ProActive SPMD and Fault Tolerance

Protocol and Benchmarks

Brian Amedro et al.

INRIA - CNRS

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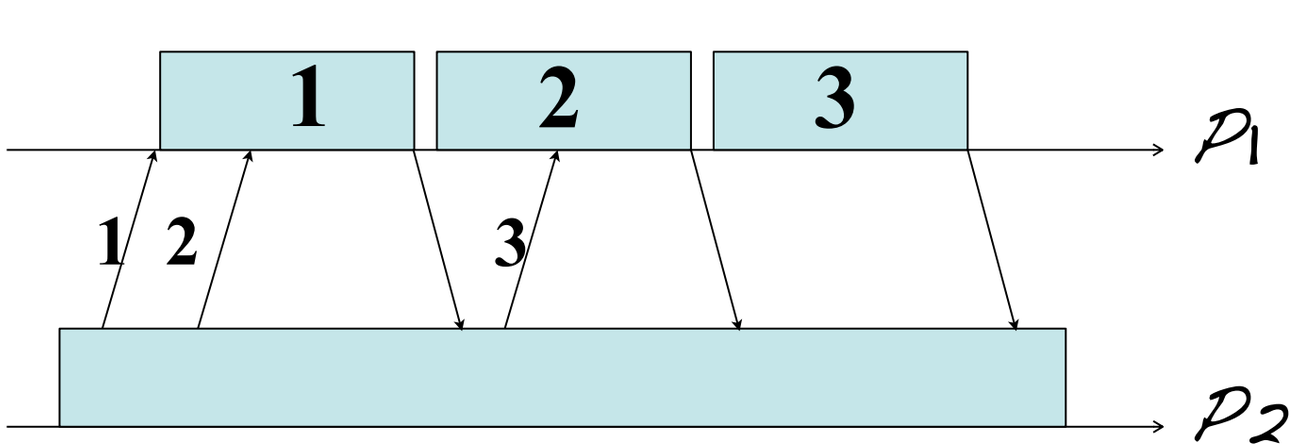
Outline

- ASP Model Overview
- ProActive SPMD
- Fault Tolerance
- Benchmarks

Asynchronous Sequential Process

- Communication with message-passing
  - Request / Reply
  - No memory sharing
- Asynchronous request services
  - Request queue
  - Rendezvous
  - Future with wait-by-necessity
- Confluence and determinacy
  - Causal ordering
  - Activity state characterization
- Java implementation



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Asynchronous and Deterministic Objects, POPL'04

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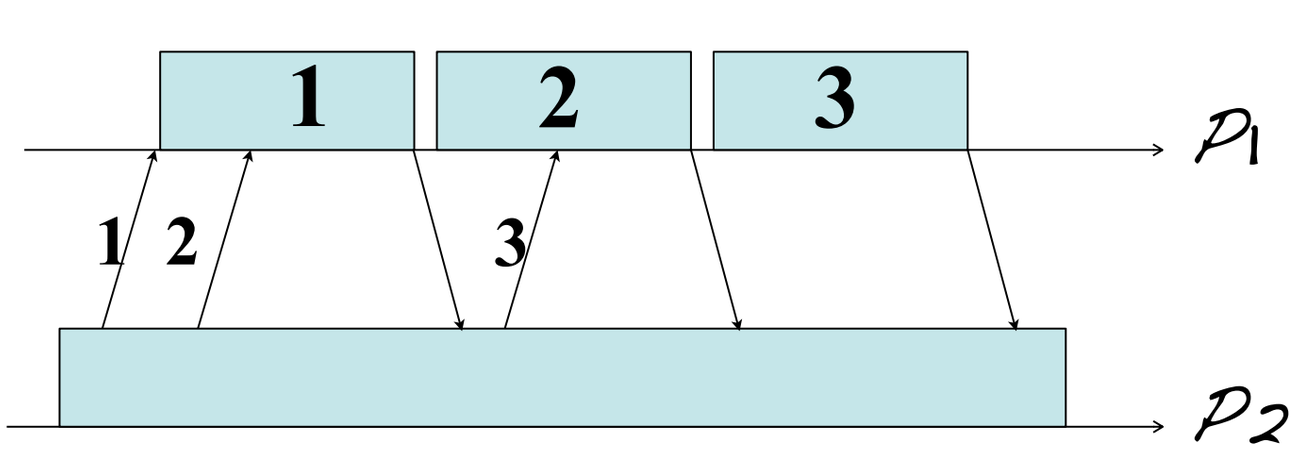

