Process Evolution with Atomicity Consistency

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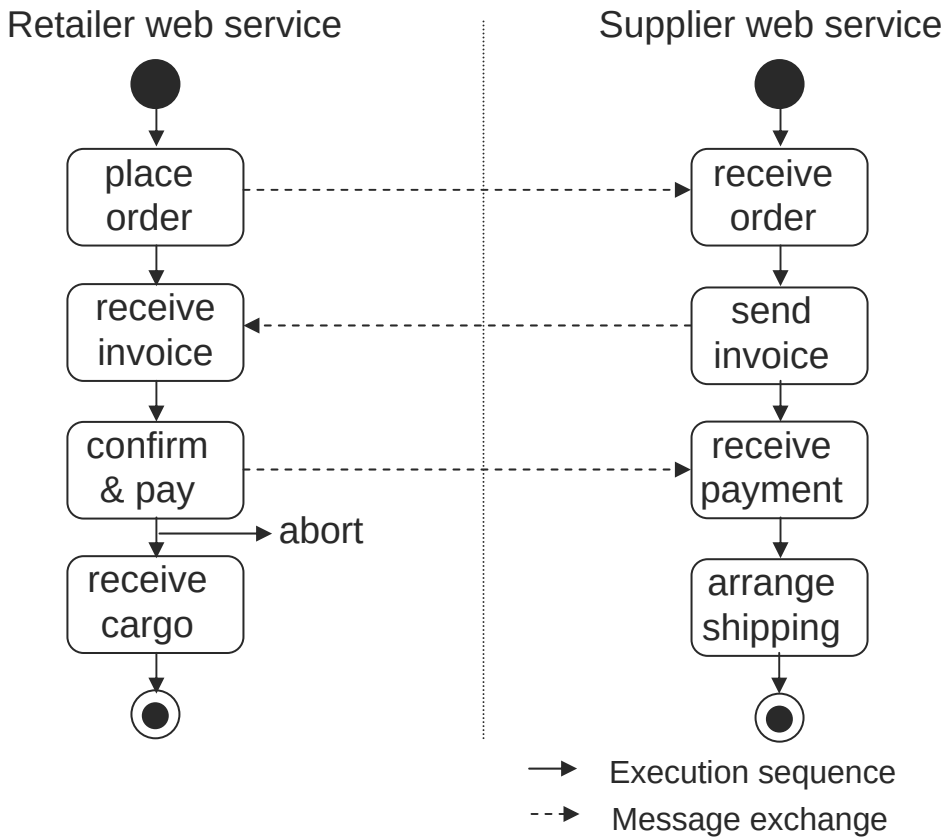
Outline

- Introduction
- Motivation
- Process evolution
  - Evolution scenarios
  - Principles for evolution
- Discussions
- Conclusion

