Ricart Agrawala's Distributed Mutual Exclusion Algorithm

Reference : Mukesh Singhal & N.G. Shivaratri, Advanced Concepts in Operating Systems, 5th Edition

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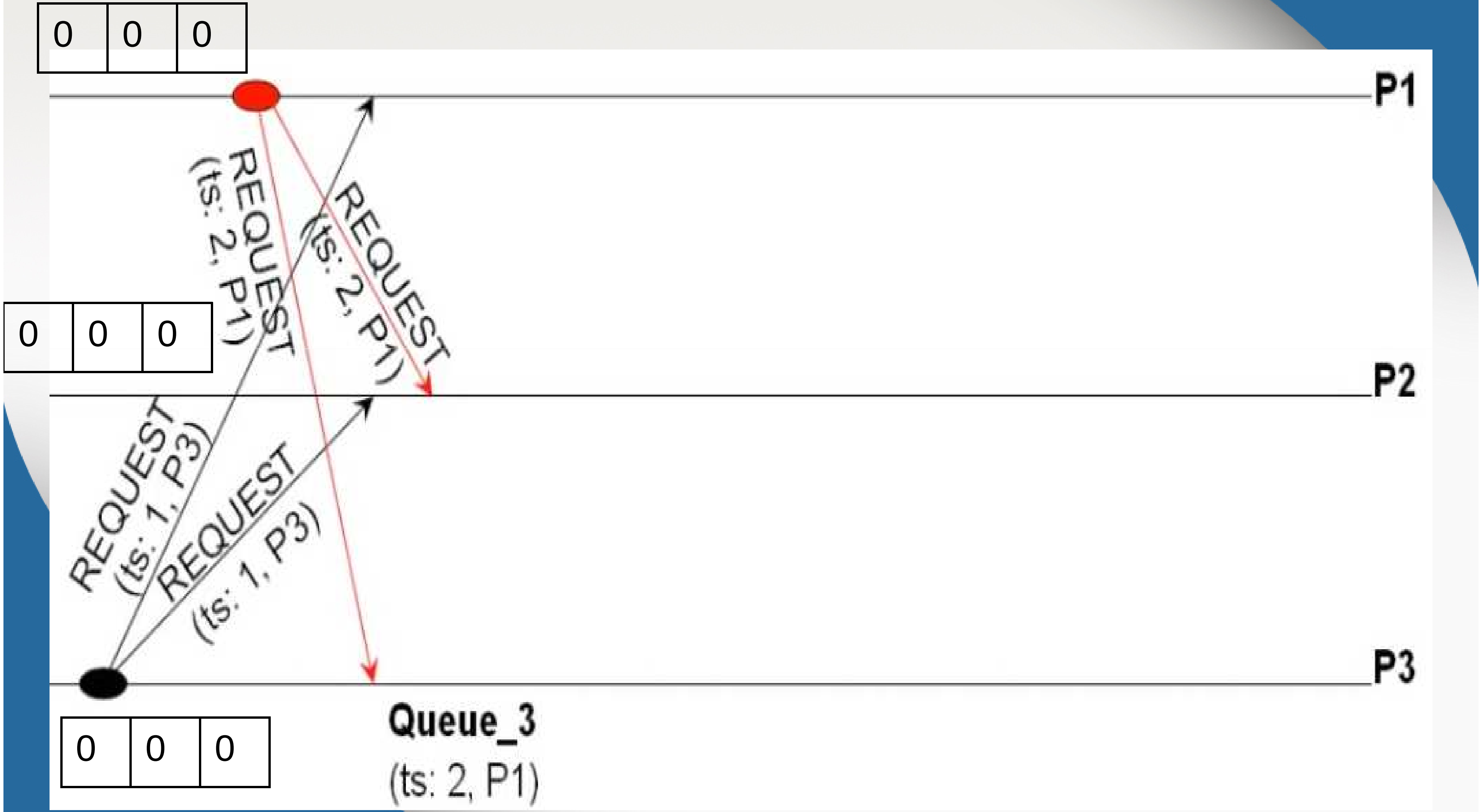

