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Data Consistency In Distributed Systems

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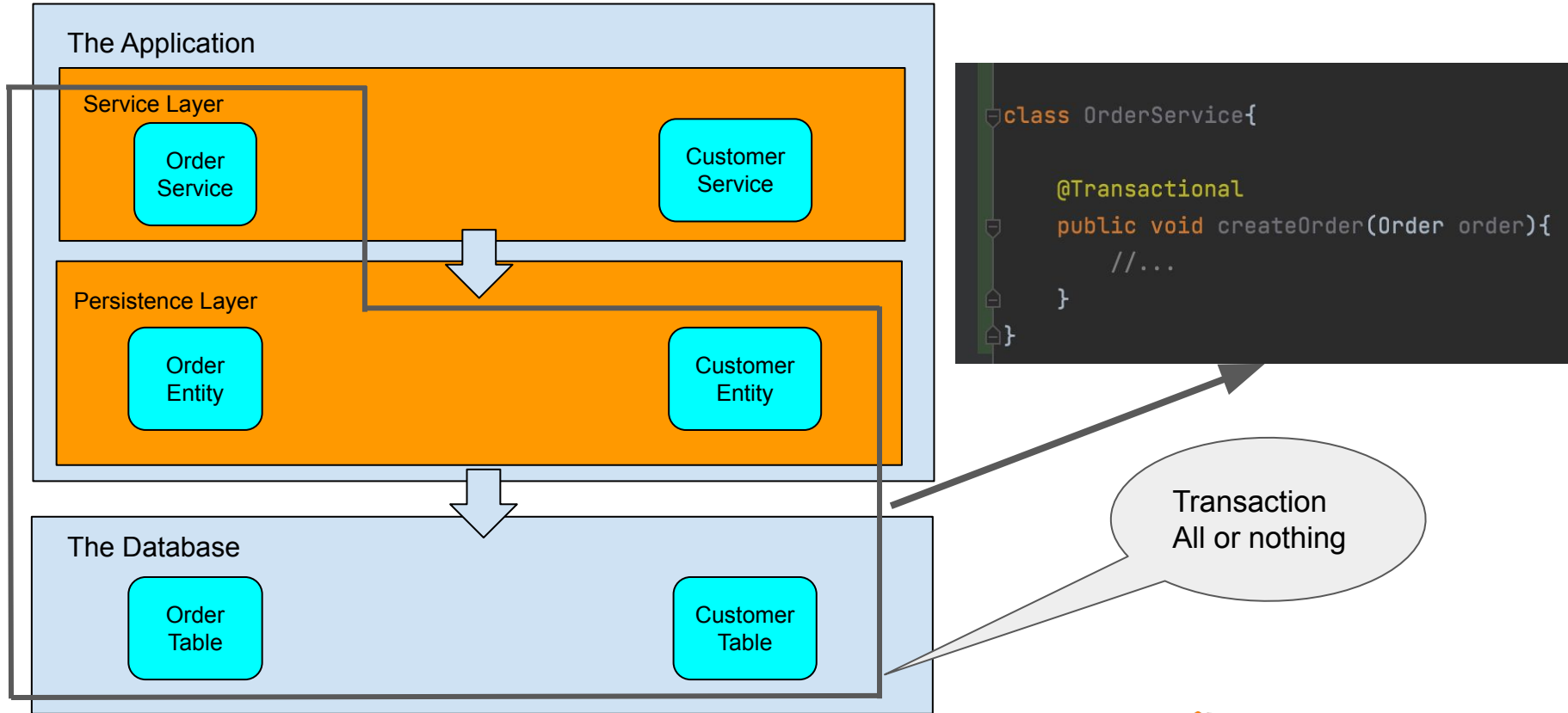
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<https://github.com/osadikk>

Agenda

- ❏ ACID and distributed systems
- ❏ 2PC
- ❏ BASE
- ❏ SAGA
- ❏ Implement SAGA with BPMN