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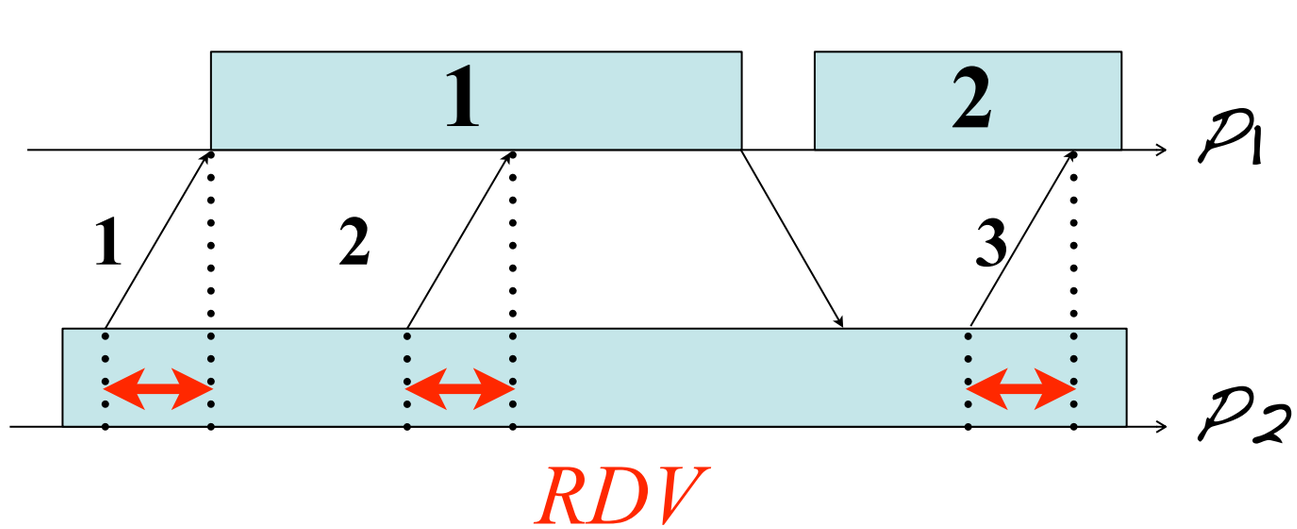

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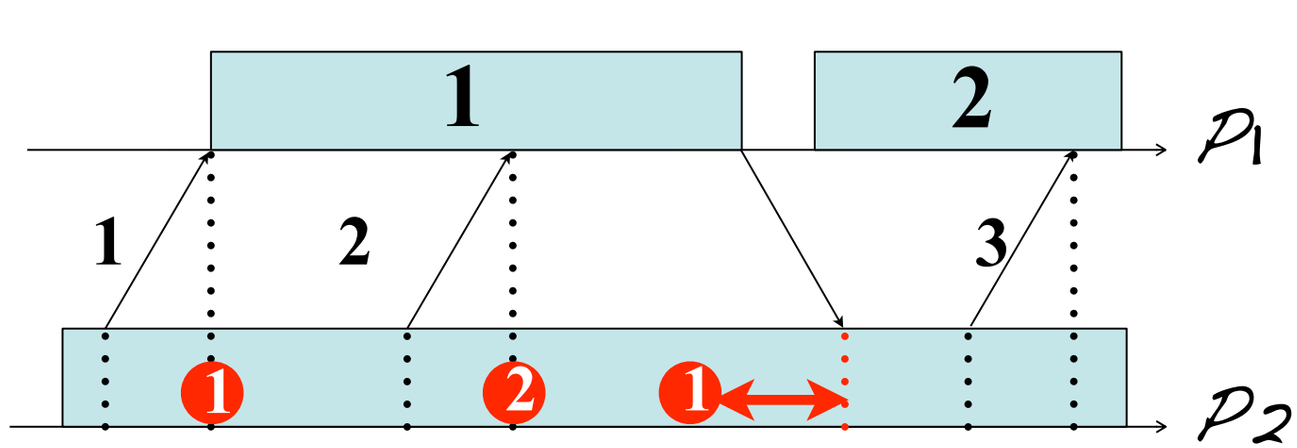