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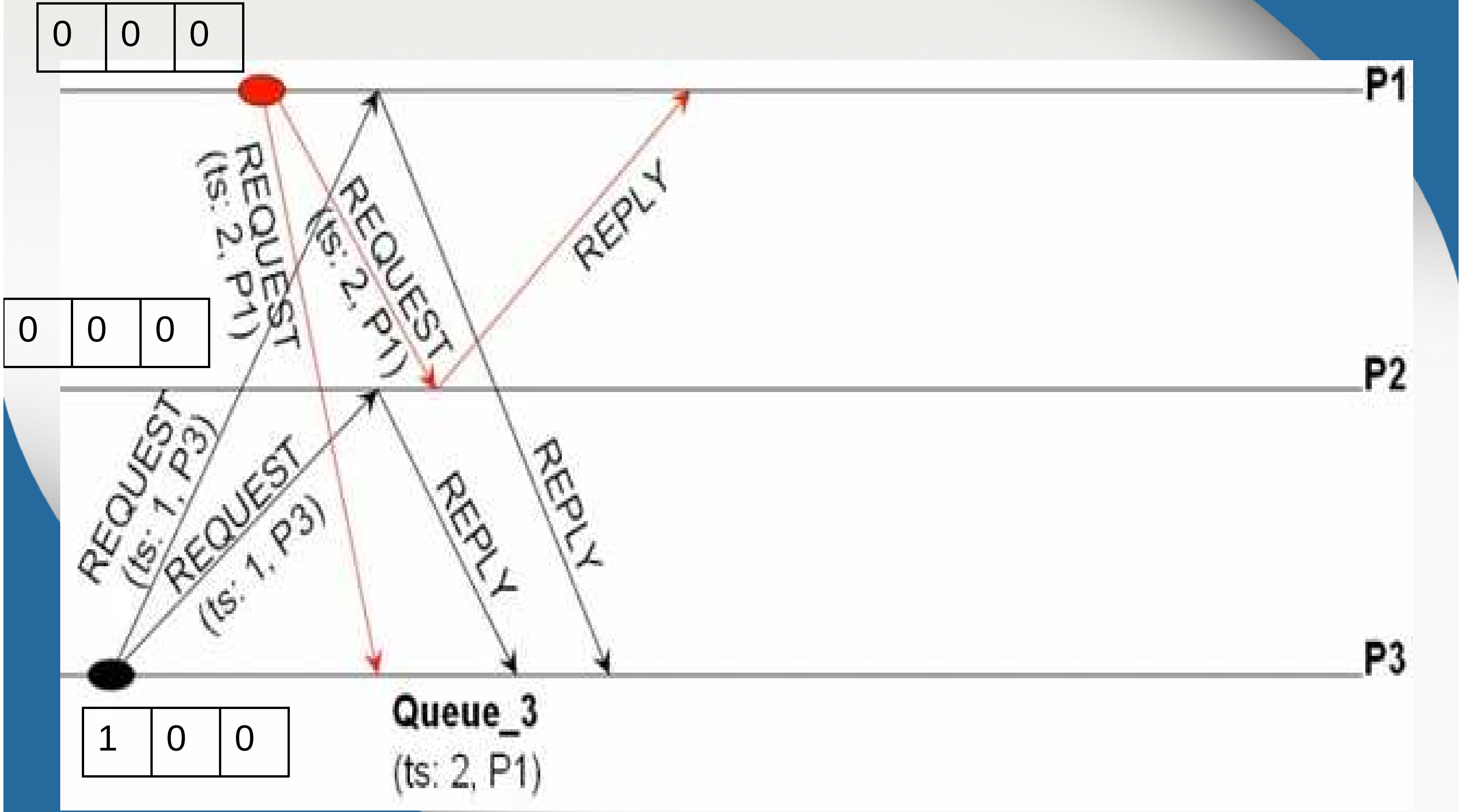