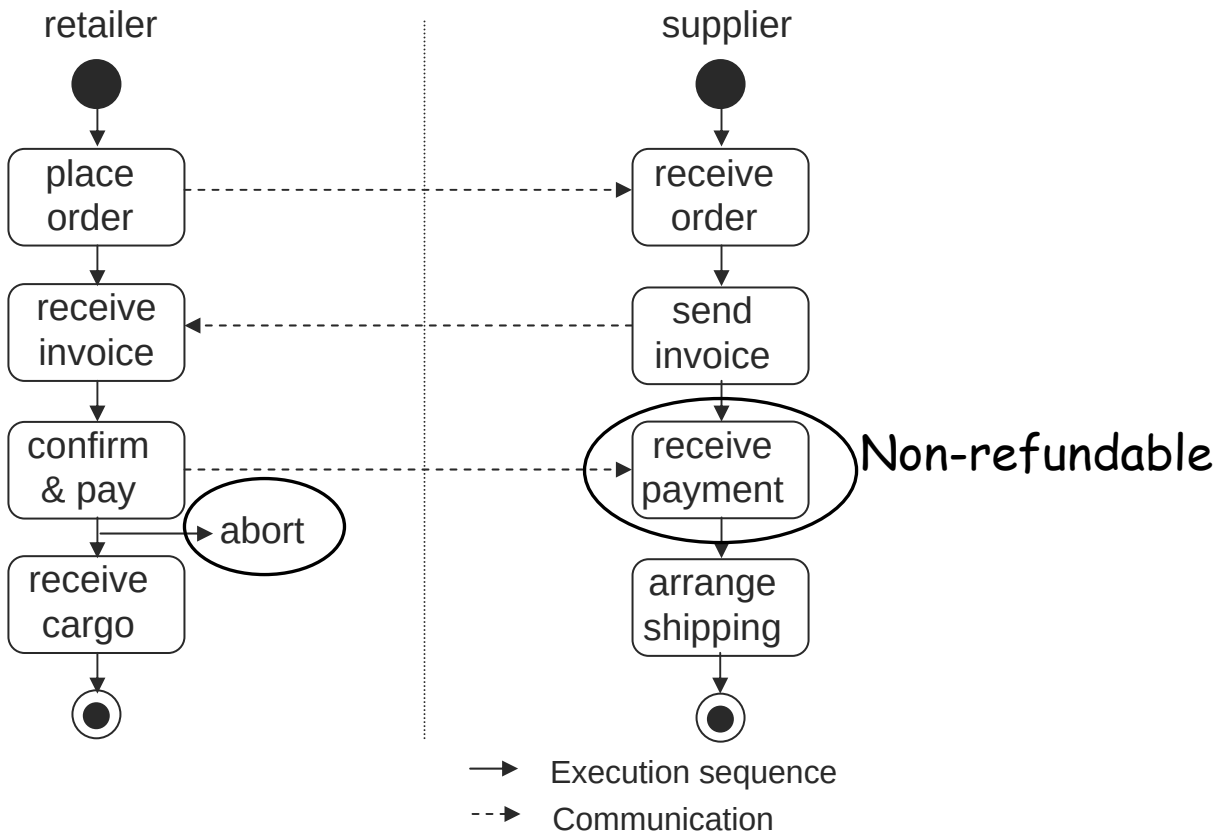
Introduction

- Service composition



Introduction

- Value loss can occur

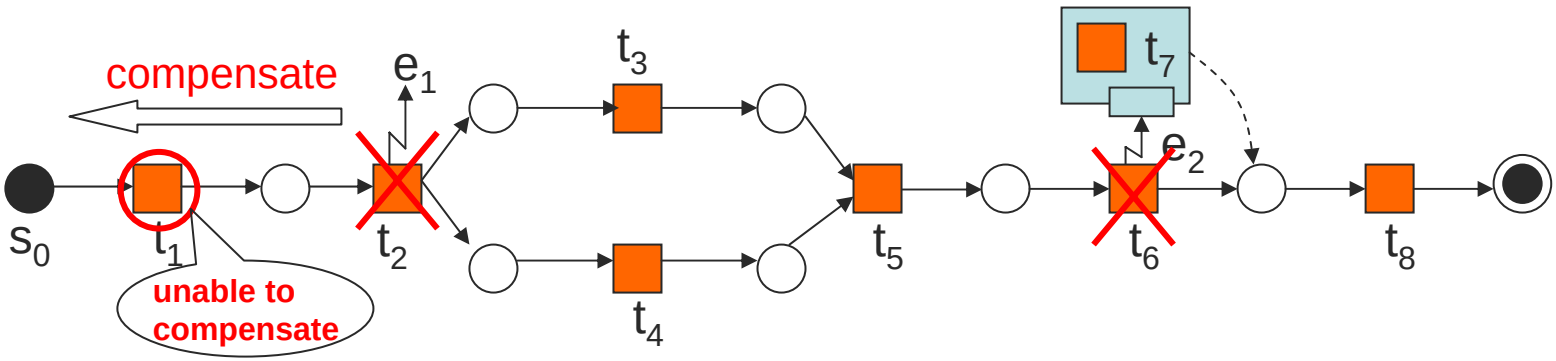


Introduction

- Atomicity atop service composition is desirable
  - Help avoid value loss
  - Difficult to enforce conventional database transaction
  - One alternative way to achieve atomicity is through the concept of ***atomicity sphere***

Introduction – Atomicity

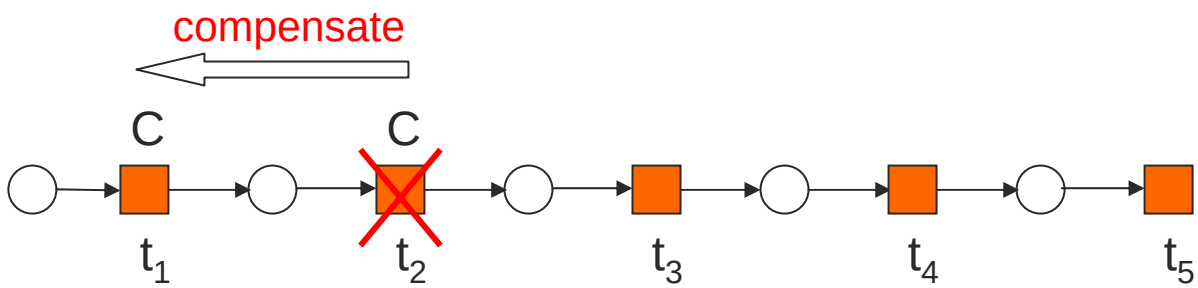
- A process satisfying atomicity sphere[1]
  - Could either terminate successfully
  - Or, rewind to a state as if the process has not executed in case of failure



[1] C. Hagen and G. Alonso. Exception handling in workflow management systems. *TSE,* vol.26, no.10, Oct. 2000, pp.943-958.

Introduction

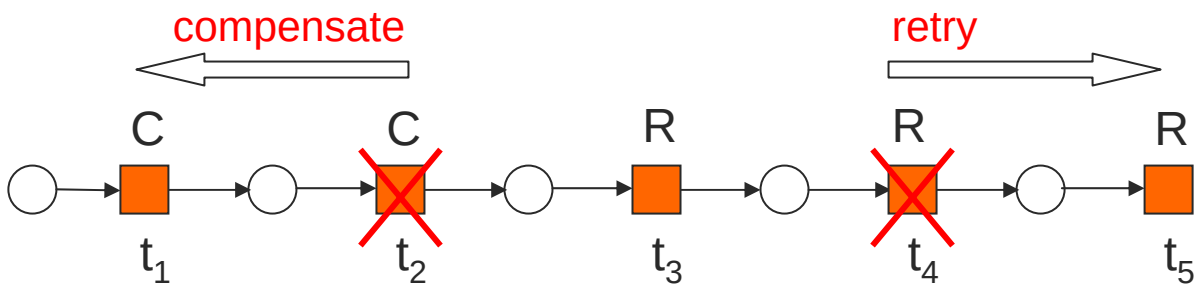
- To check atomicity
  - Tasks have two properties: compensability and retriability
  - A ***compensable task*** is one that can be undone one way or another in case the process fails or is canceled.



