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On the Effect of Protected Entry Servicing Policies on the Response Time of Ada Tasks

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Context

- Apply general **multiprocessor** resource sharing protocols to Ada tasking model
 - Scheduling
 - Implementation

Problem statement

- Multiprocessor protocols define general policies for accessing shared resources
 - Upper-bound number of access requests
 - Upper-bound access time per request

- Servicing policies
 - Priority based
 - FIFO queues

MSRP

MrsP

FMLP

RNLP

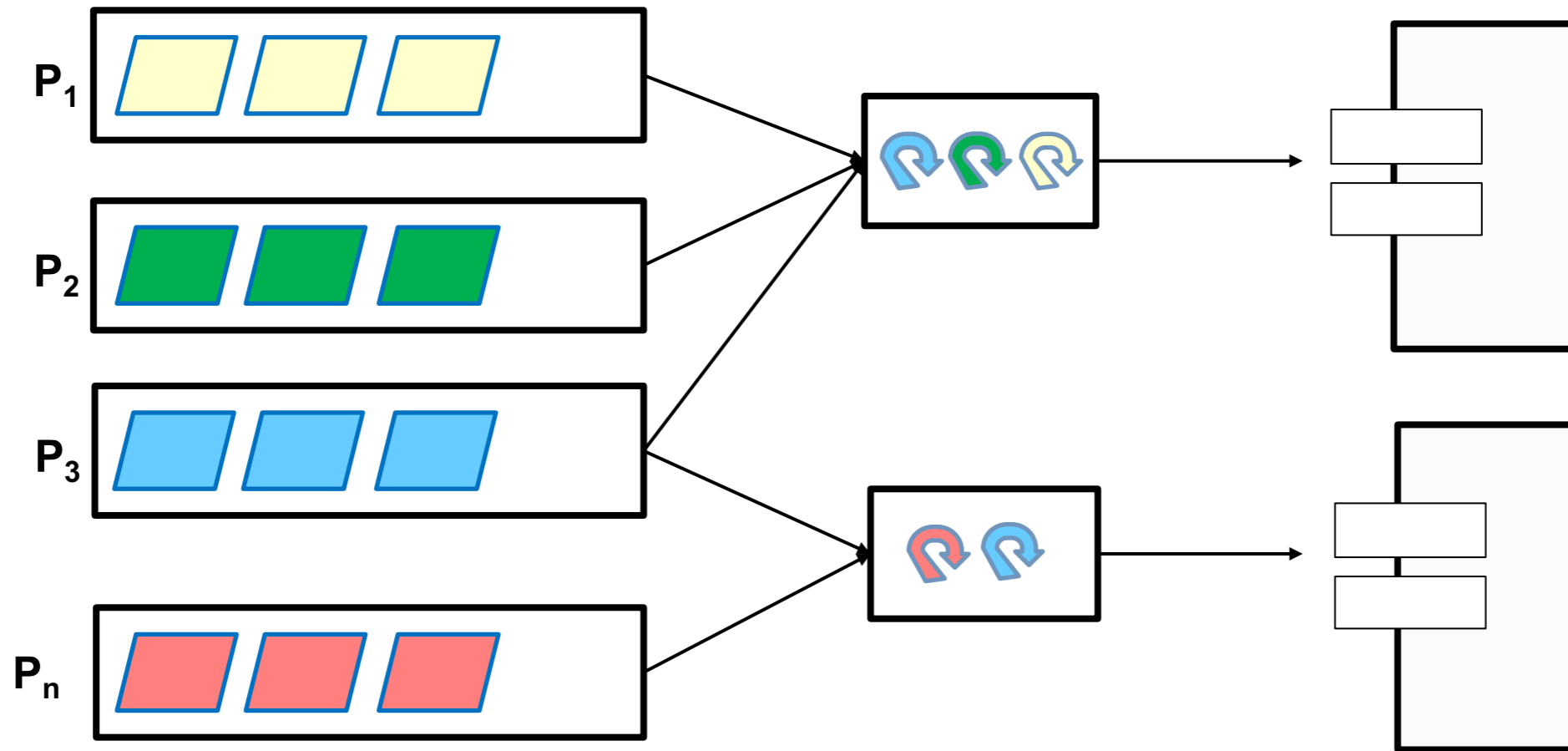
SEPP

M-BWI

MSRP & MrsP

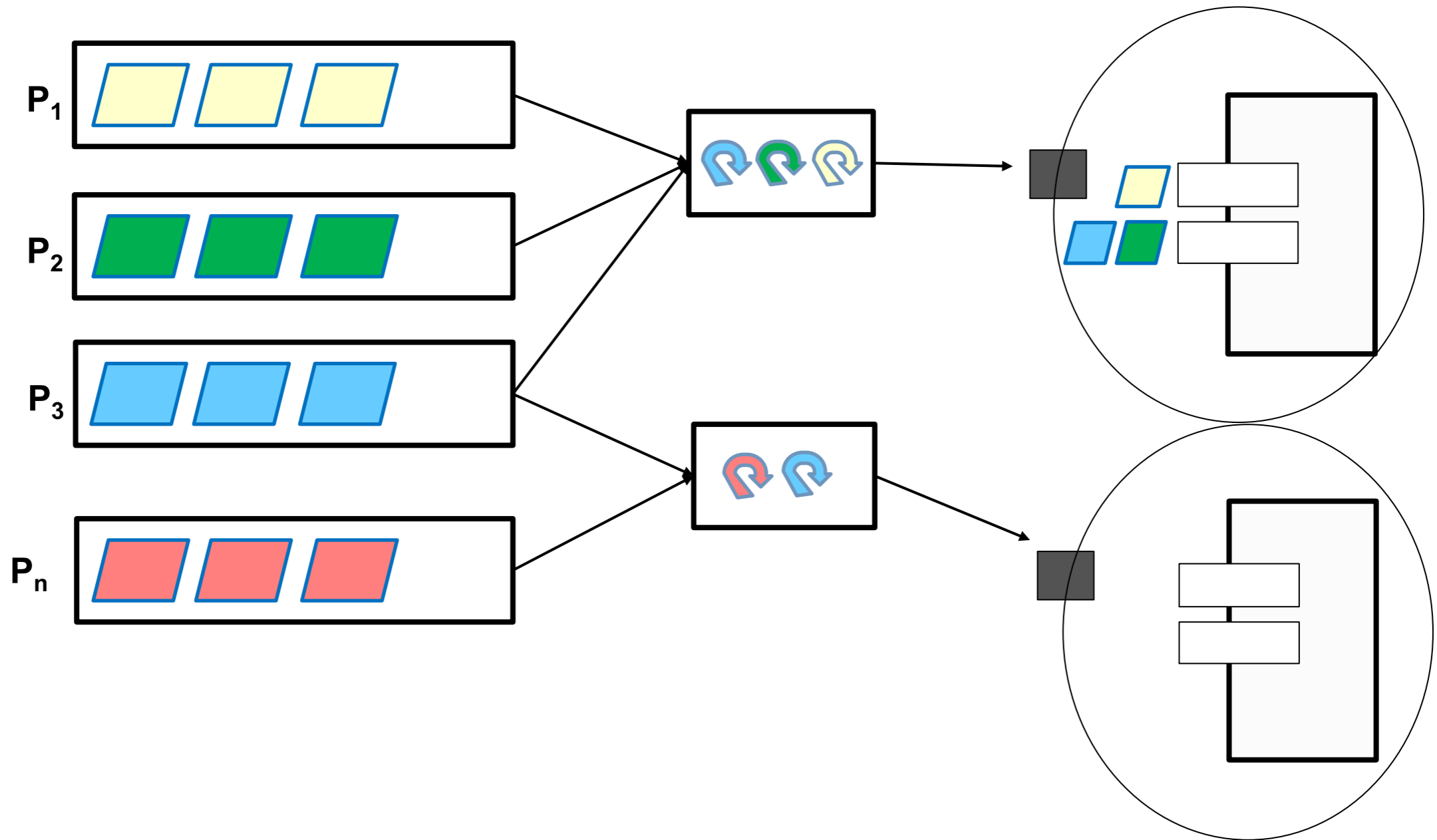
- MSRP – Multiprocessor Stack Resource Policy
 - MrsP – Multiprocessor Resource Sharing Protocol
-
- ✓ PCP/SRP-based protocols
 - ✓ Fixed priority scheduling
 - ✓ Access cost to globally shared resources bounded
 - ✓ Number of concurrent accesses
 - ✓ Spin-waiting FIFO order
 - ✓ Spin-wait & access
 - MSRP : non-preemptable
 - MrsP : local ceiling priority + helping mechanism