Futures and *WBN*

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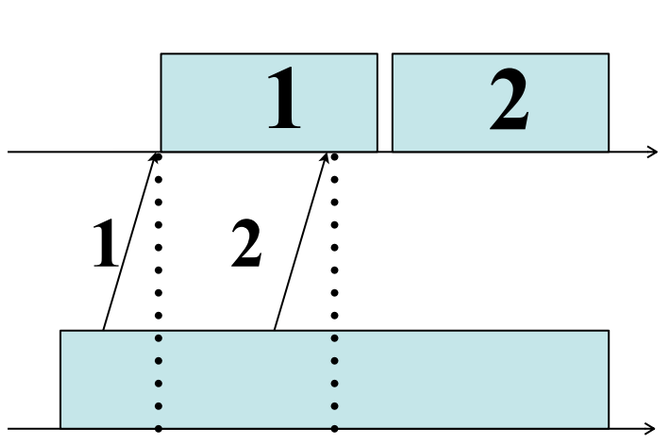
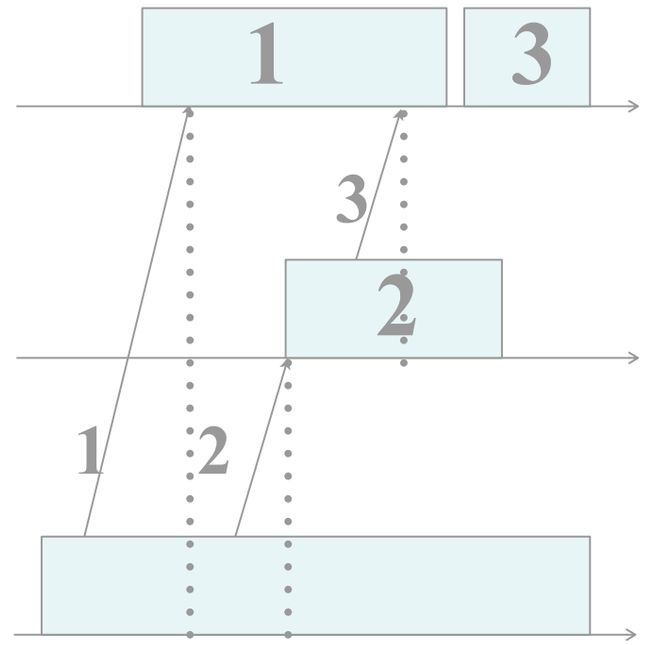


point-to-point FIFO order



causal ordering

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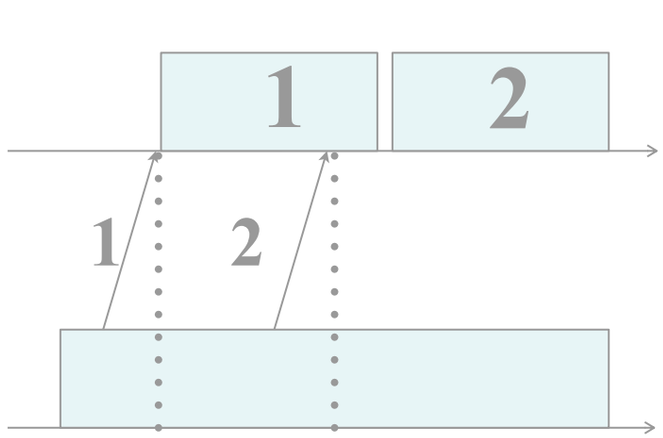

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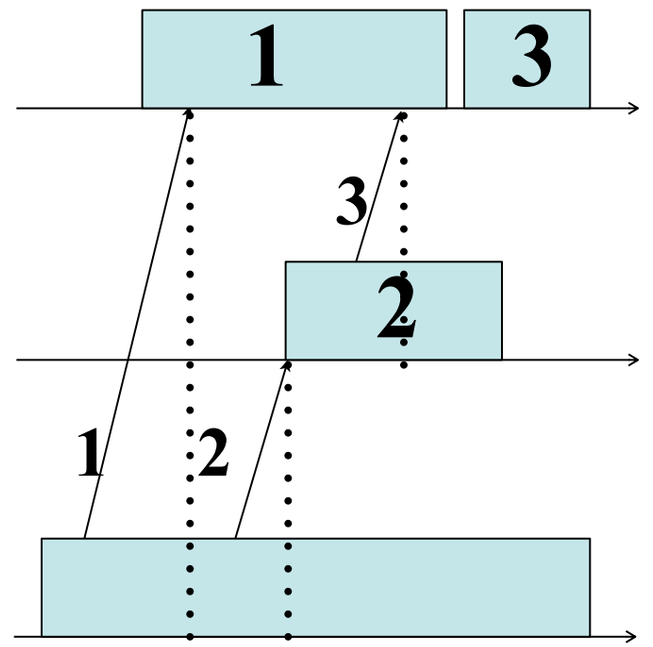

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ProActive Parallel Suite

http://proactive.inria.fr

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ProActive OO-SPMD

Objectives

- Provide an MPI-like programming model
- Ease the porting an MPI application to ProActive
- Give *Object Oriented* to SPMD model

ProActive OO-SPMD

Features

- Asynchronous collective operations
  Asynchronous barrier
- Asynchronous group communication
  Scattering, gathering
- Take into account topology
  Optimized algorithm