Transactions in a Monolithic Architecture



ACID

DATABASE TRANSACTIONS

A

Atomic

All changes to the data must be performed successfully or not at all

C

Consistent

Data must be in a consistent state before and after the transaction

I

Isolated

No other process can change the data while the transaction is running

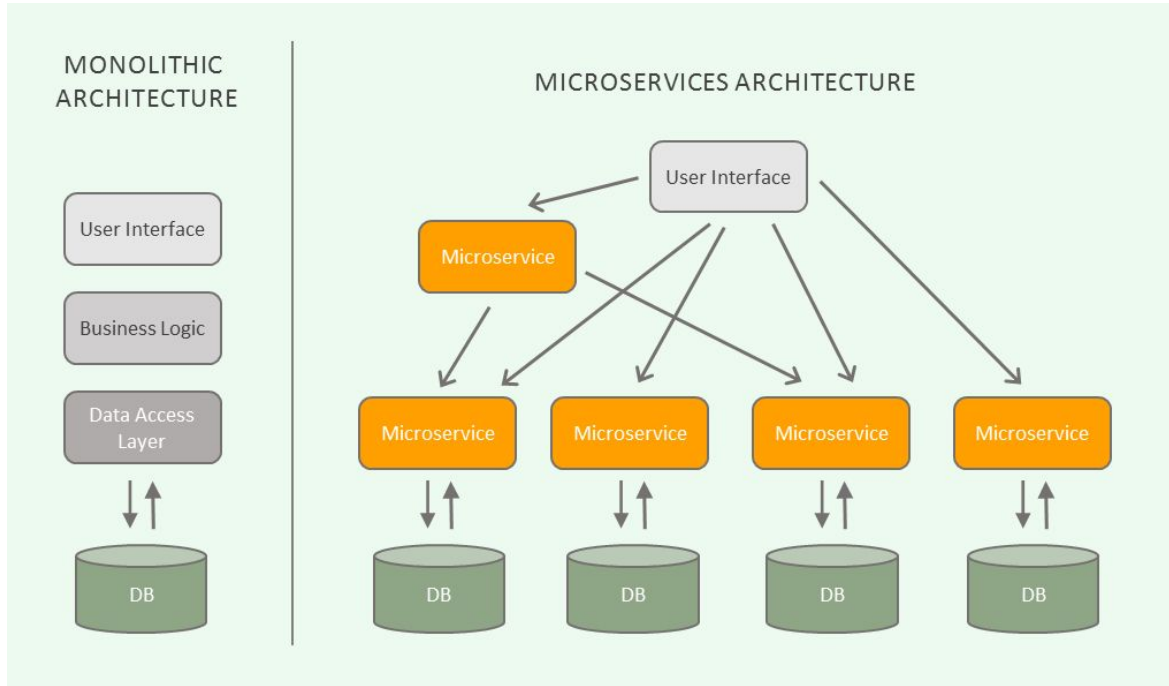
D

Durable

The changes made by a transaction must persist

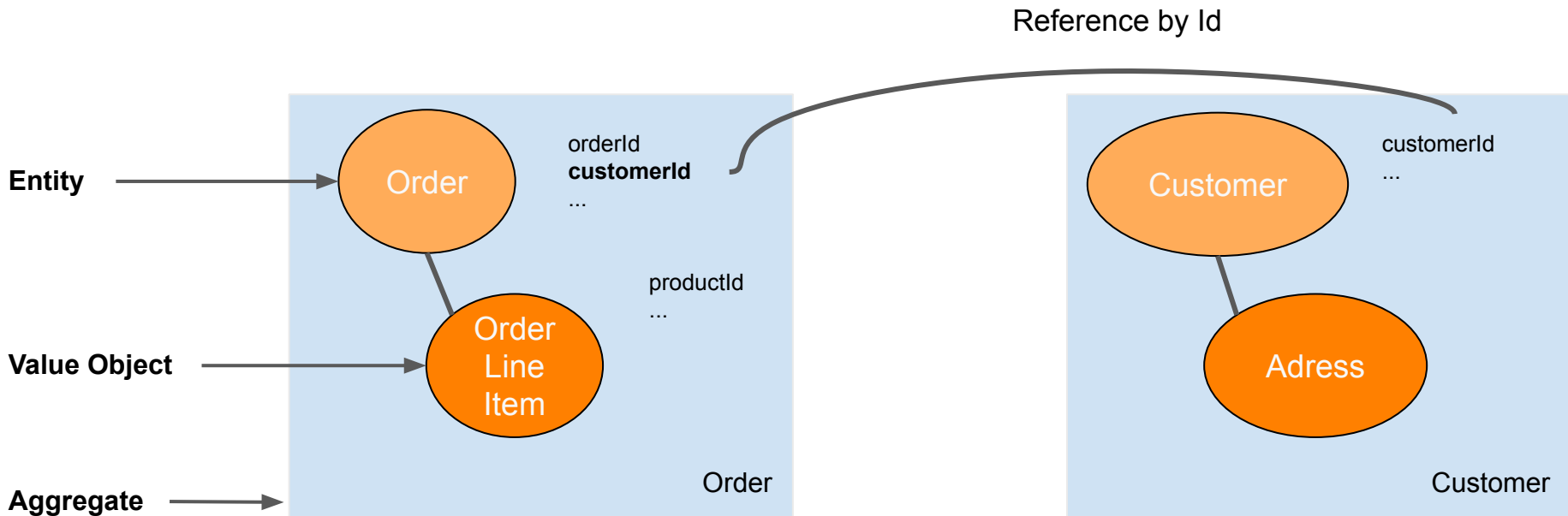
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Distributed Systems