C: compensable NC: non-compensable
R: retriable NR: non-retriable

Introduction

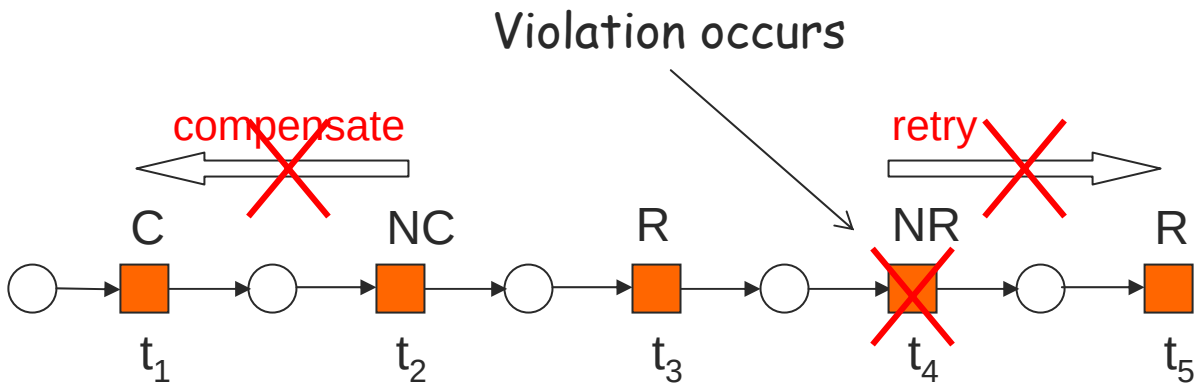
- To check atomicity
  - Tasks have two properties: compensability and retriability
  - A ***compensable task*** is one that can be undone one way or another in case the process fails or is canceled.
  - A ***retriable task*** is one that can finally succeed by retrying itself a finite number of times in face of failure.



C: compensable NC: non-compensable
R: retriable NR: non-retriable

Introduction

- Atomicity violation occurs:
  - a non-retriable (NR) task is executed after some non-compensable (NC) task.



C: compensable NC: non-compensable
R: retriable NR: non-retriable

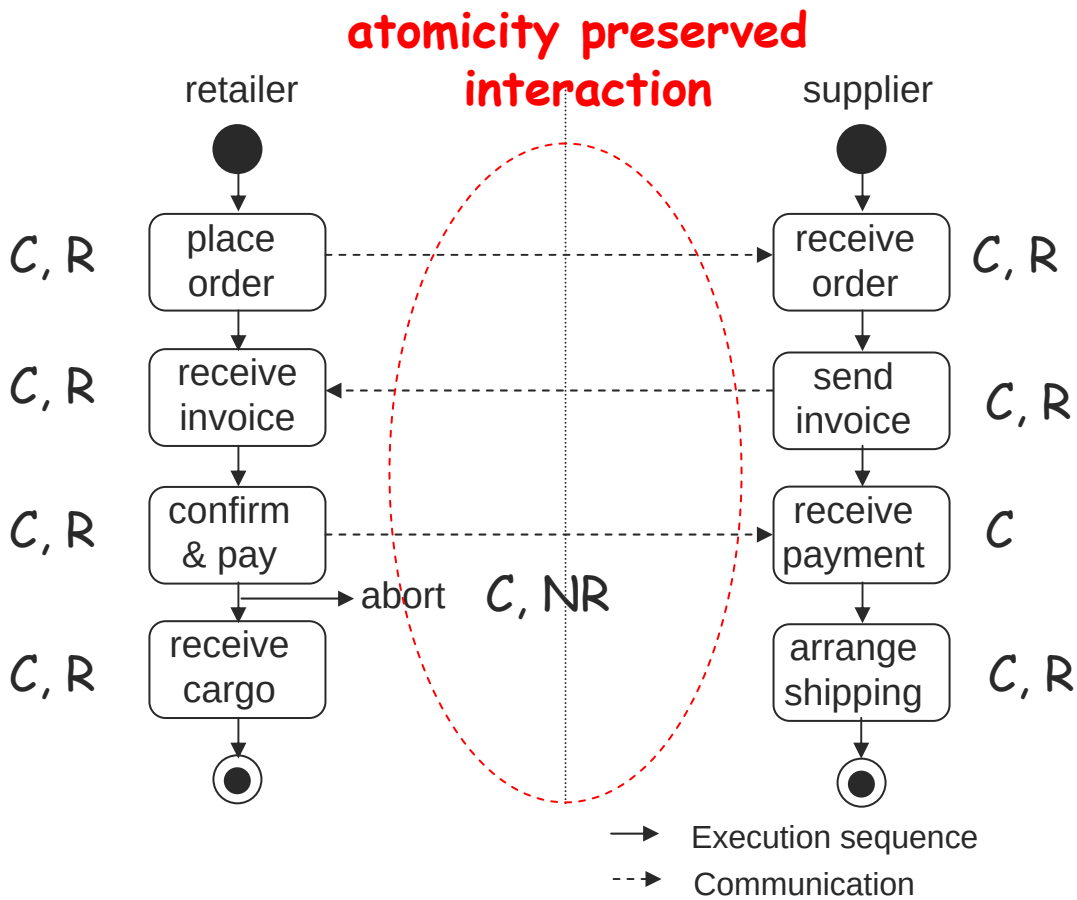
Introduction

- Checking atomicity in service composition
  - Difficult due to only restricted views are exposed.
  - Our previous work[2][3]
    - Address this problem by projecting atomicity information into the public views.
    - Use the public views to check atomicity instead of the original processes.