MSRP & MrsP



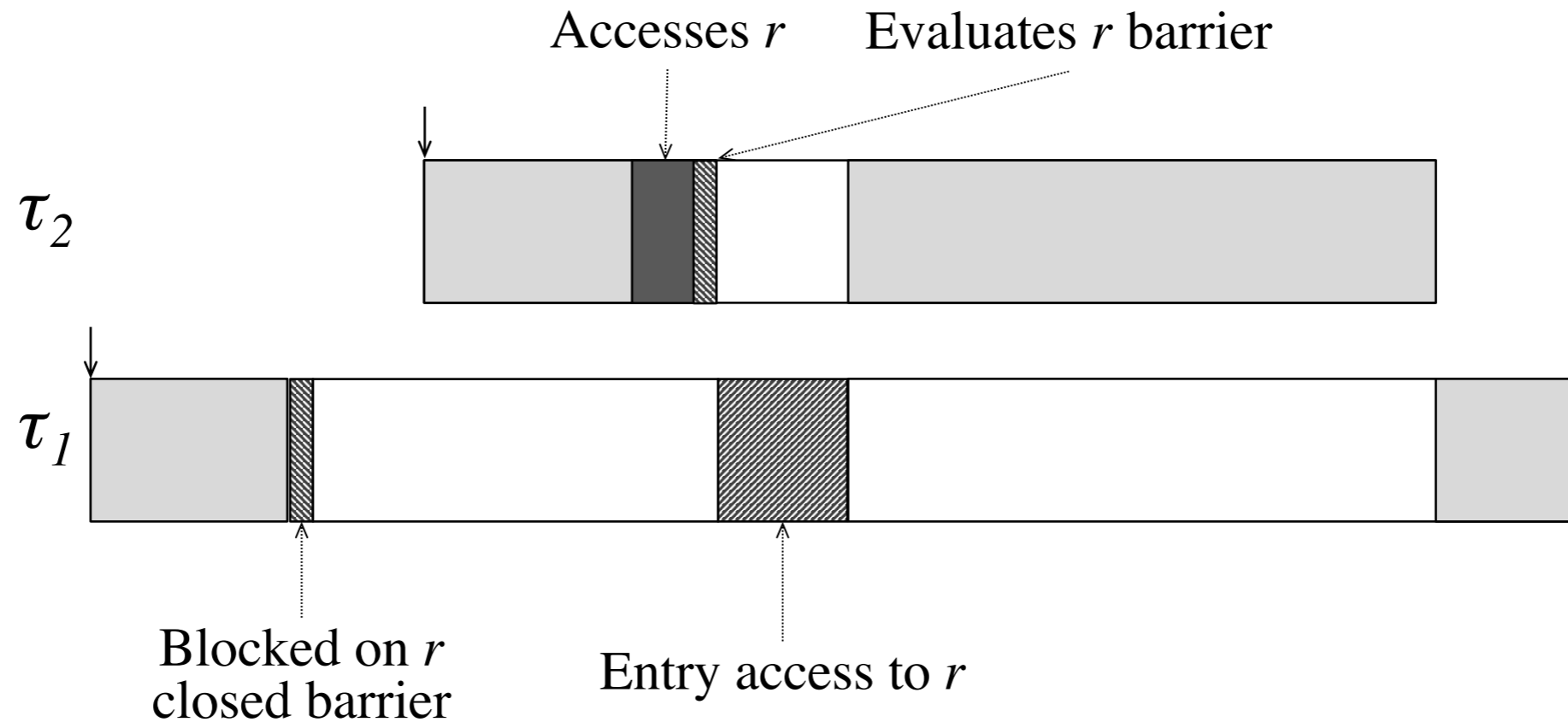
$$e^j = \underbrace{|map(G(r^j))|}_{\text{queue}} \underbrace{c^j}_{\text{access time}}$$