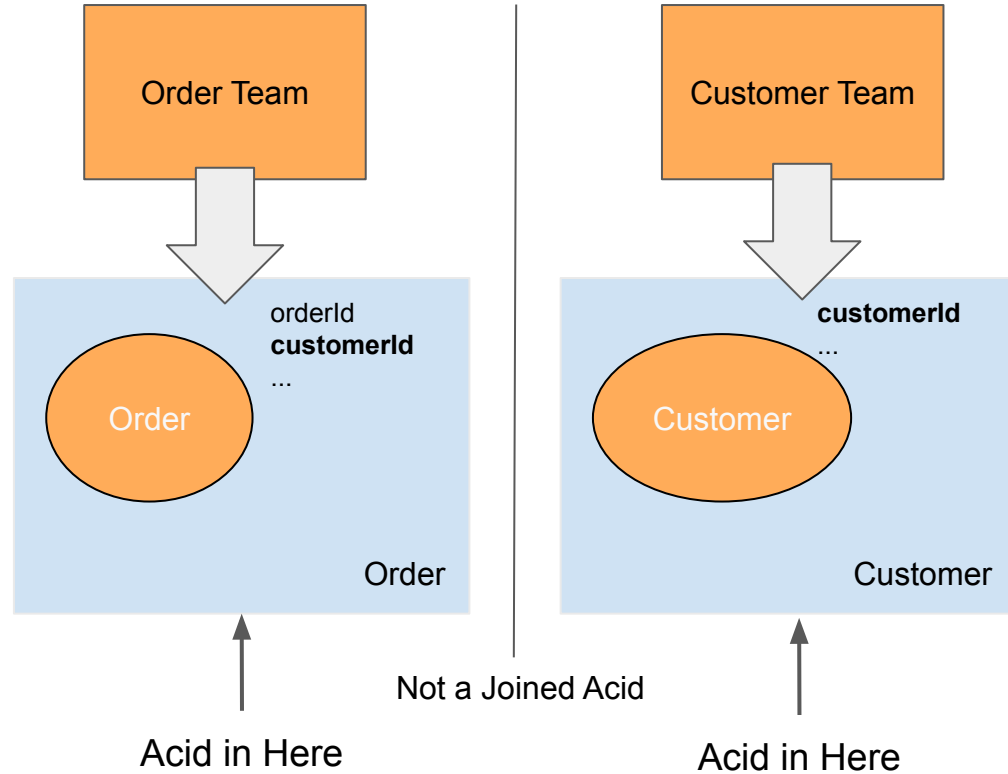


<https://medium.com/hackernoon/how-microservices-saved-the-internet-30cd4b9c6230>

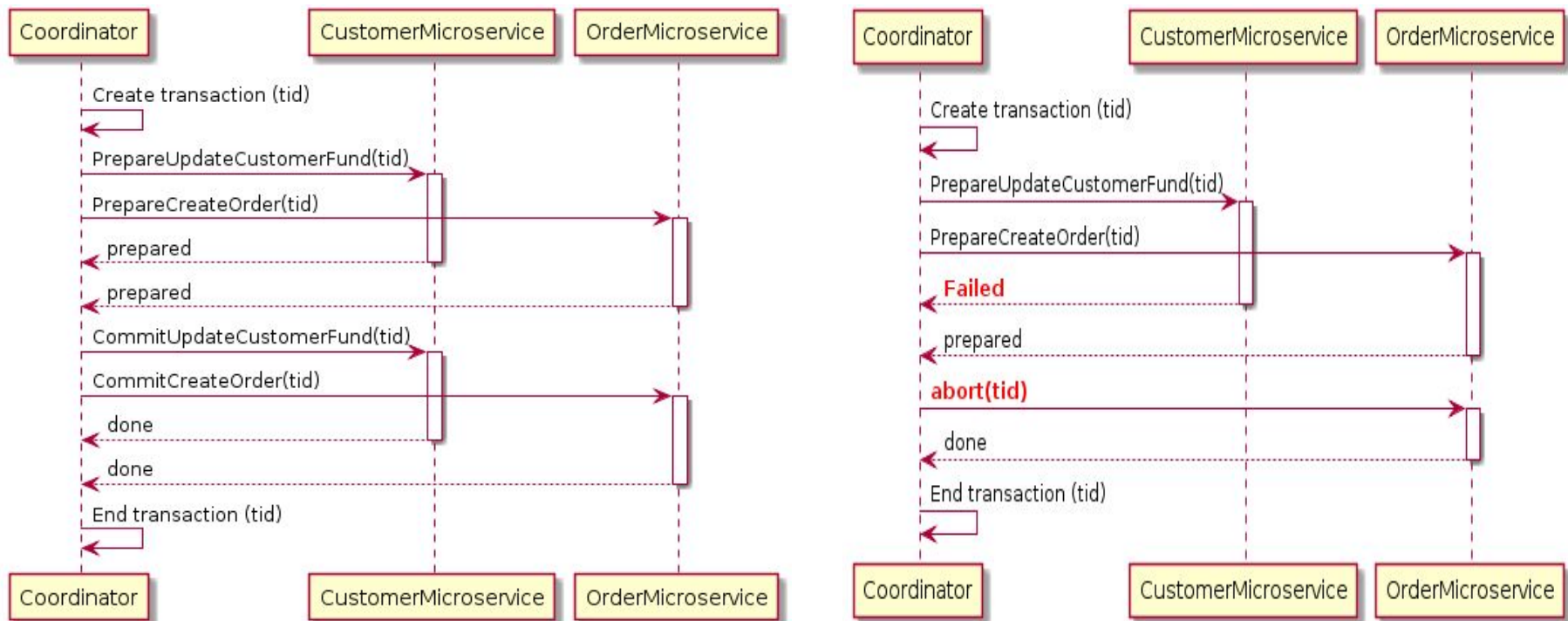
Aggregates



Transaction in Aggregates



2PC (XA)



https://developers.redhat.com/blog/2018/10/01/patterns-for-distributed-transactions-within-a-microservices-architecture#what_is_a_distributed_transaction