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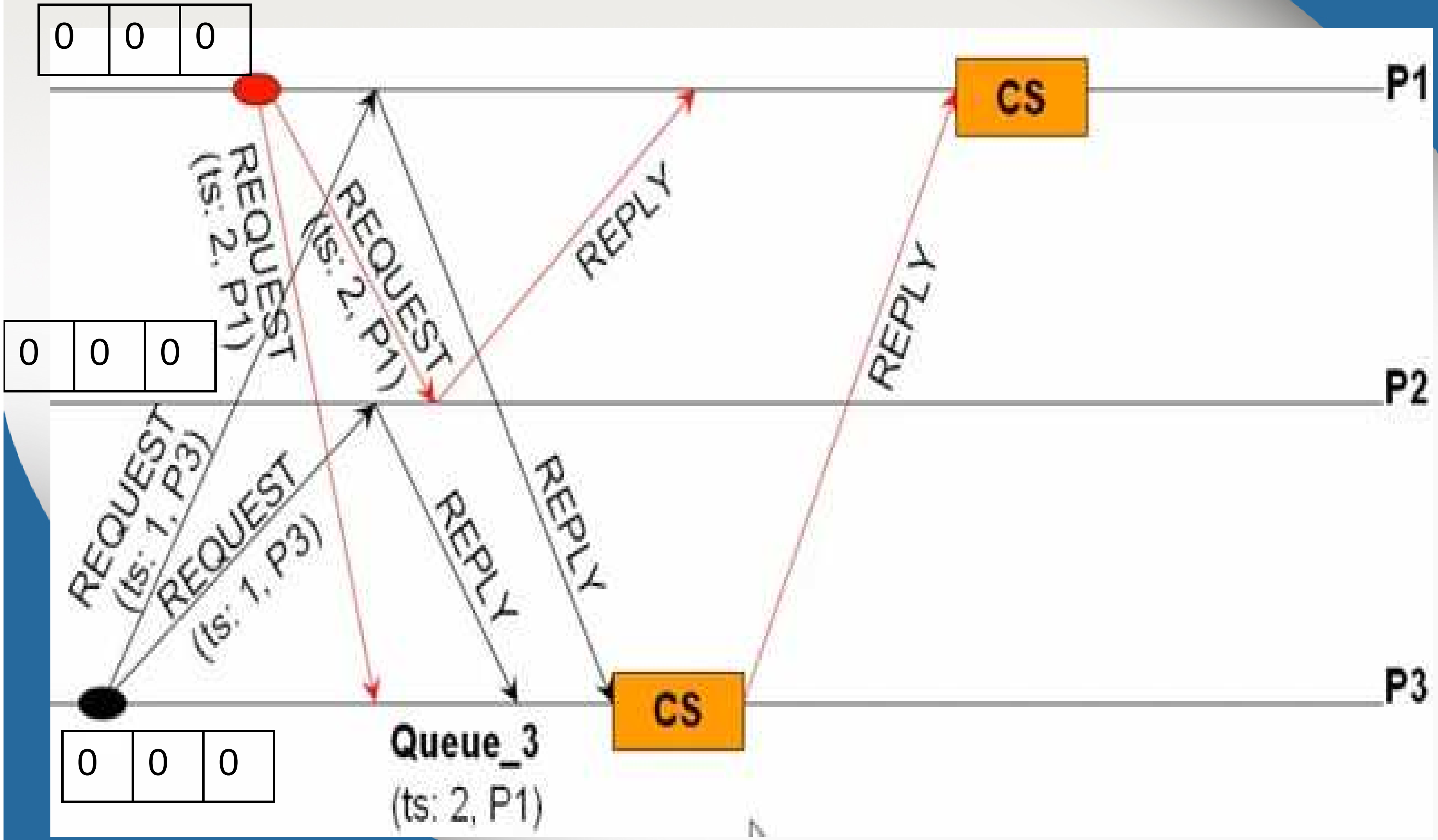