[2] C.Y. Ye, S.C. Cheung, and W.K. Chan. Publishing and composition of atomicity-equivalent services for B2B collaboration. *ICSE06.*
[3] C.Y. Ye, S.C. Cheung, W.K. Chan, and C. Xu. Local analysis of atomicity sphere for B2B collaboration. *FSE06.*

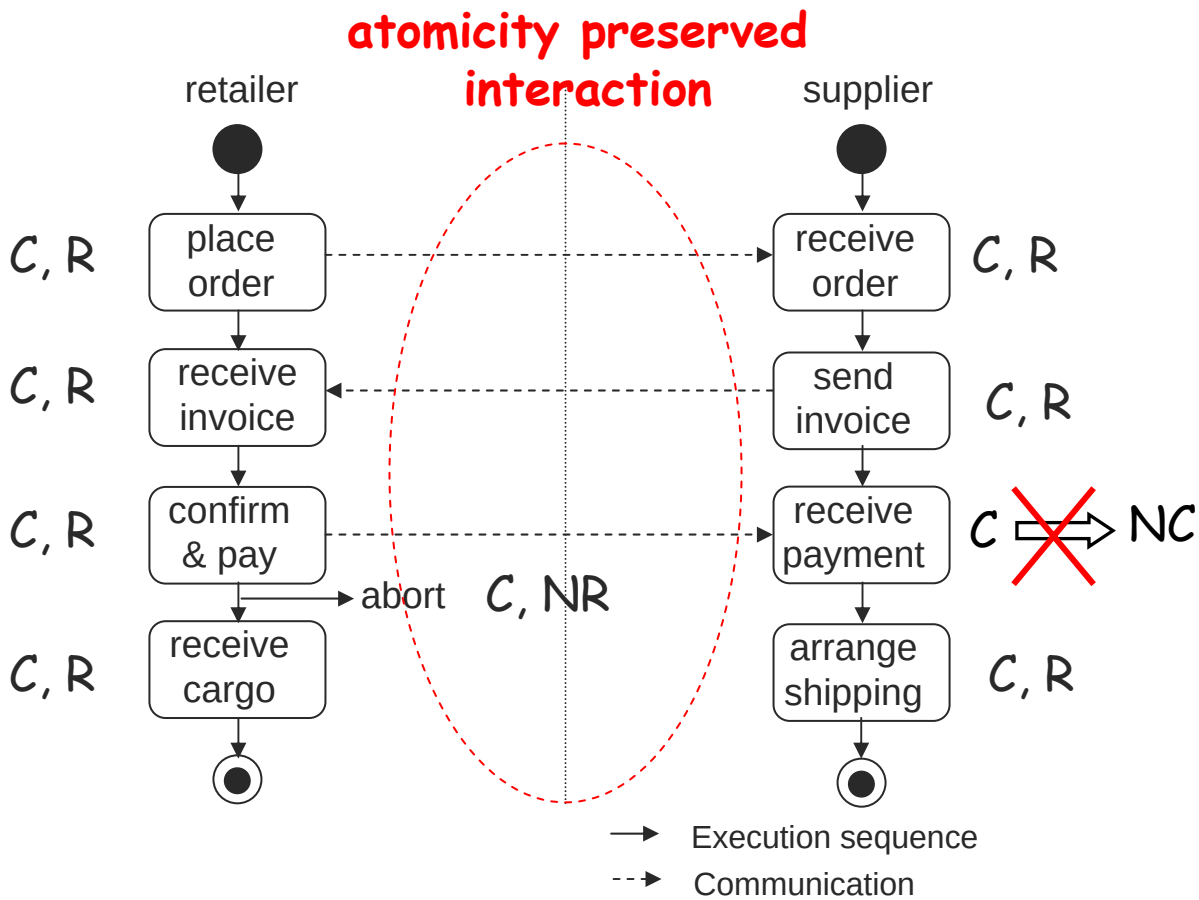
Motivation

- Our previous work assumes processes do not change



Motivation

- Our previous work assumes processes do not evolve

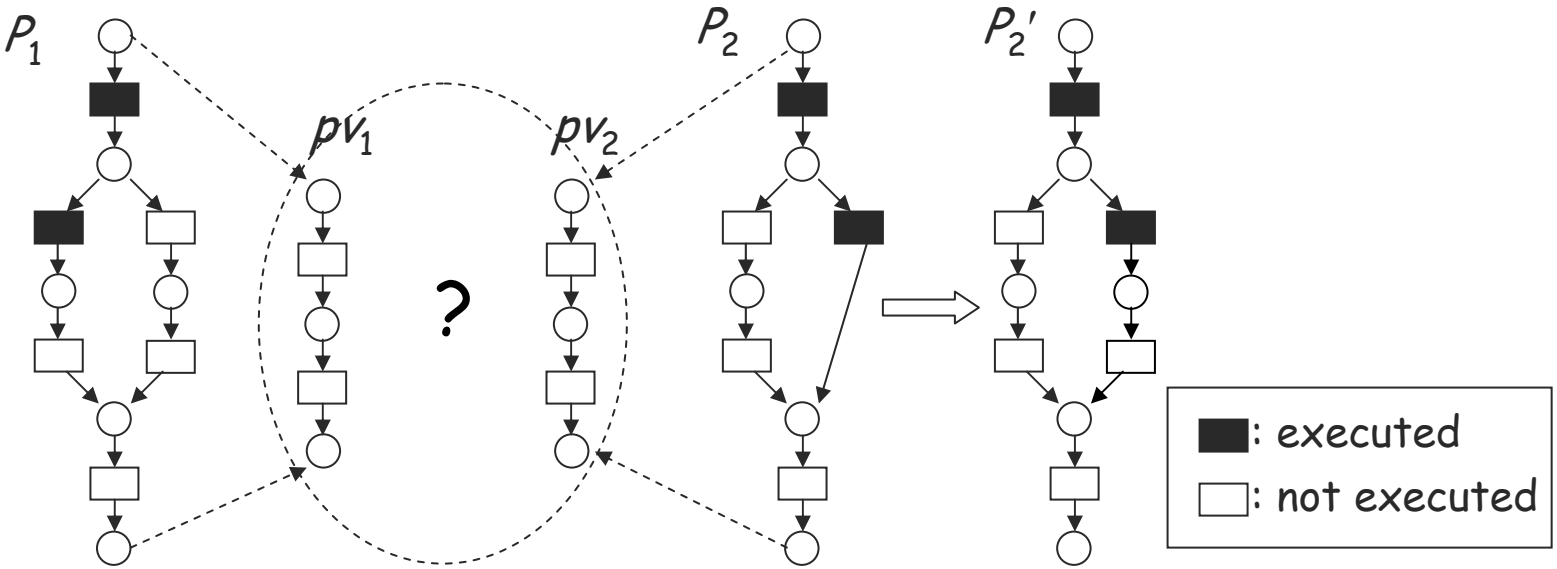


Motivation

