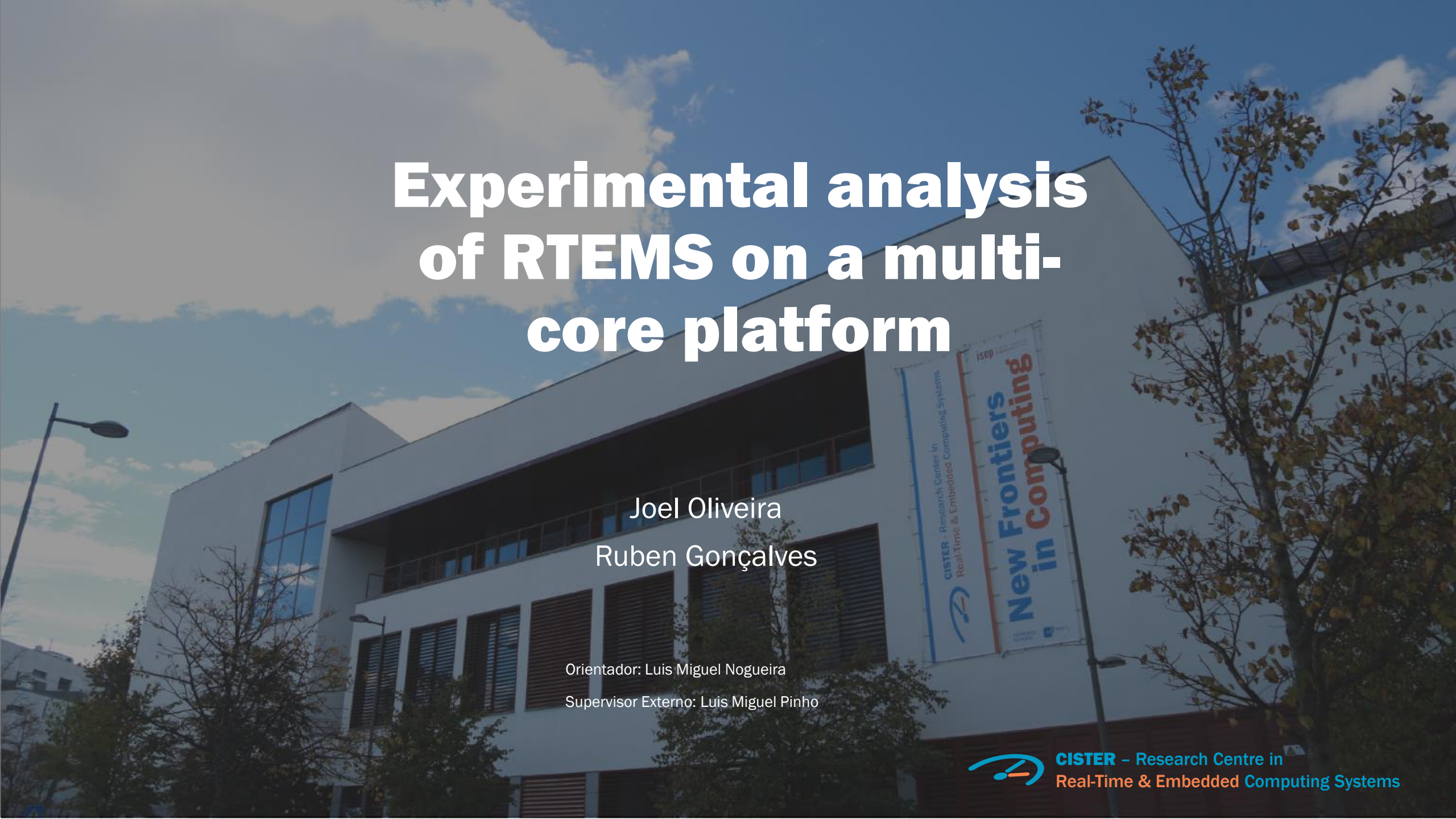


Experimental analysis of RTEMS on a multi-core platform

Joel Oliveira

Ruben Gonçalves

Orientador: Luis Miguel Nogueira

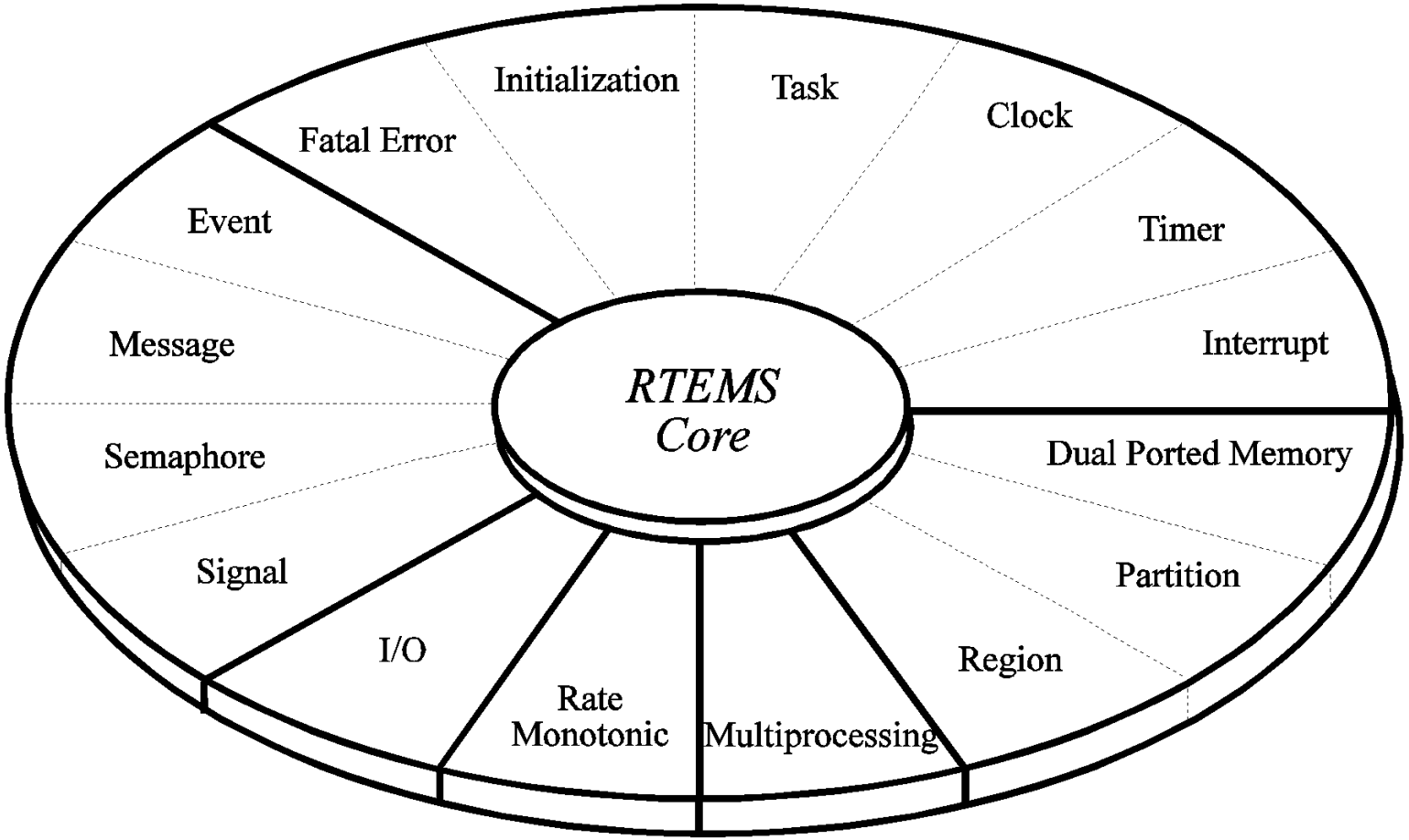
Supervisor Externo: Luis Miguel Pinho

CISTER – Research Centre in Real-Time & Embedded Computing Systems

The Problems

- Switch from UniProcessor to MultiProcessor
  - Scheduling
  - Synchronization (shared resources)

RTEMS


Initialization
Task
Clock
Fatal Error
Event
Timer
Message
Interrupt
RTEMS
Core
Semaphore
Dual Ported Memory
Signal
Partition
I/O
Region
Rate
Monotonic
Multiprocessing

RTEMS SMP Schedulers

- Simple Priority
- Deterministic Priority
- EDF (Earliest Deadline First)
- Arbitrary Affinity Deterministic Priority

RTEMS Synchronization

- Signals
- Events
- Message Queues
- Semaphores
  - barriers
  - binary semaphores with MrsP (priority ceiling)
  - binary semaphores with OMiP (priority inheritance)

Multiprocessor Resource Sharing Protocol (MrsP)

- Generalization of Priority Ceiling Protocol
- Considerations kept to fixed-priority scheduling
- Spin-based locking
- Helping hand mechanism

O(m) Independece Preserving Protocol (OMiP)

- Generalization of Priority Inheritance Protocol
- First independence preserving protocol for multiprocessor
- Suspension-based locking
- Migratory Priority Inheritance
- Proved to be impossible to bound priority inversion times while preserving the independence of tasks and avoid inter-cluster migration.