MSRP & MrsP



$$e^j = ?$$

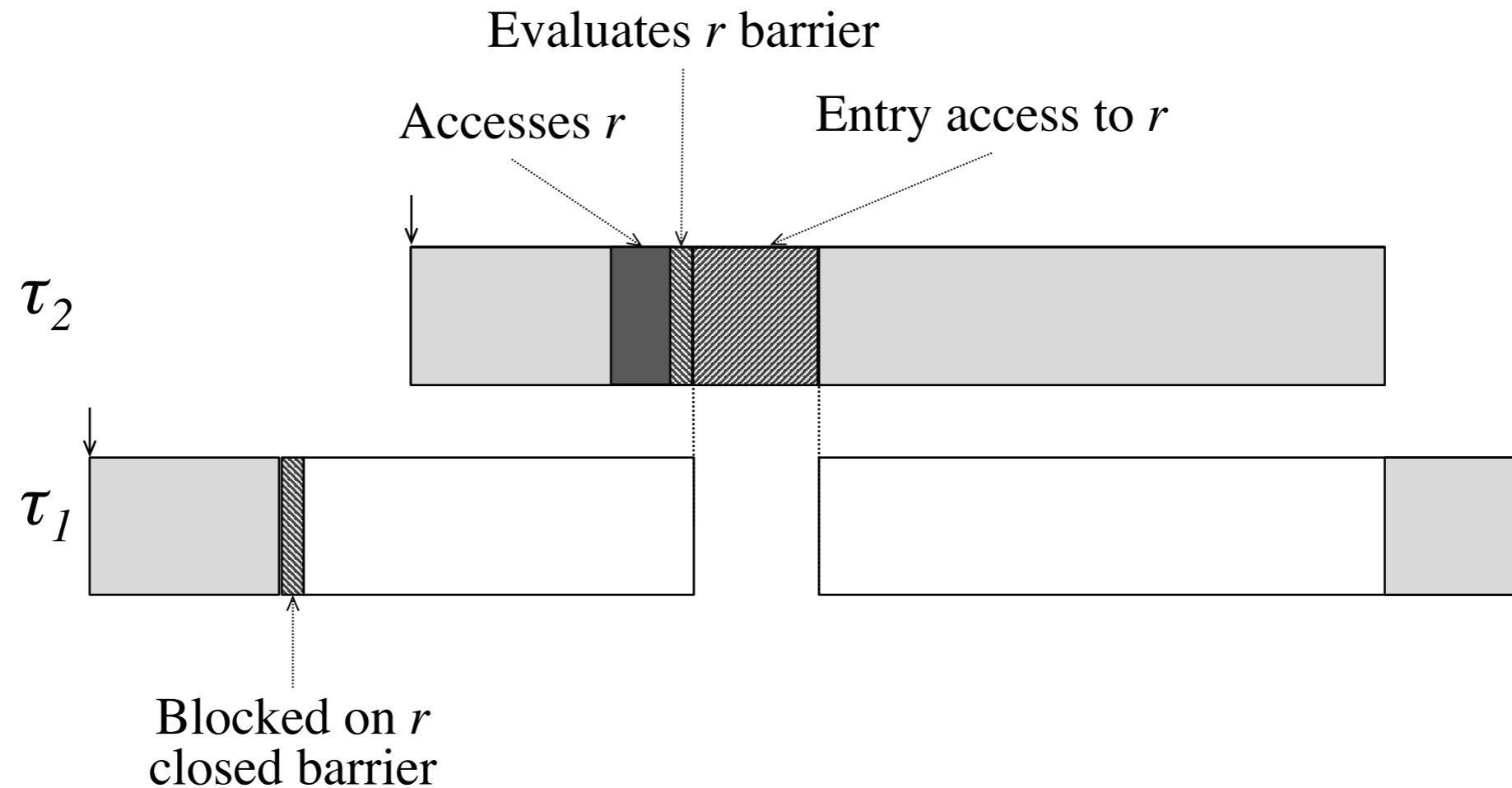
Self-Service Model



- Simple approach
- Potential parallel execution on multiprocessors

- More context switches if on same processor
- Difficult to implement

Proxy Model