Fault Tolerance with ASP

Objectives

- Transparency
  No piece of code dedicated to Fault Tolerance in applications

- Portability
  No assumption about underlying hardware

- Consistency

Fault Tolerance with ASP

Propositions

- Rollback Recovery

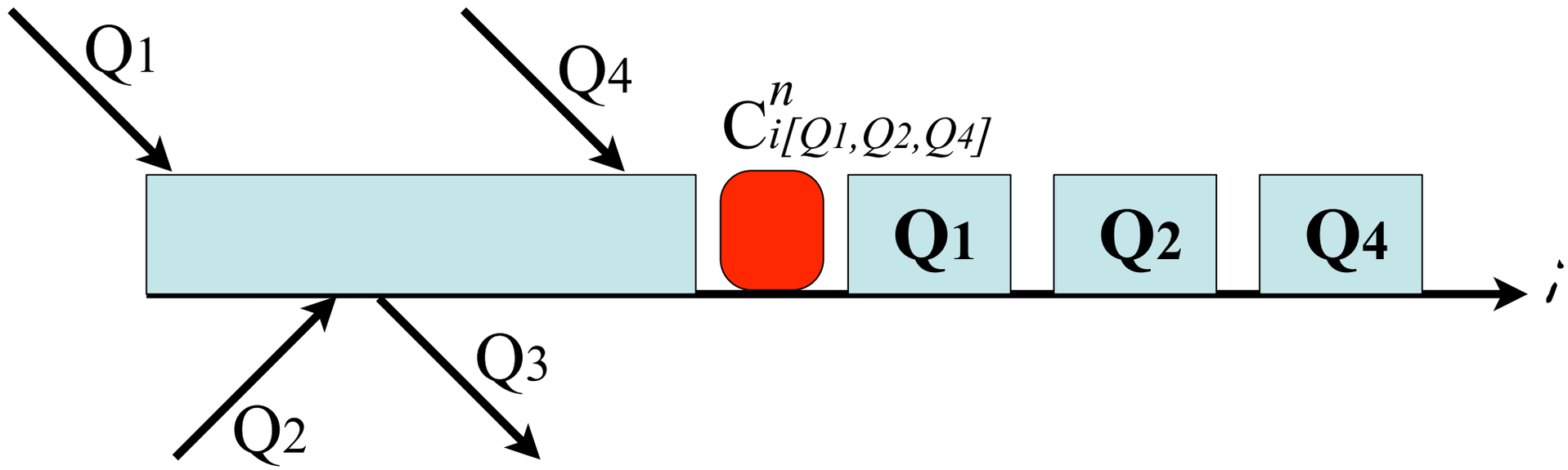
- TTC + Communication Induced Checkpointing: *Transparency*
  No programmer intervention

- Constrained Checkpointability: *Portability*
  No Checkpoint during a service
  Un-consistency of recovery lines

Christian Delbé, PhD Thesis, 2007
Tolérance aux pannes pour objets actifs asynchrones - protocole, modèle et expérimentations

Fault Tolerance with ASP

Principles of the Protocol



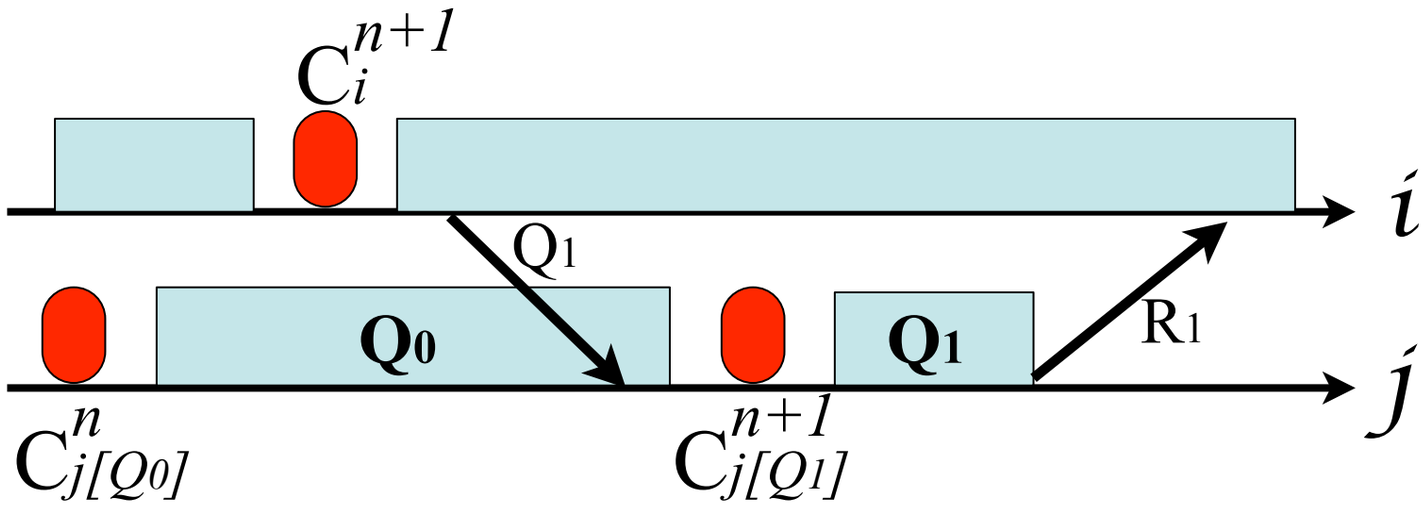
Fault Tolerance with ASP

Principles of the Protocol

- *Orphan* and *In-transit* Messages
- Promised Requests
- Request Reception History