- One way to handle process evolution
  - Service providers re-publish their public views.
  - Re-conduct the atomicity checking using the updated public views.
  - However, this strategy has limitations:
    - May need to delay evolution until collaboration completes
    - Aborting ongoing collaboration may cause value loss

Motivation

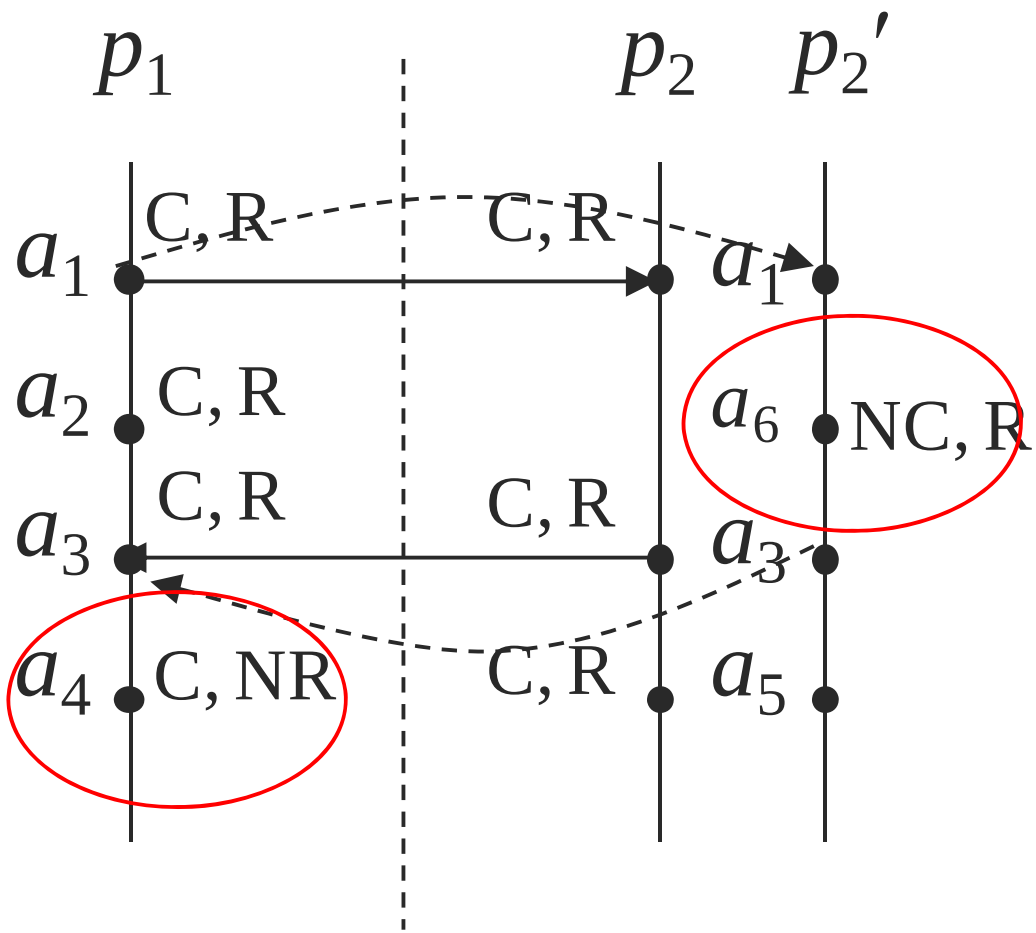
- Can a process evolve independently without affecting atomicity?
- Can the decision be made with local information?



