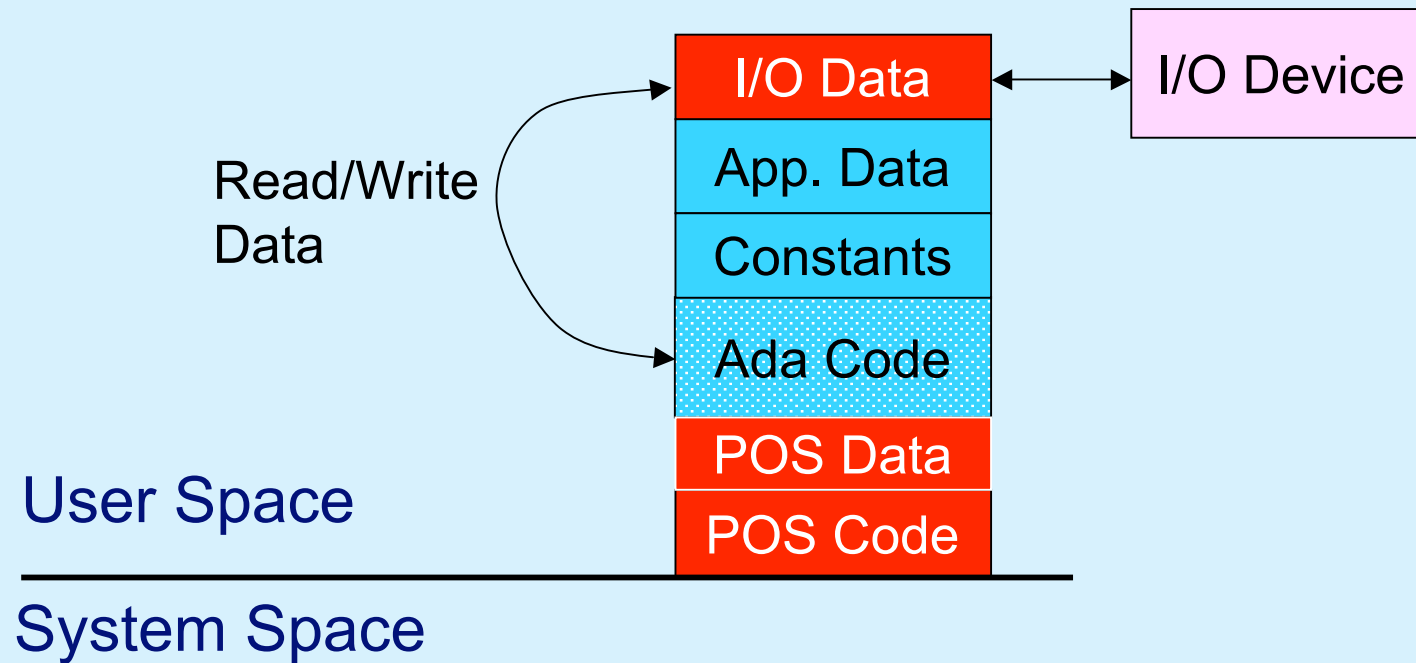


## Ada Program timing.

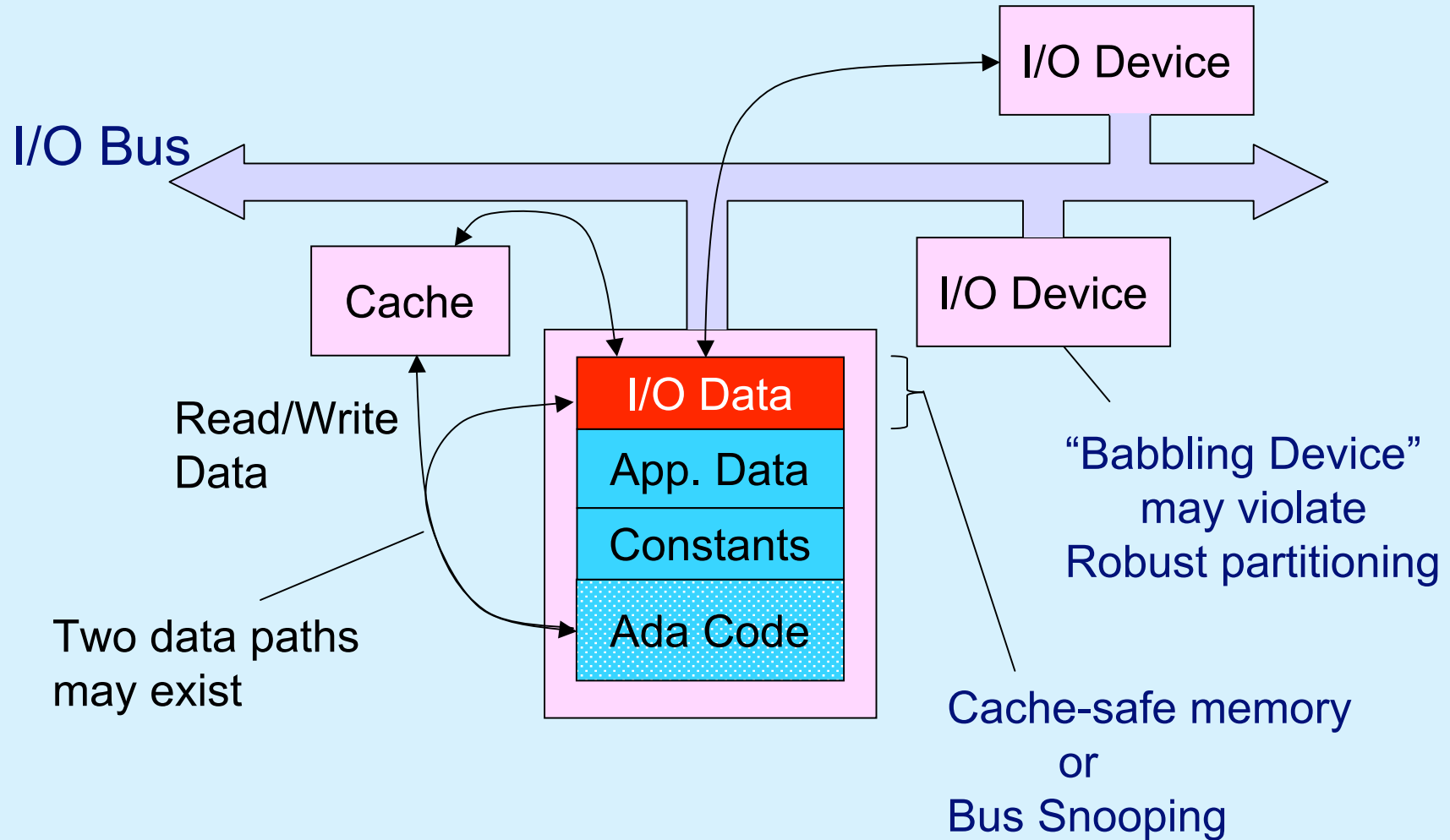
- ≡ Time moves with wall clock (not partition)
- ≡ External events are only recognised during partition time
- ≡ Output only to Ports or “Special” I/O
- ≡ Time ticks are “bunched” to start of partition window
- ≡ Cache effects may cause time of throughput to stretch