Fault Tolerance with ASP

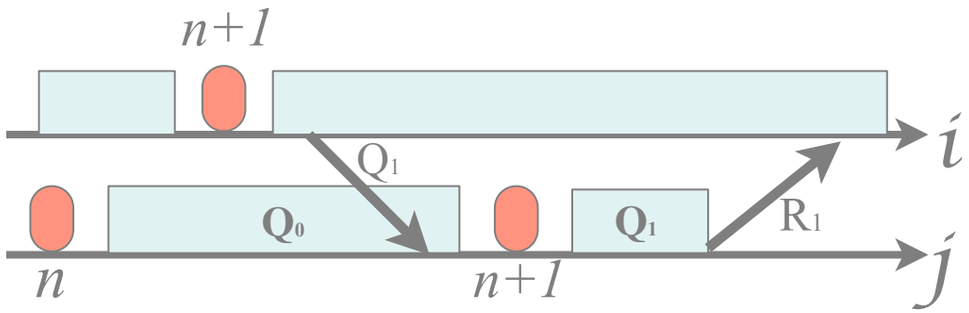
Orphan Messages

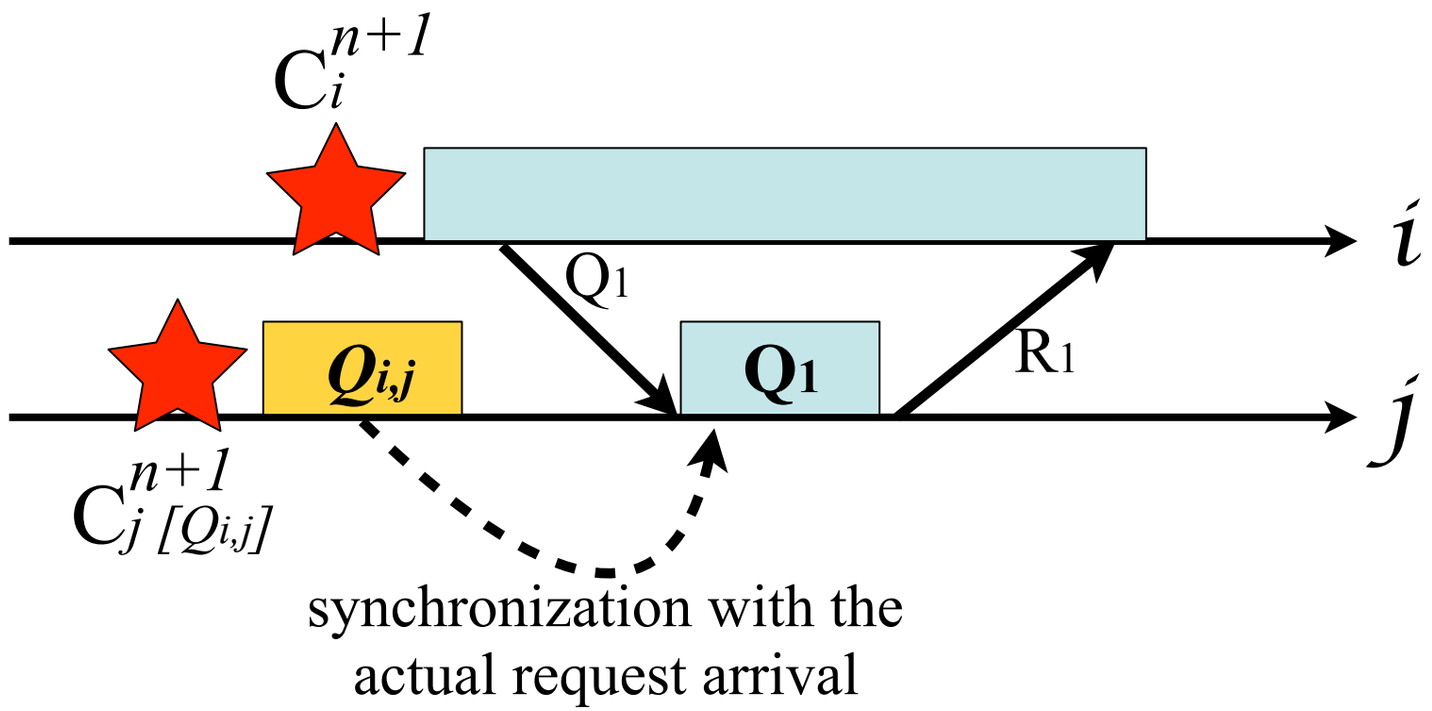


Q_1 is an *Orphan Request*

Fault Tolerance with ASP

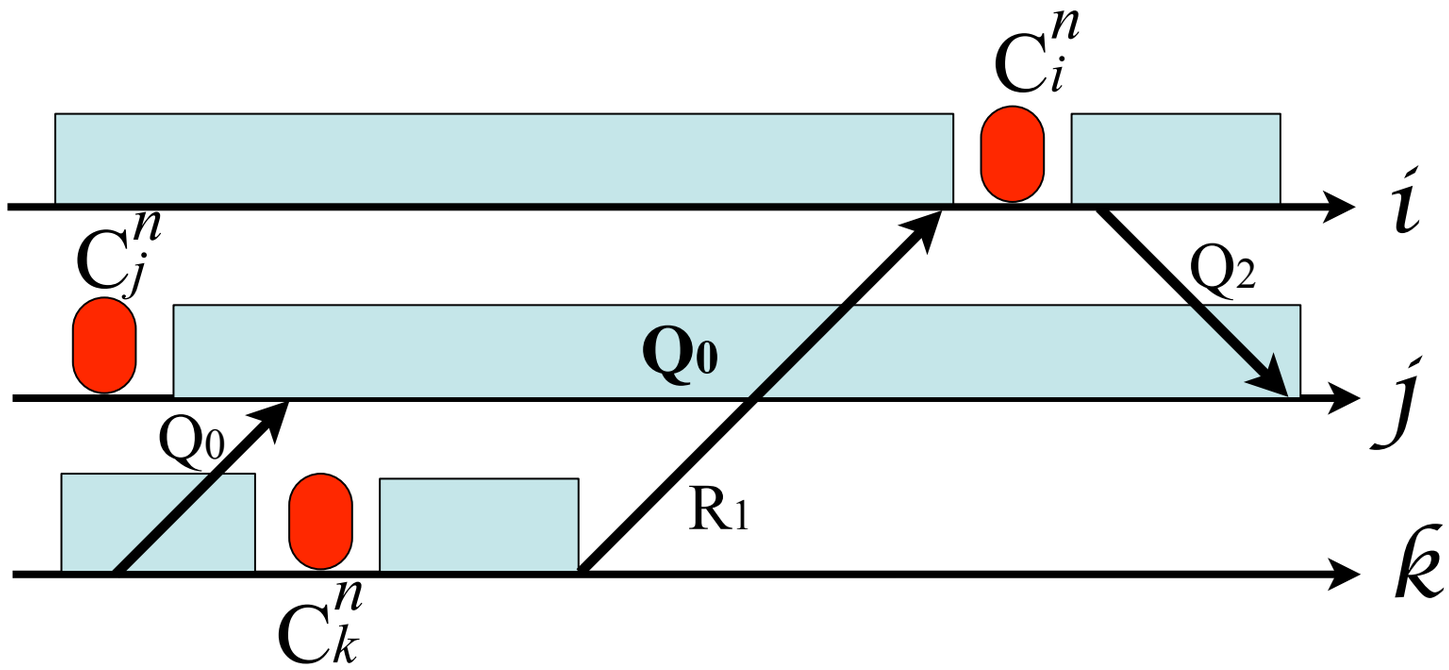