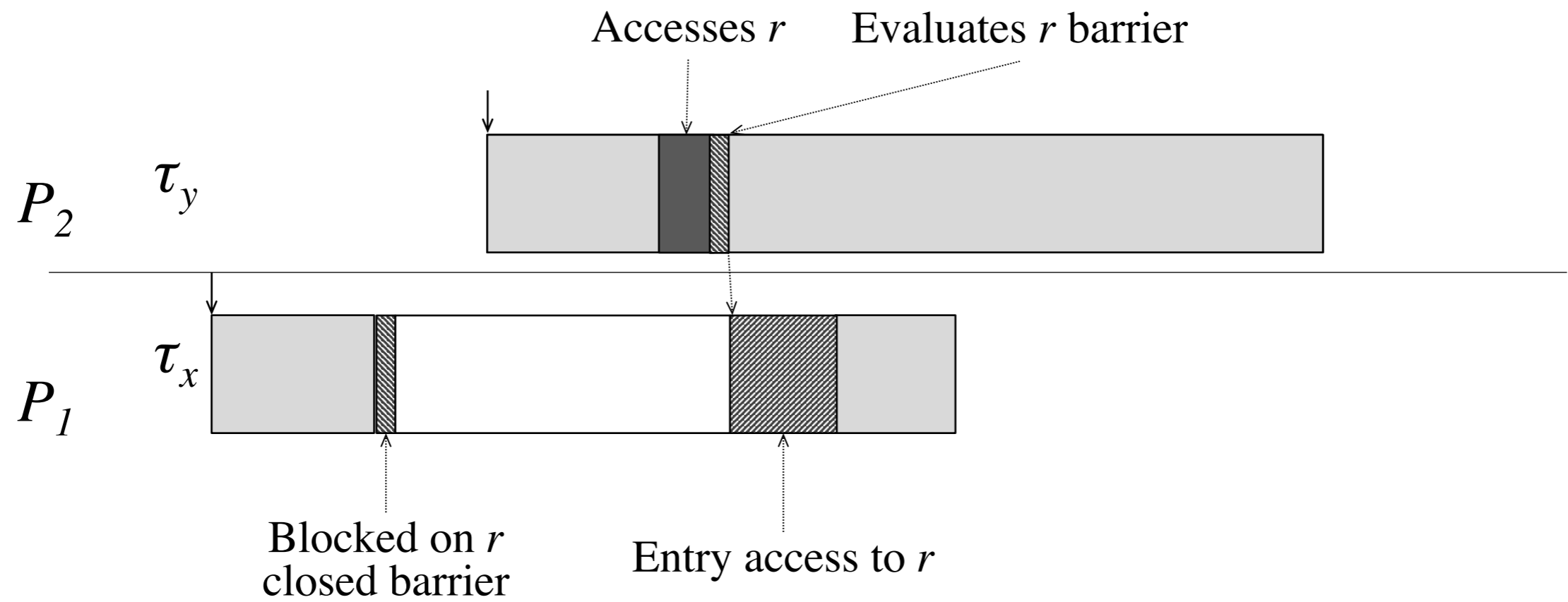


- Less context switches
- Simple implementation

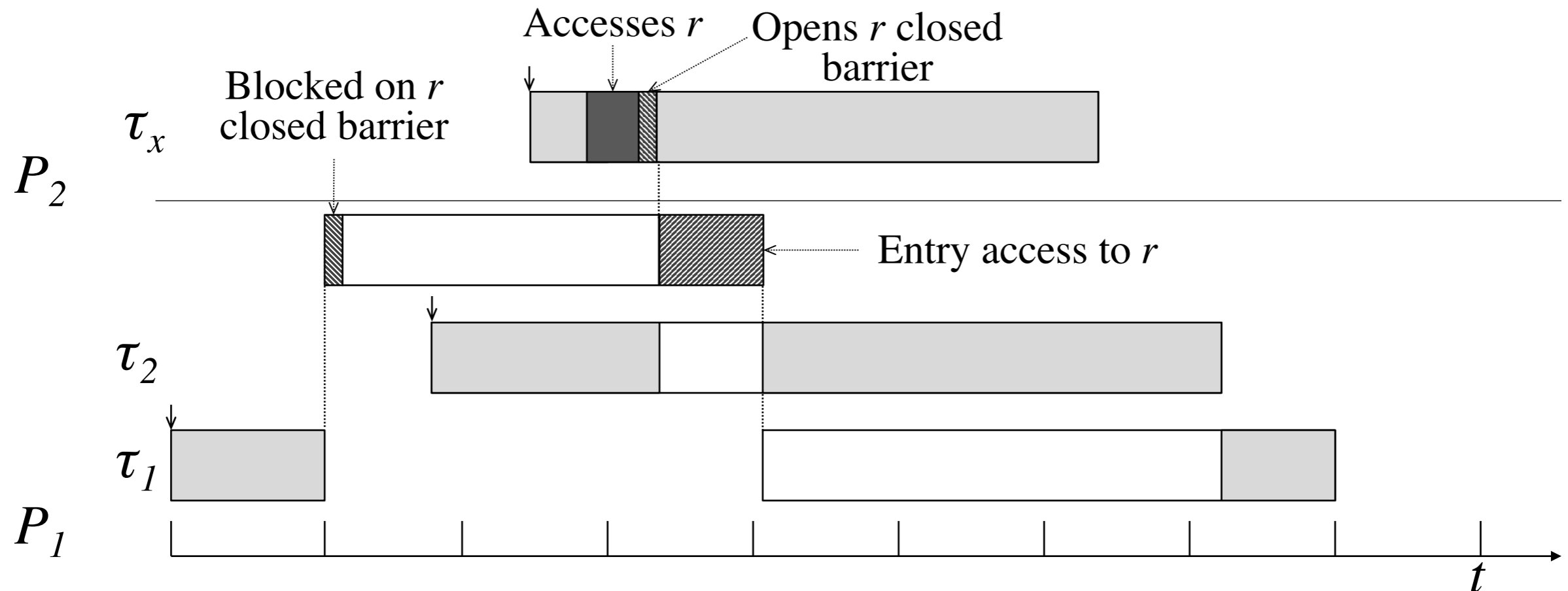
- More complex design
- Overhead for server task

Which should be the preferred servicing implementation model for multiprocessor systems?