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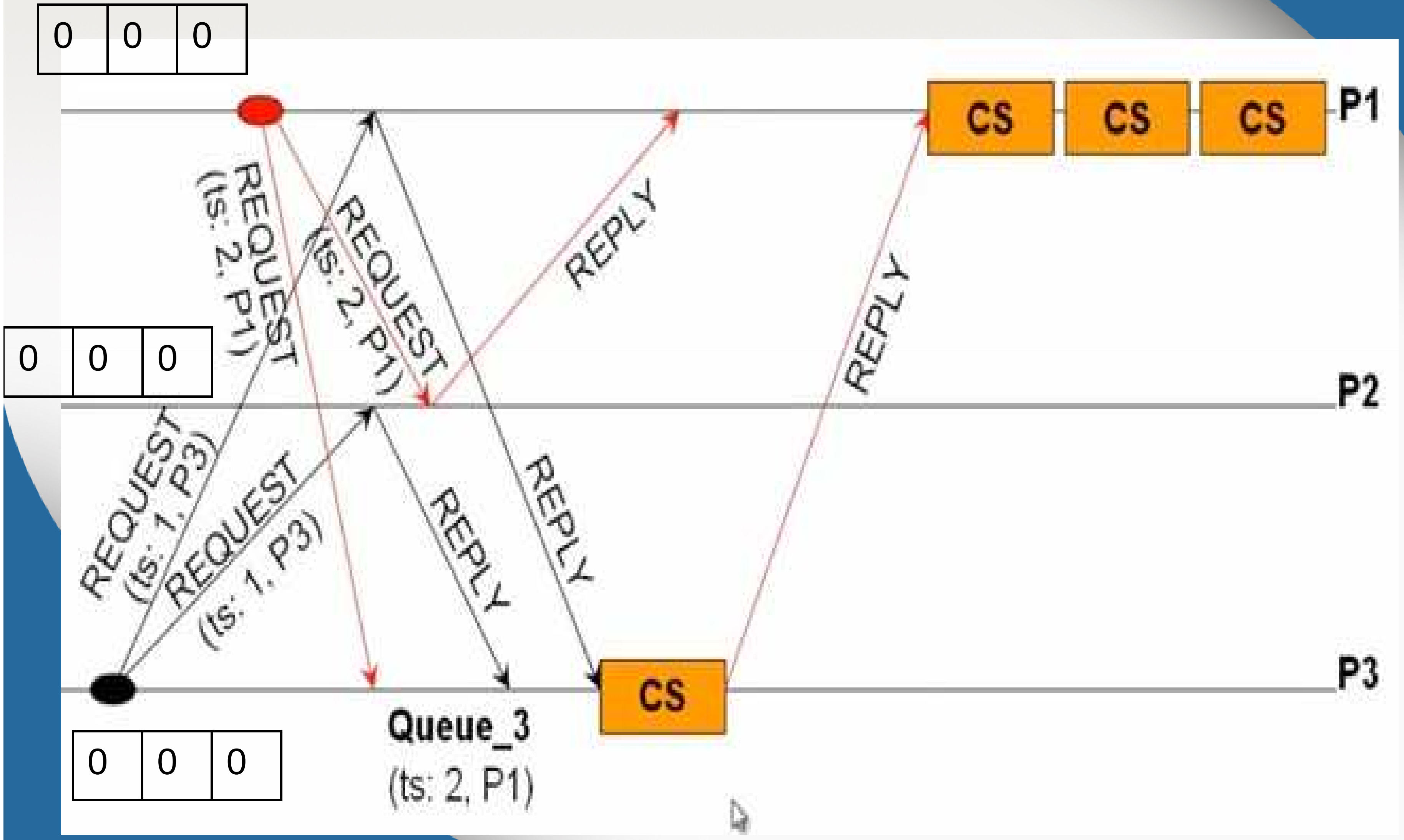