Promised Request





Fault Tolerance with ASP

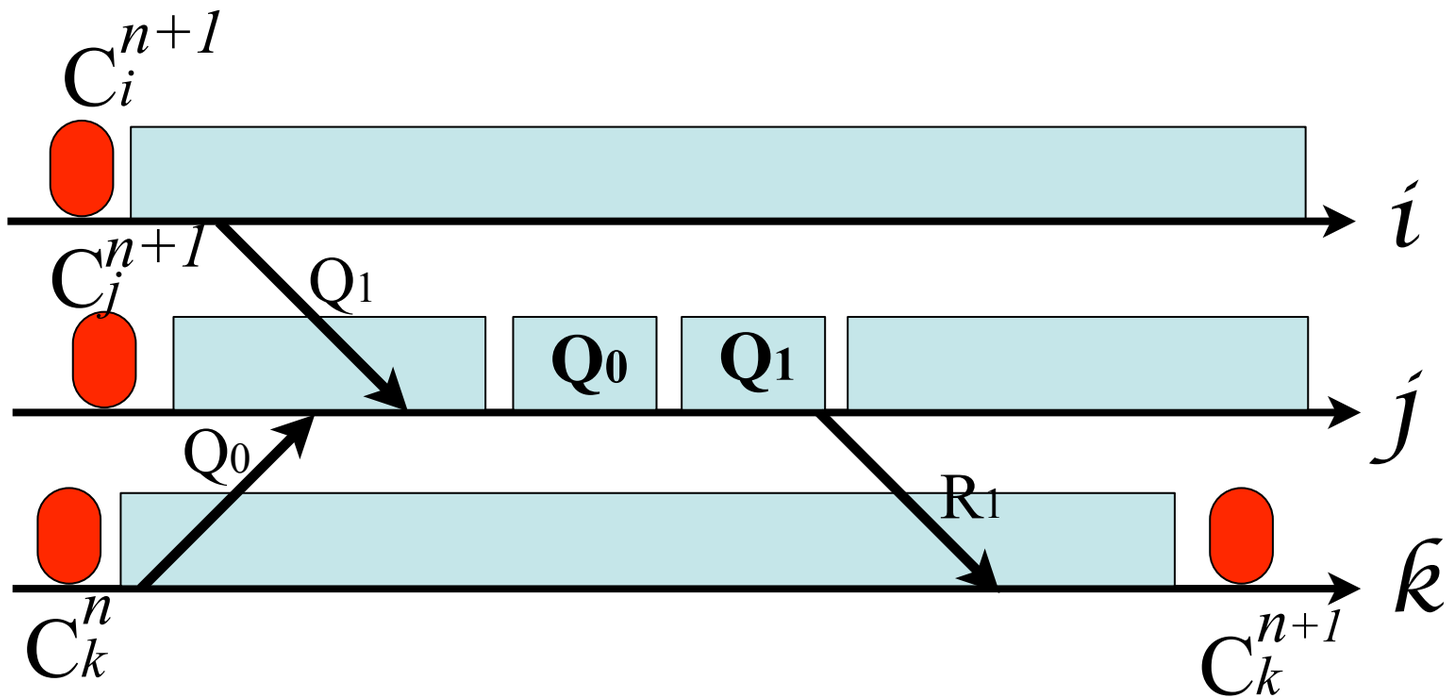
In-transit Messages



Q_0 is an *In-transit Request*

Fault Tolerance with ASP

Request Reception History



Fault Tolerance with ASP