2PC Advantages/Disadvantages

- ❑ Strong consistency
- ❑ Read Write Isolation

BUT

- ❑ Single point of failure
- ❑ Long delays due to locks
- ❑ More messaging
- ❑ Not support by many No-Sql databases

Base

- ◆ But we forfeit “C” and “I” for availability, graceful degradation, and performance

This tradeoff is fundamental.

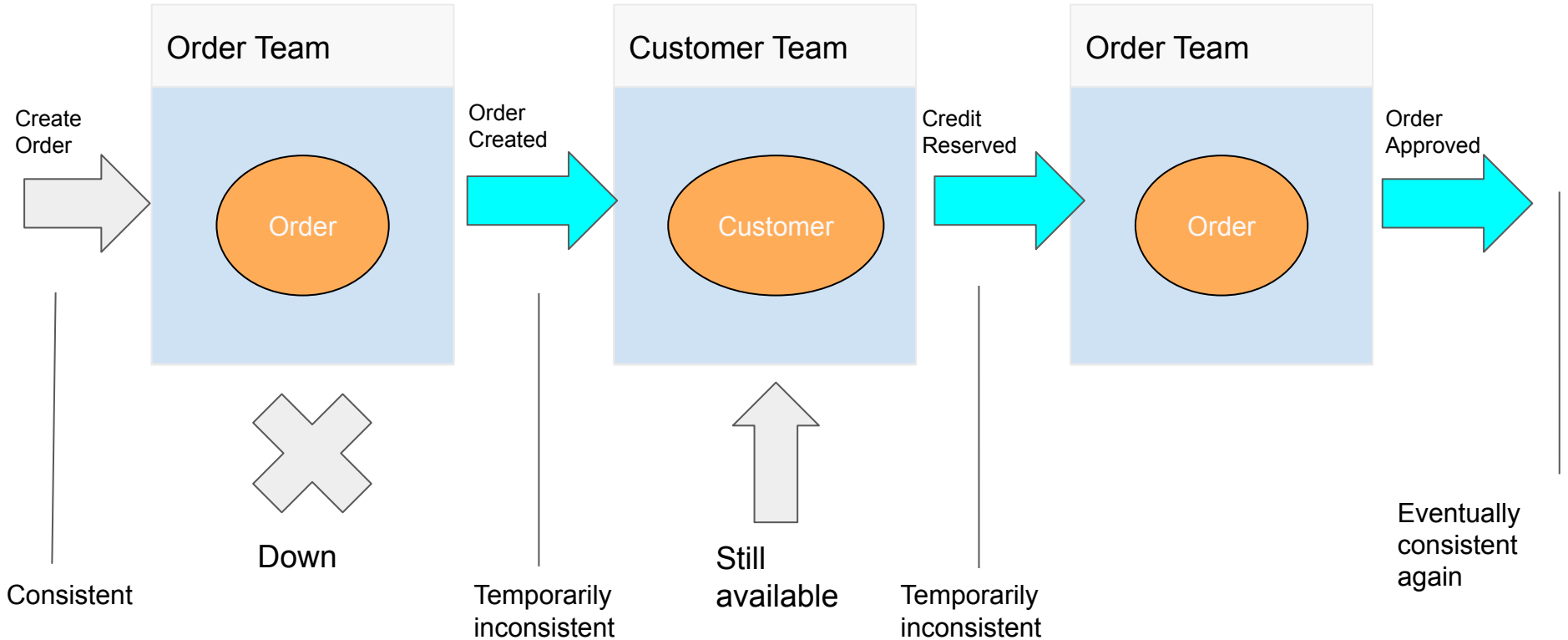
BASE:

- **B**asically **A**vailable
- **S**oft-state
- **E**ventual consistency

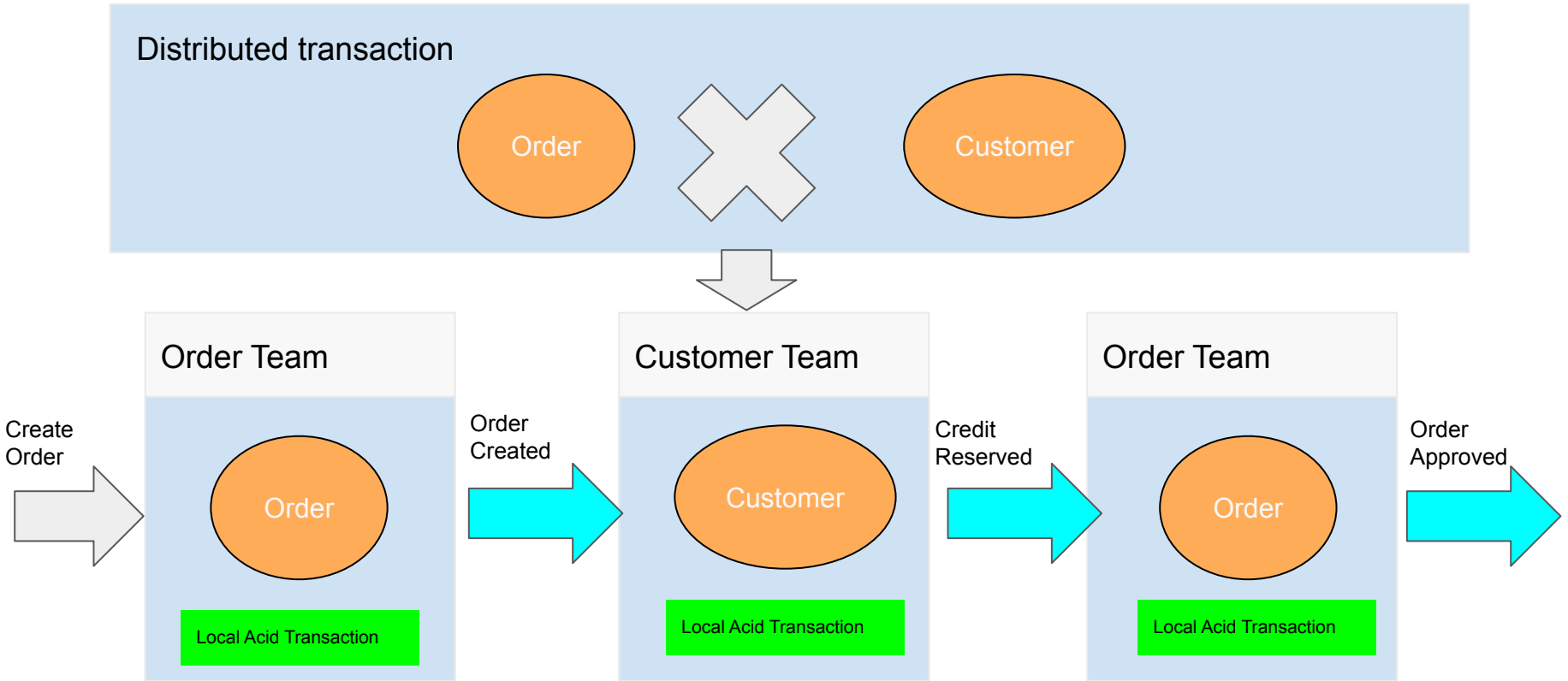
PODC Keynote, July 19, 2000