Dynamic Evolution Operators

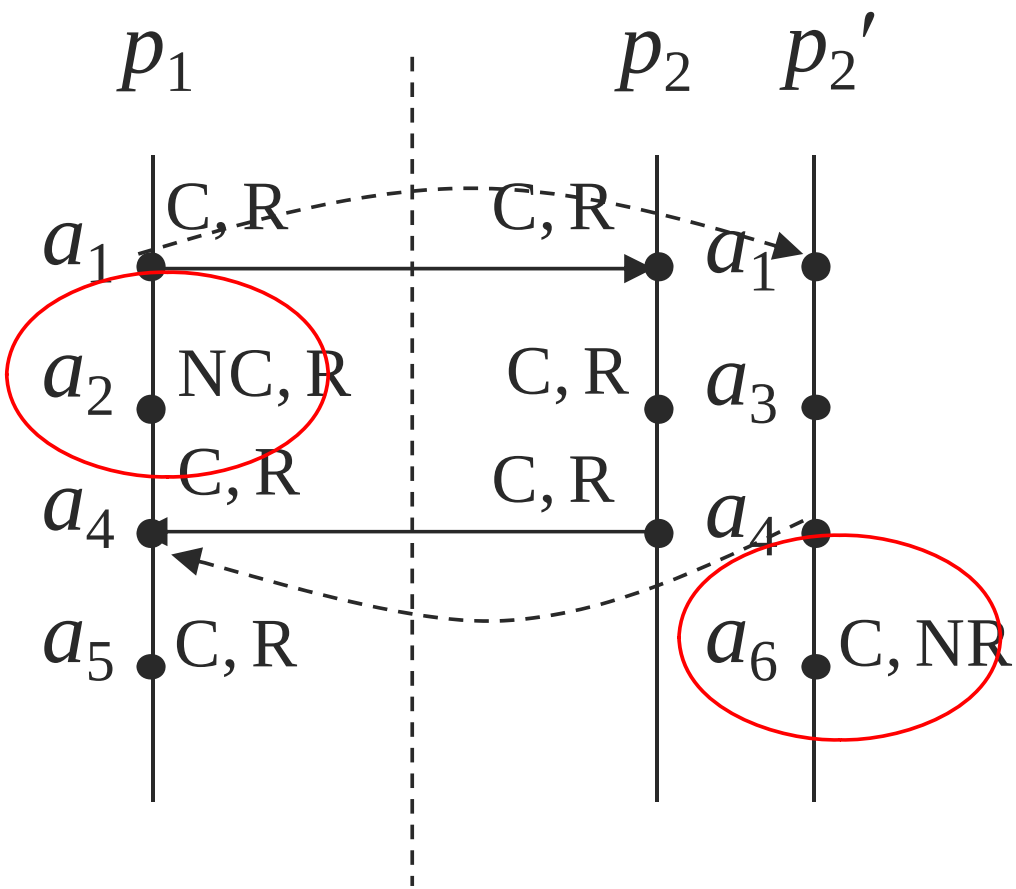
- Two basic operators
  - Insert an action
  - Remove an action
- Other operators
  - E.g., Change the property, relocate an action
  - Could be simulated by the two basic operators