Synthesis

- Orphan Request
  Replace with a promised request with wait-by-necessity

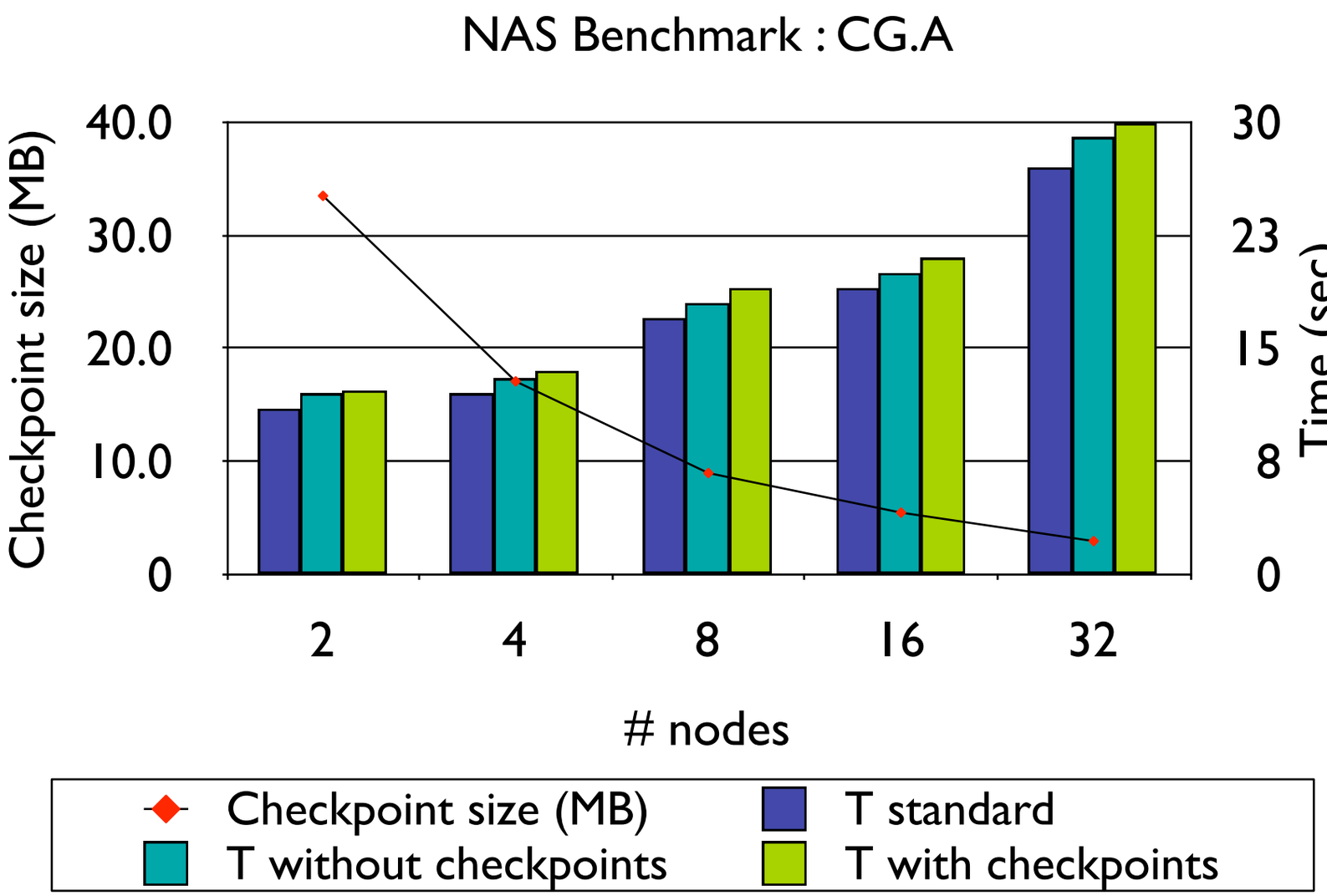
- In-transit Requests
  Reception of such a request is journalized into a request reception history