Solution

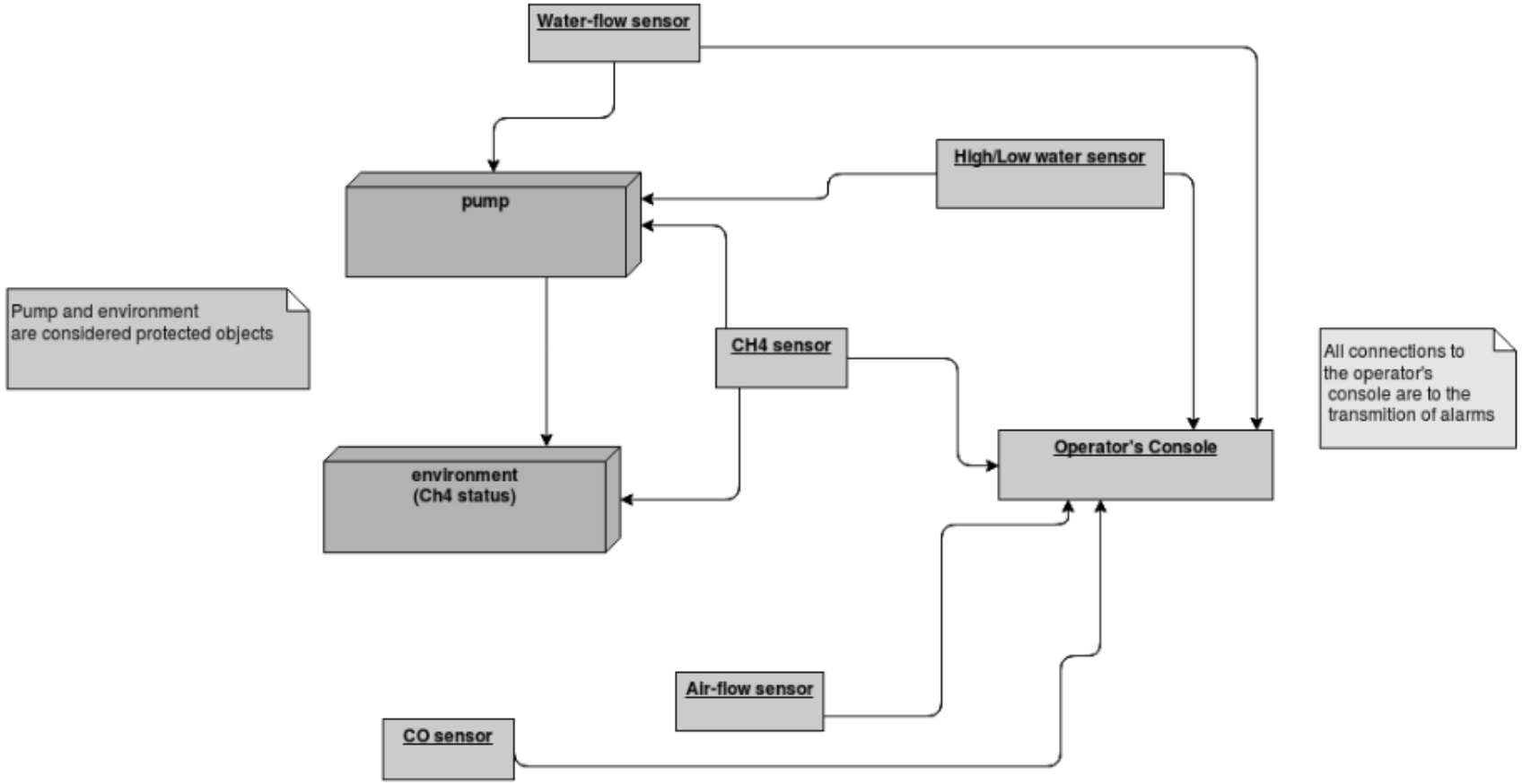
- Circular Buffer
- Samples (RTEMS Applications)
- Mine Control Case Study

Testsuites implemented

- Simple Priority
- Deterministic Priority
- EDF (Earliest Deadline First)
- Arbitrary Affinity Deterministic Priority
- Clustered scheduling

- MrsP helping protocol
- Omip helping protocol (not implemented)
- Barriers
- Events
- Message Queues

Mine Control Case Study



Mine Control Schedulability Test

$$R_k^{max} \leftarrow C_k + \frac{1}{m} \sum_{\tau_j \in hp(k)} \left(\left\lceil \frac{R_k^{max}}{T_j} \right\rceil C_j + C_j \right)$$

Conclusion and Future Work