Potential problems



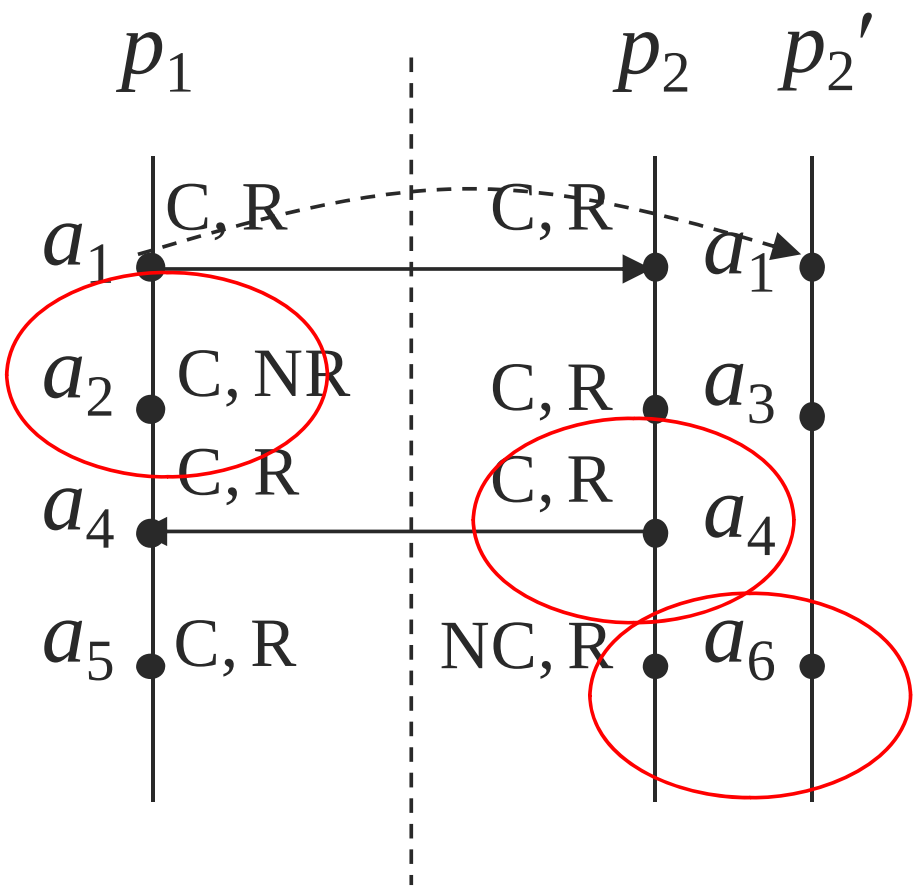
Insert a NC action

Potential problems



Insert a NR action

Potential problems

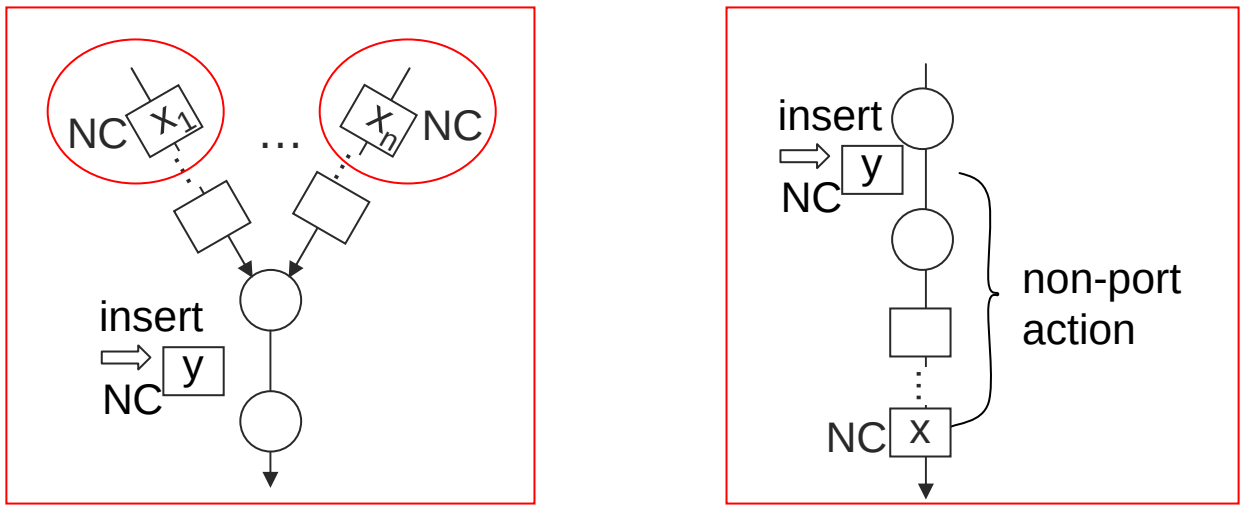


Remove a port action

Underlying Principles of Evolution

- An NC task can be inserted if it is/will be executed after an NC task
- An NR task can be inserted if it isn’t or won’t be executed after an NC task
- A message exchange (or port action) can be skipped if its removal does not introduce a new NC-NR pair.