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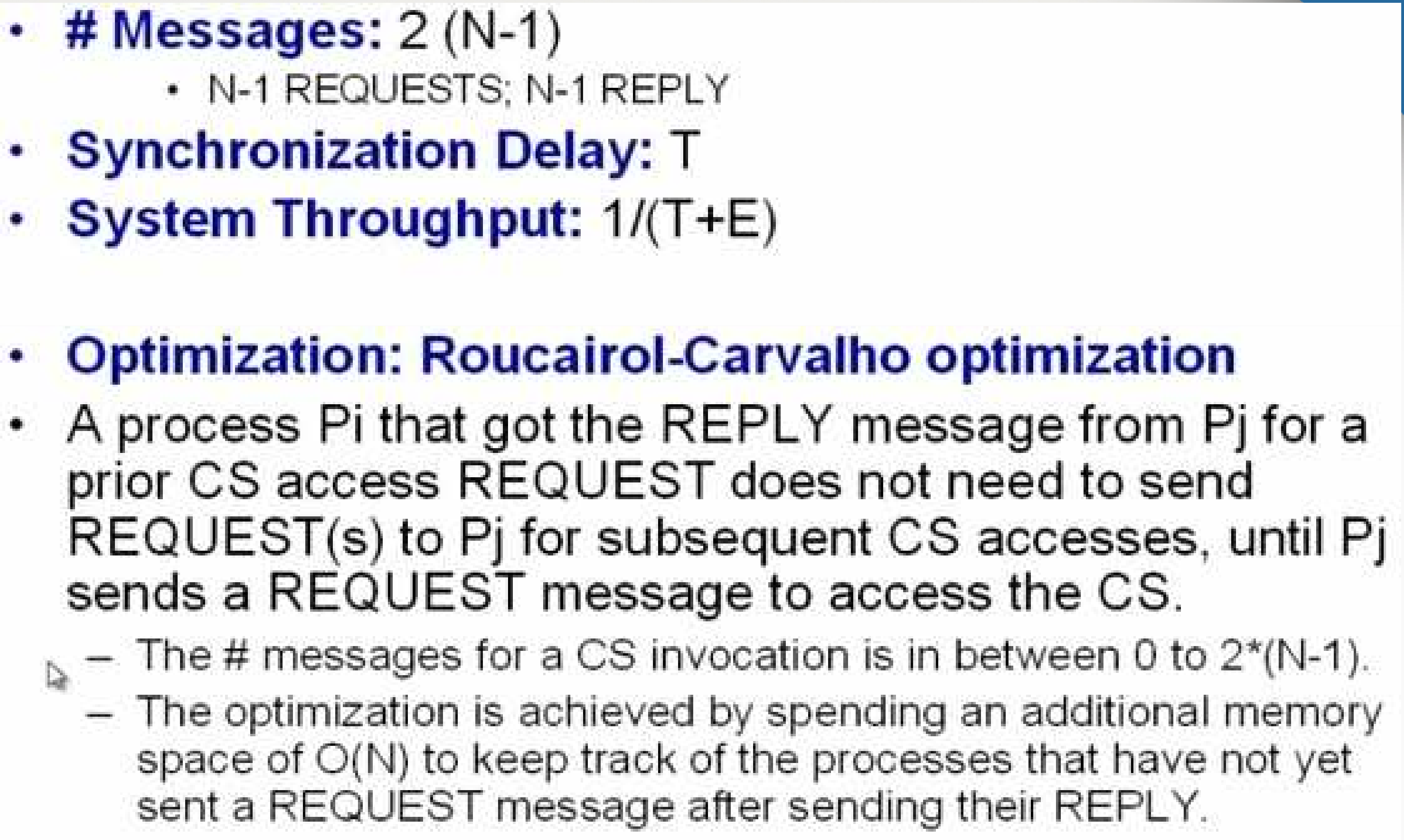

- **# Messages:** 2 (N-1)
  - N-1 REQUESTS; N-1 REPLY
- **Synchronization Delay:** T
- **System Throughput:** 1/(T+E)

- **Optimization: Roucairol-Carvalho optimization**
- A process Pi that got the REPLY message from Pj for a prior CS access REQUEST does not need to send REQUEST(s) to Pj for subsequent CS accesses, until Pj sends a REQUEST message to access the CS.
  - The # messages for a CS invocation is in between 0 to 2*(N-1).
  - The optimization is achieved by spending an additional memory space of O(N) to keep track of the processes that have not yet sent a REQUEST message after sending their REPLY.