Ideal

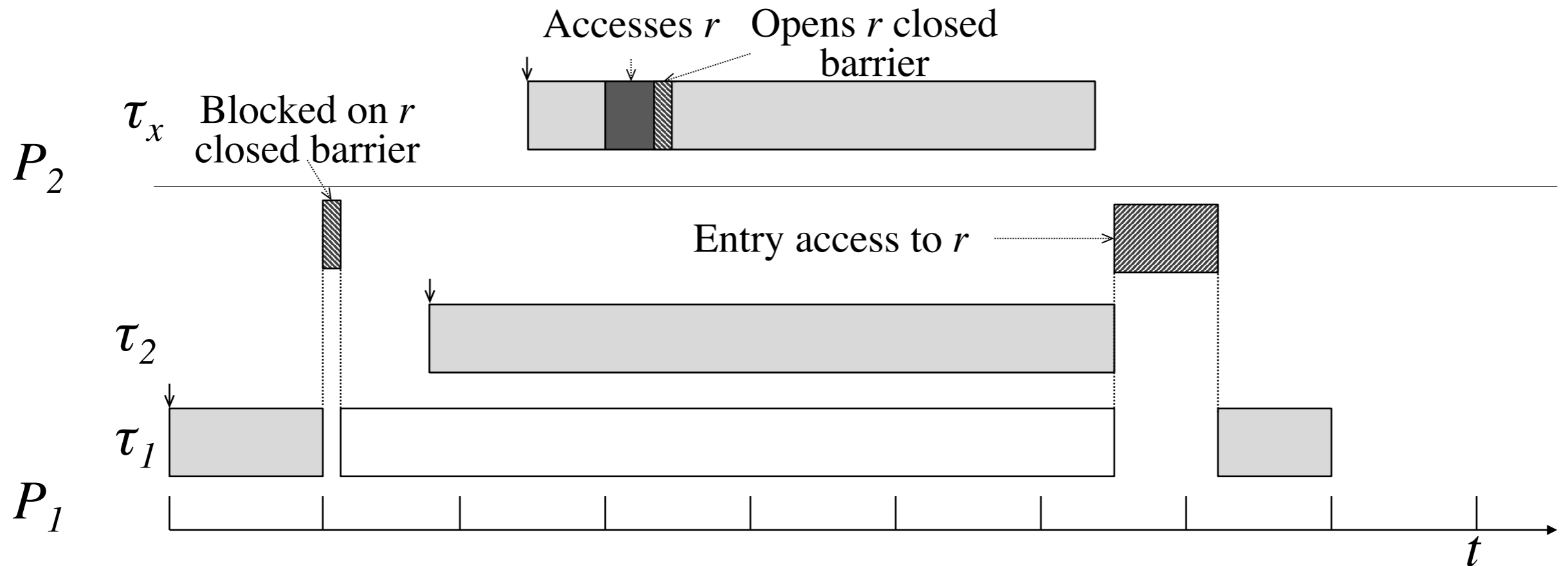


Self-service approach (I)



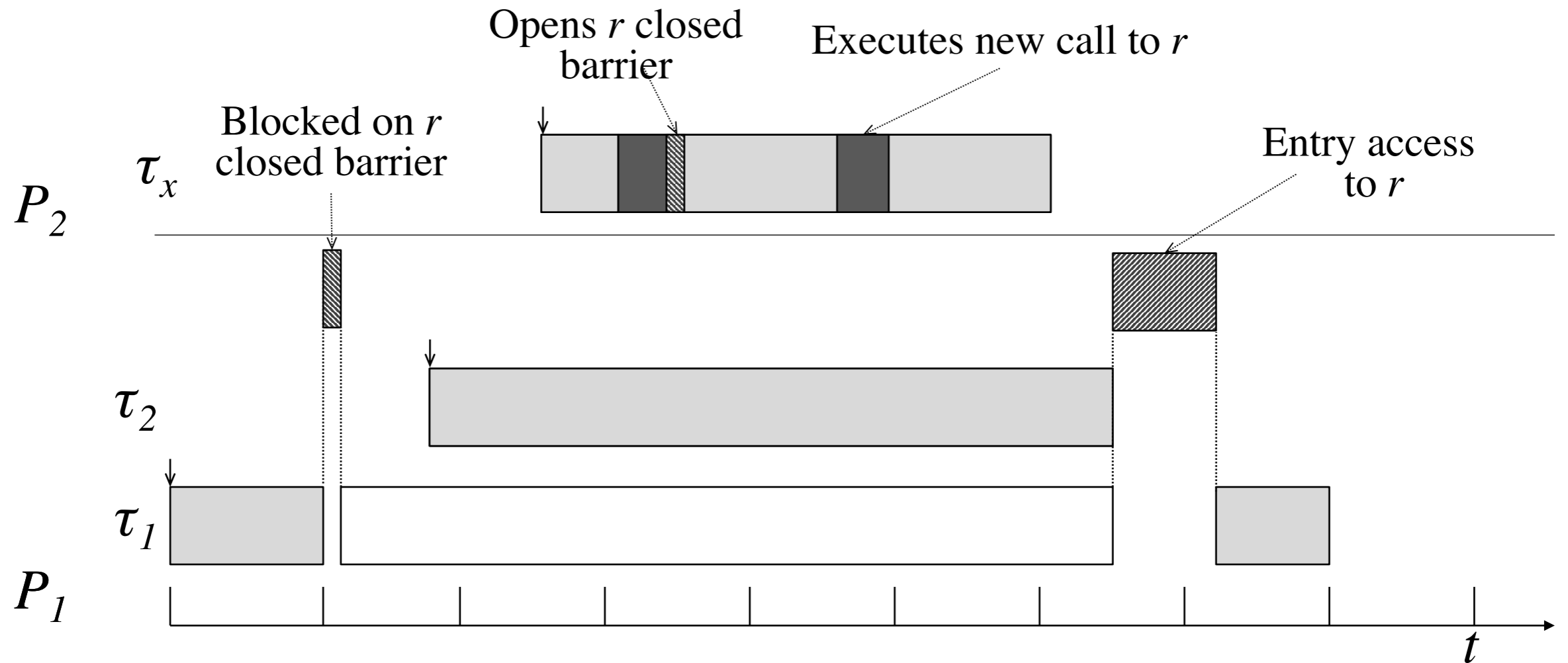
- Directly applying self-service on multiprocessor
 - Does not preserve PCP/SRP properties