Situation 1

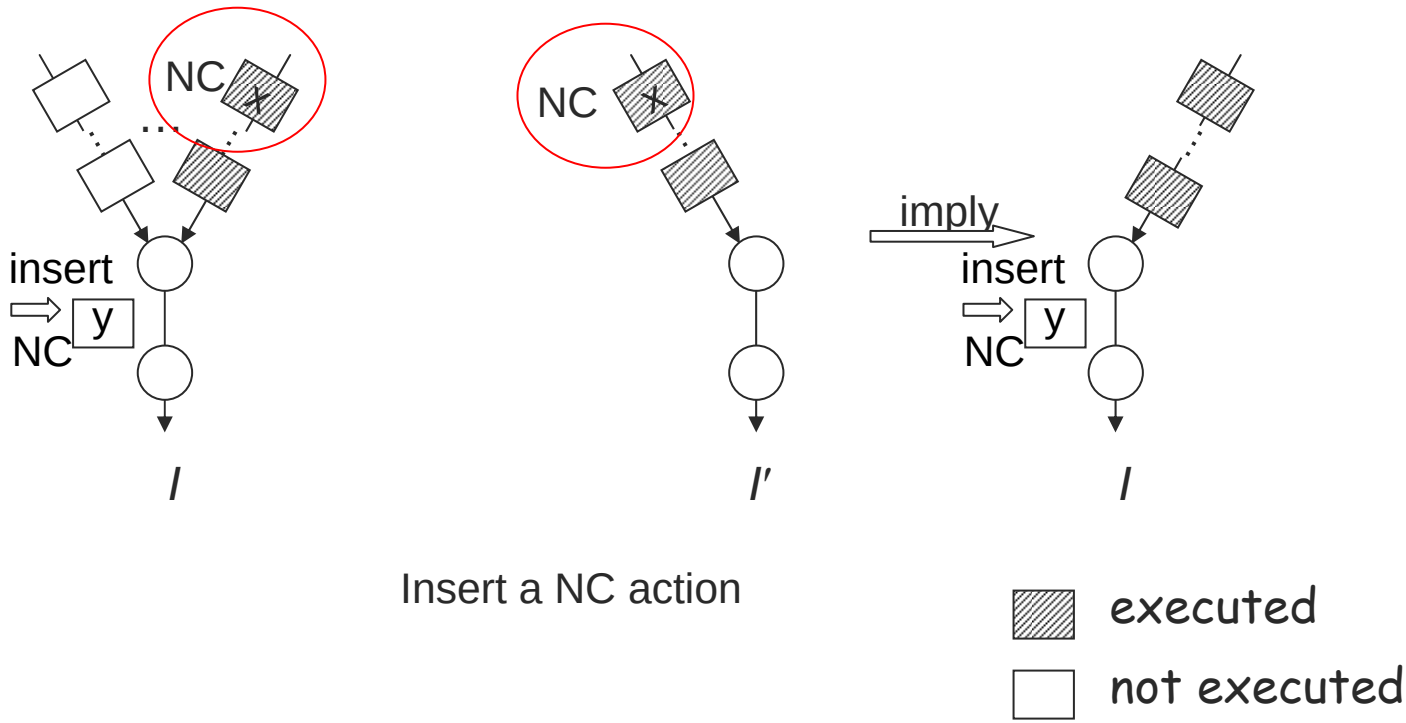


Insert a NC action

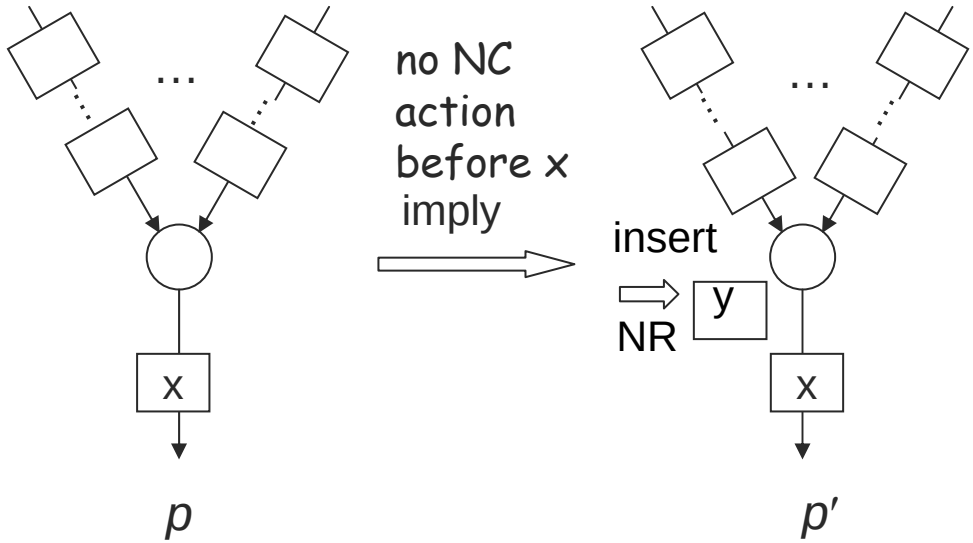
task

state

Situation 2


NC
insert
y
NC
I
NC
I′
imply
insert
y
NC
I
Insert a NC action
executed
not executed

Situation 3



Correctness

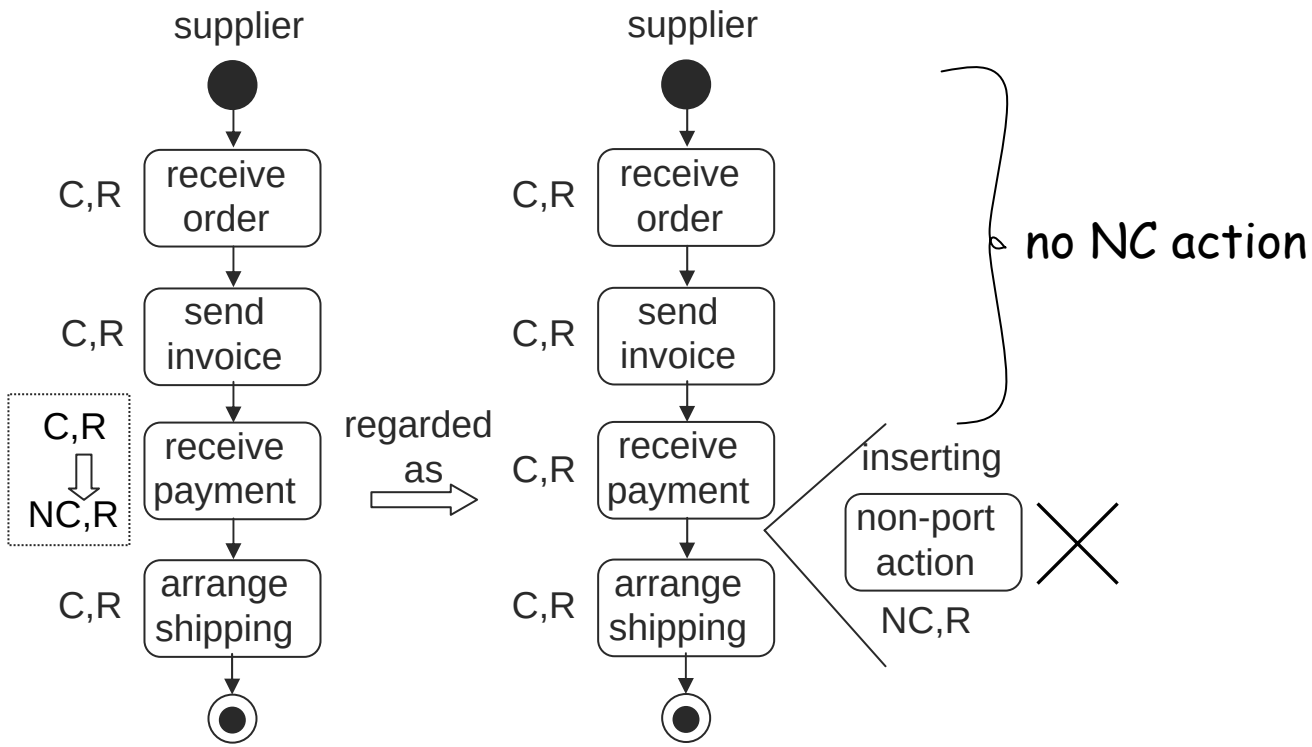
- Let *p* be a process, and *pv* be its atomicity-equivalent public view.
- Suppose *p′* is the resultant process of inserting a new action into *p* satisfying the principles, then for any process *q*,

if $\varphi(pv \parallel q) = true$, then $\varphi(p' \parallel q) = true$.

Original collaboration satisfy atomicity

New collaboration also satisfy atomicity

Application



Discussions

- Related work
  - From the perspective of behavior consistency, not address atomicity
  - [Aalst et al. 02][Basten et al. 01][Casati et al. 98][Ellis et al. 95]
- Limitations
  - Completeness?
    - Missing operators
    - Missing situations

Conclusion and future work

- Evolution principles are analyzed
- Situations of these principles are discussed
  - To prevent atomicity violation in dynamic evolution
- Future work
  - Study the completeness issue

Thank you!