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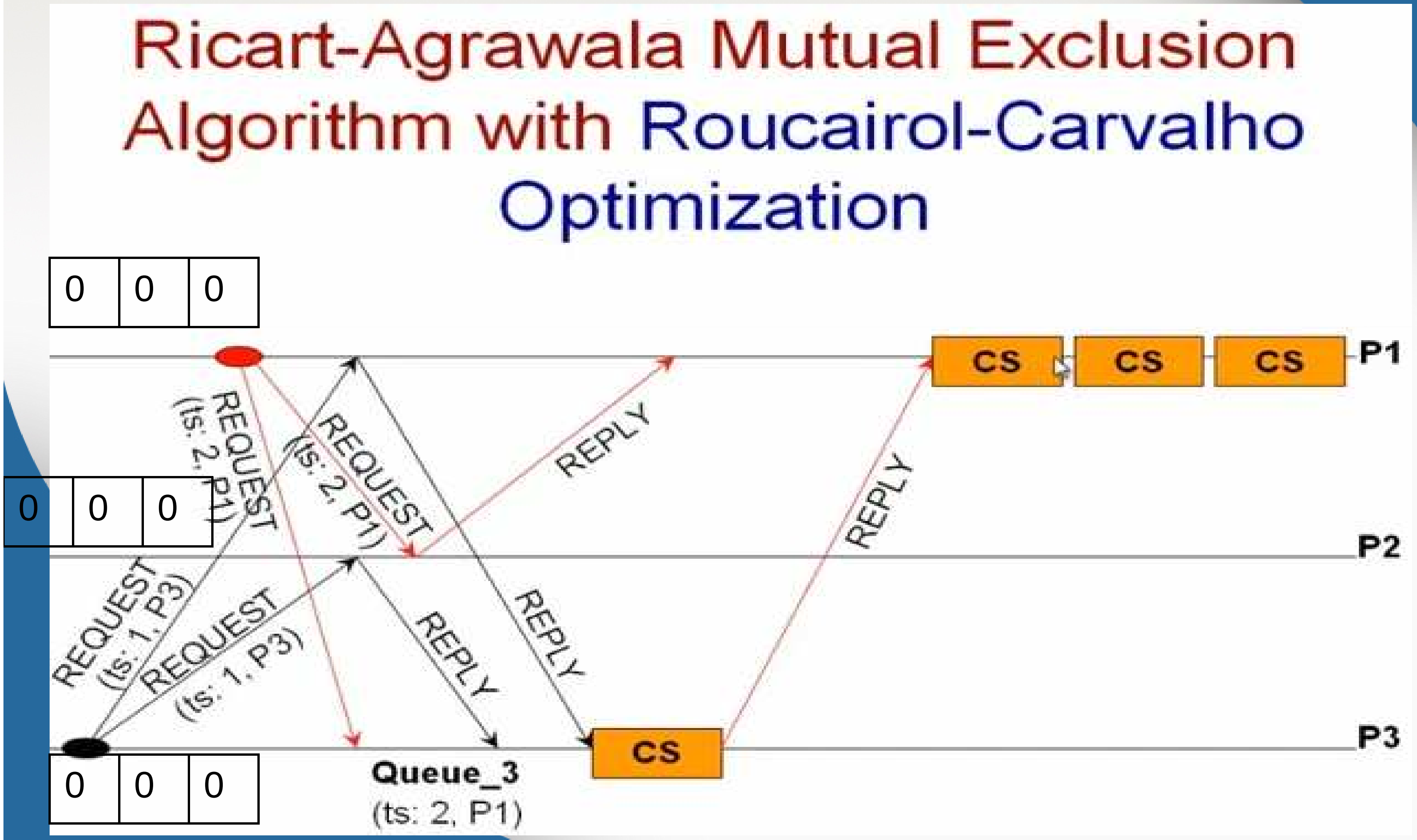