Self-service approach (II)



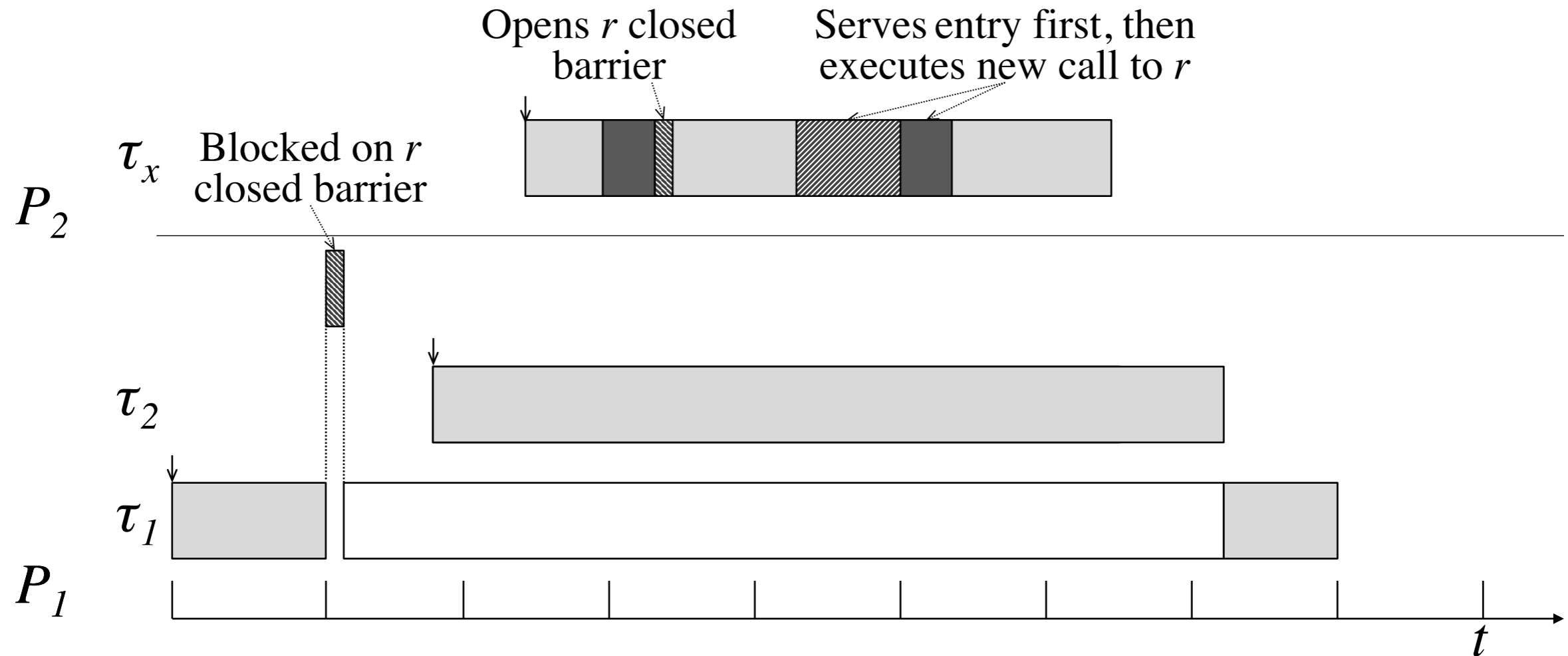
- Potential solution:
 - Revert to previous active priority when queued on entry
- But ...