Application timing requires large margins  
or  
careful analysis

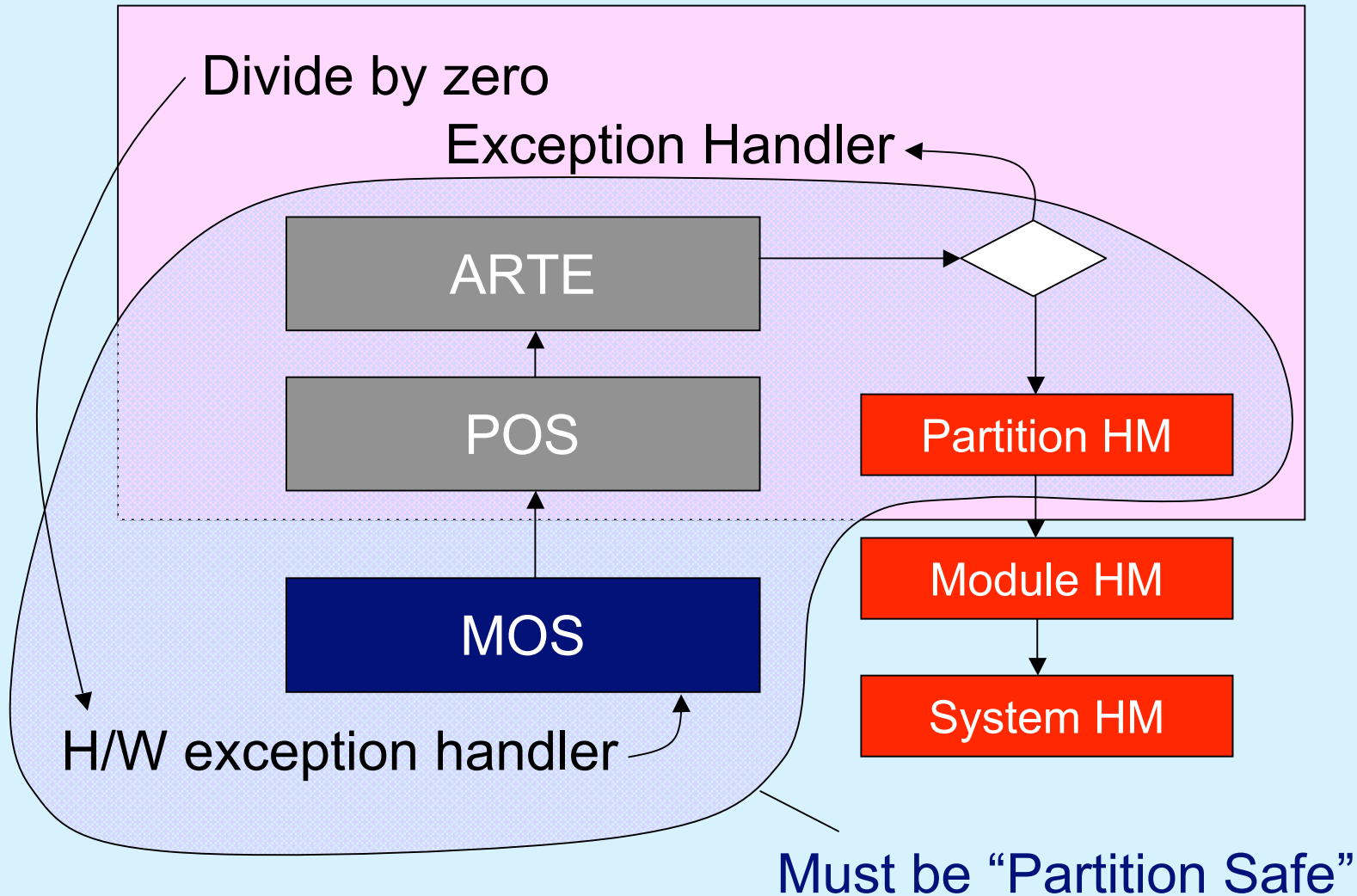
# Virtual Memory Mapped I/O



# Physical Memory Mapped I/O



# Ada Exceptions



# Ada on ARINC 653 – Robust Partitioning

- ≡ Memory
  - ≡ Easiest to configure and analyse (depending on tools provided)
- ≡ Shared global resources
  - ≡ Analysis depends on how device drivers were written
  - ≡ Can be very system specific
- ≡ Time
  - ≡ Most difficult to analyse
  - ≡ May require ‘generous’ margins

## Ada on ARINC 653

- ≡ Use of ARINC 653 platform growing quickly
  - ≡ Most new airframes are based on ARINC 653
  - ≡ Lots of software in the avionics field is being adapted to ARINC 653

**Applications Require Careful Configuration**