Ricart-Agrawala Mutual Exclusion Algorithm with Roucairol-Carvalho Optimization

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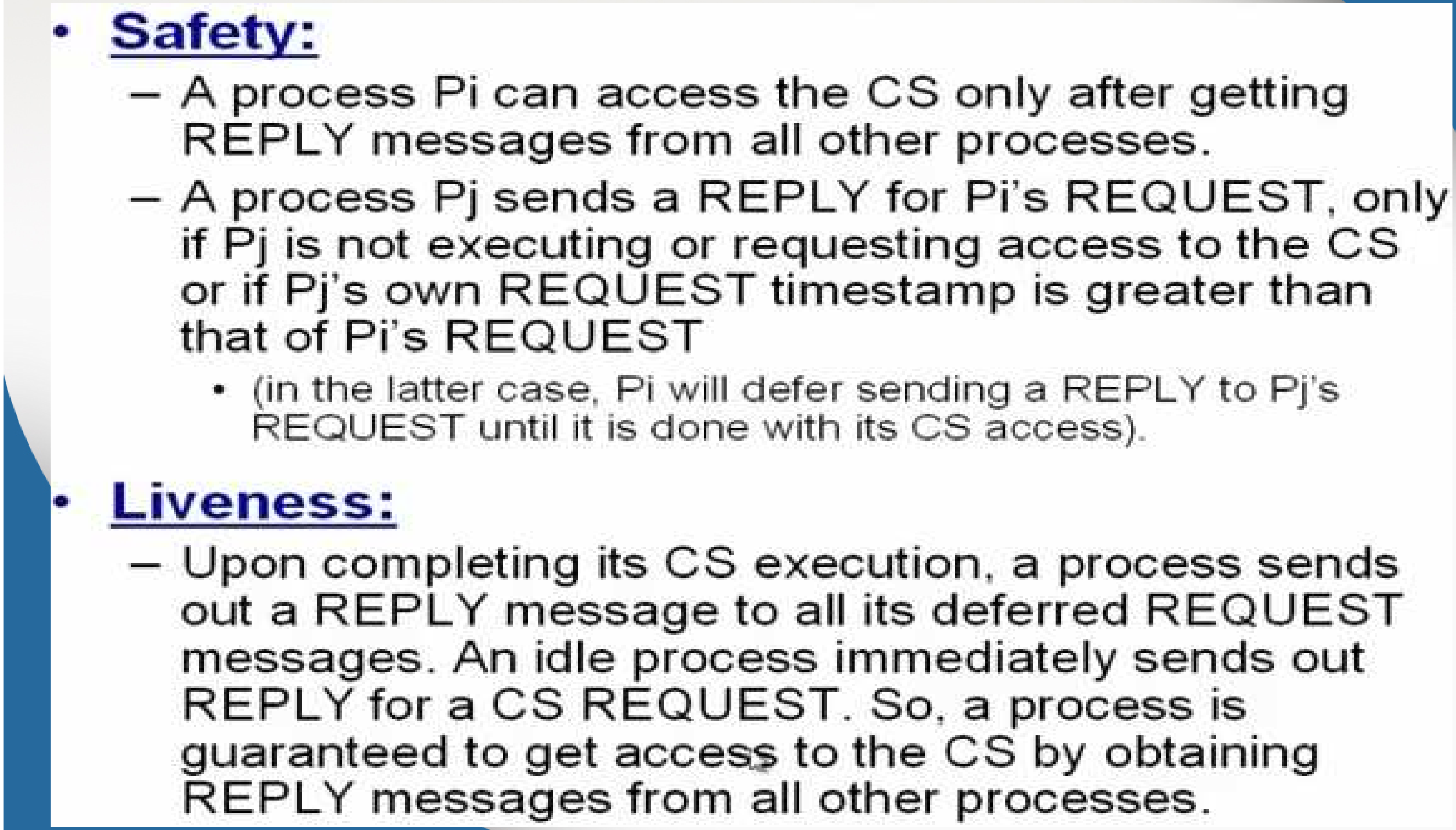

- **Safety:**
  - A process Pi can access the CS only after getting REPLY messages from all other processes.
  - A process Pj sends a REPLY for Pi's REQUEST, only if Pj is not executing or requesting access to the CS or if Pj's own REQUEST timestamp is greater than that of Pi's REQUEST
    - (in the latter case, Pi will defer sending a REPLY to Pj's REQUEST until it is done with its CS access).
- **Liveness:**
  - Upon completing its CS execution, a process sends out a REPLY message to all its deferred REQUEST messages. An idle process immediately sends out REPLY for a CS REQUEST. So, a process is guaranteed to get access to the CS by obtaining REPLY messages from all other processes.