- In-transit Reply
  Can’t happen: occur after the reception of an orphan request, so a checkpoint have been performed

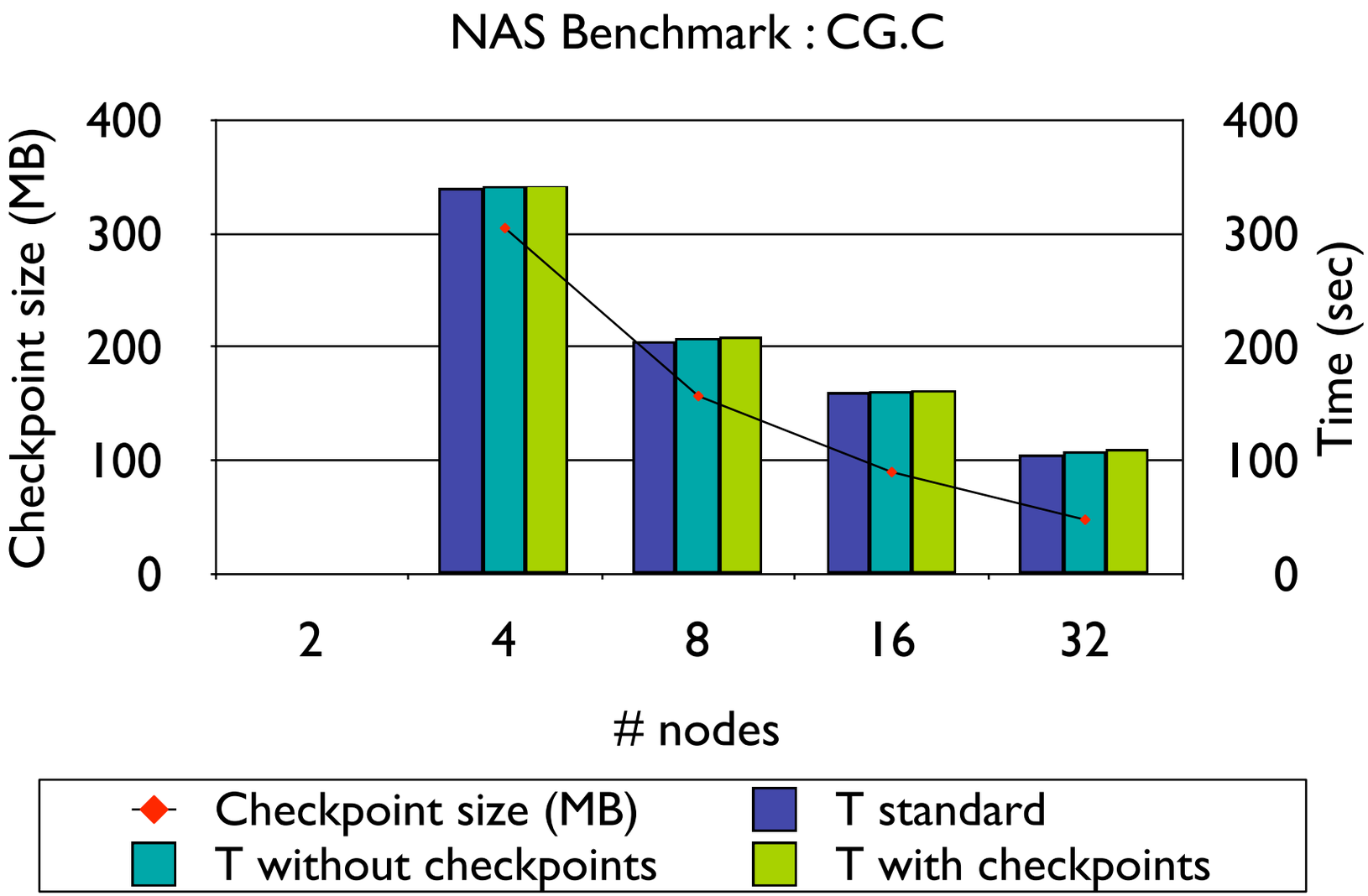
Benchmarking Fault Tolerance

- NAS Parallel Benchmarks
- 5 kernels : EP, CG, FT, MG, IS
- About 10,000 LOC

Benchmarking Fault Tolerance



Benchmarking Fault Tolerance



Thank you for your attention

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