Self-service approach (III)



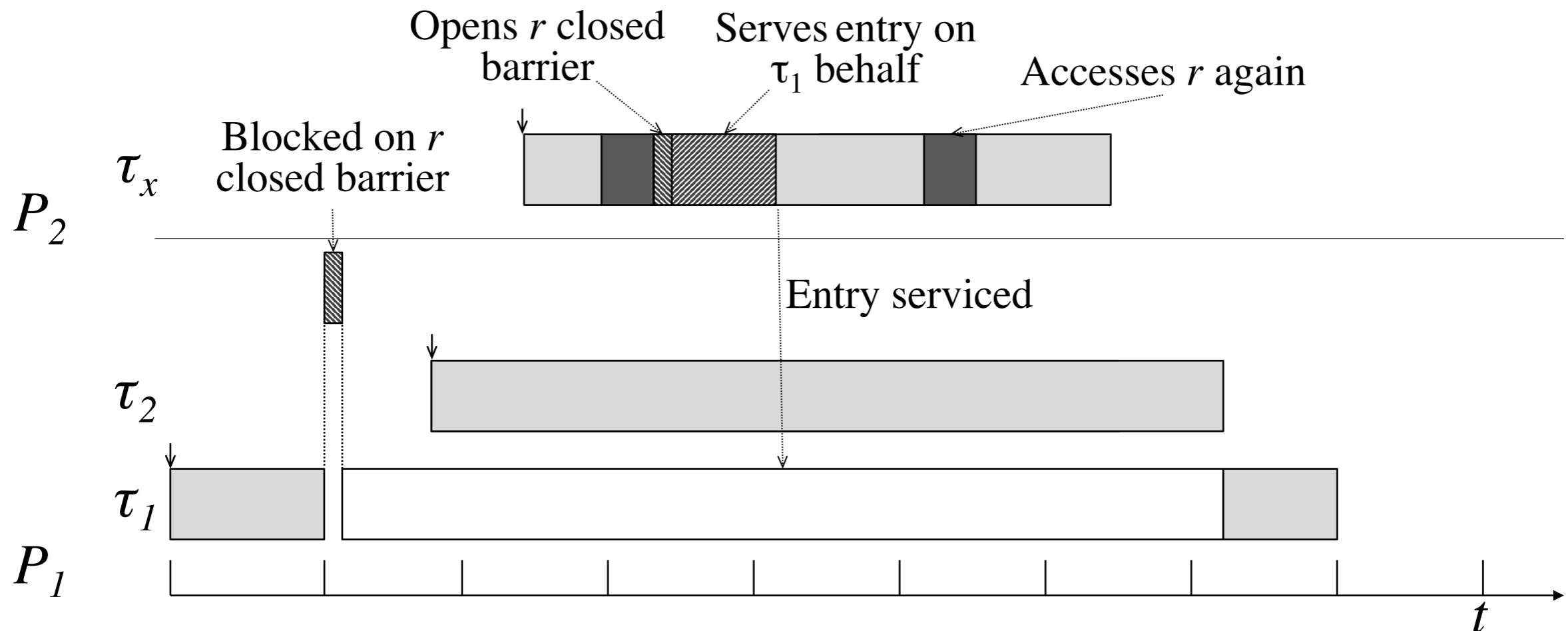
... any access in between breaks the eggshell model

Self-service approach (IV)



- Can be solved by servicing open entry barriers first
 - But that is a 'delayed proxy model'
 - More complex implementation

Proxy model



- Proxy model preserves SRP/PCP and eggshell properties
- Remote entry servicing has to be notified

MSRP & MrsP – Proxy model

■ Entry servicing overhead

- Full Ada tasking: number of task accessing entries

$$e^k = |\text{map}(G(r^k))| \times (c^k + |G_e(r^k)| \times C_e^k)$$

- Ravenscar profile: one entry servicing

$$e^k = |\text{map}(G(r^k))| \times (c^k + C_e^k)$$

■ Compatible with MrsP helping mechanism

- Entry servicing considered as part of the resource access
- Overhead to be taken into account for potential number of preemptions

Conclusions

- Self-service not compatible with MSRP & MrsP
 - Might be the preferred option for other multiprocessor systems
- Proxy model can preserve relevant MSRP & MrsP properties
 - Entry servicing overhead can be computed for MSRP & MrsP
- Proxy model compatible with MrsP helping mechanism
 - Entry servicing considered as part of the resource access



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