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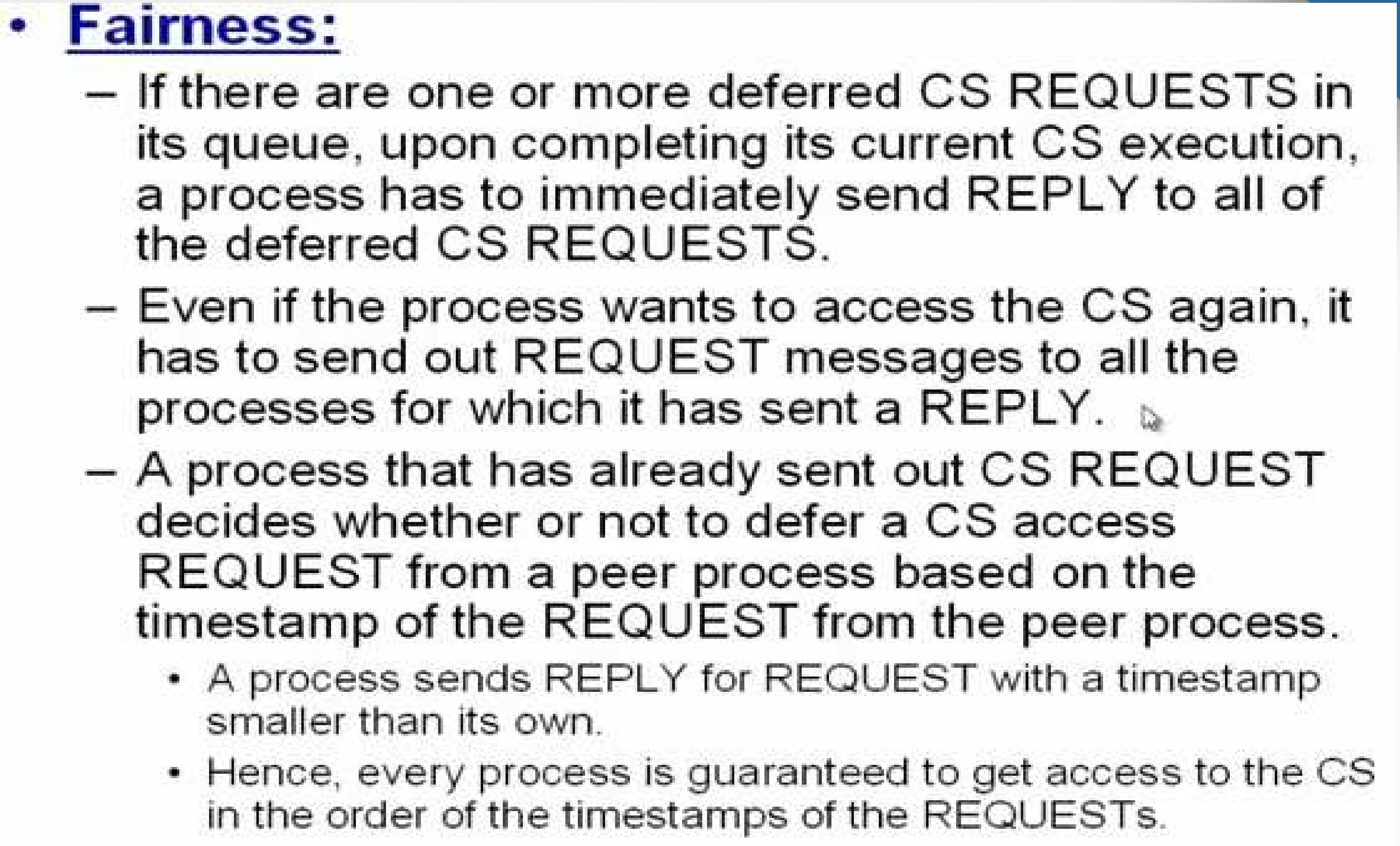

- **Fairness:**
  - If there are one or more deferred CS REQUESTS in its queue, upon completing its current CS execution, a process has to immediately send REPLY to all of the deferred CS REQUESTS.
  - Even if the process wants to access the CS again, it has to send out REQUEST messages to all the processes for which it has sent a REPLY.
  - A process that has already sent out CS REQUEST decides whether or not to defer a CS access REQUEST from a peer process based on the timestamp of the REQUEST from the peer process.
    - A process sends REPLY for REQUEST with a timestamp smaller than its own.
    - Hence, every process is guaranteed to get access to the CS in the order of the timestamps of the REQUESTs.

Source

https://www.youtube.com/watch?v=r7SJOhGF4Nc

THANK YOU