http://pld.cs.luc.edu/courses/353/spr11/notes/brewer_keynote.pdf

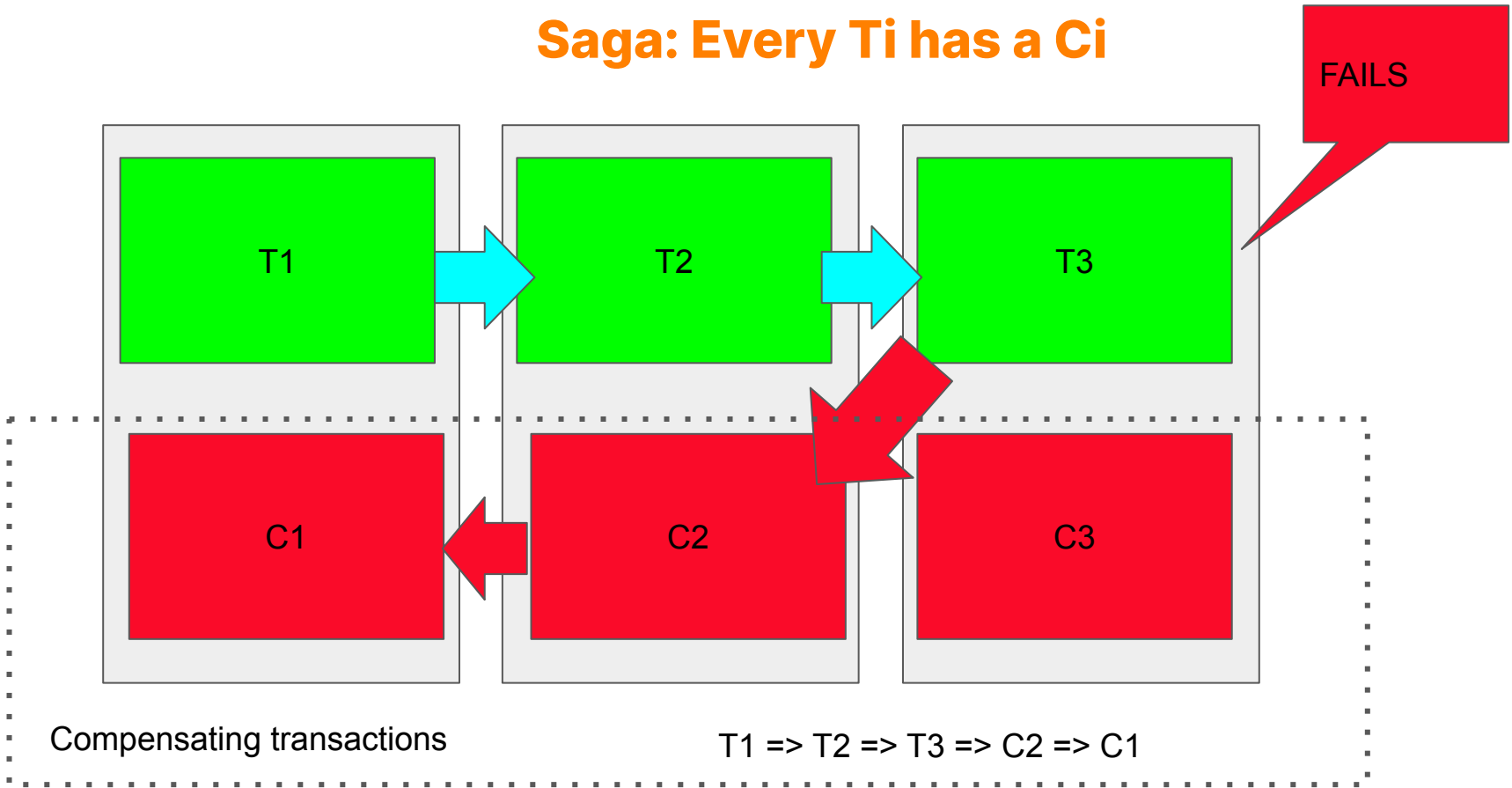
Base



Use Sagas

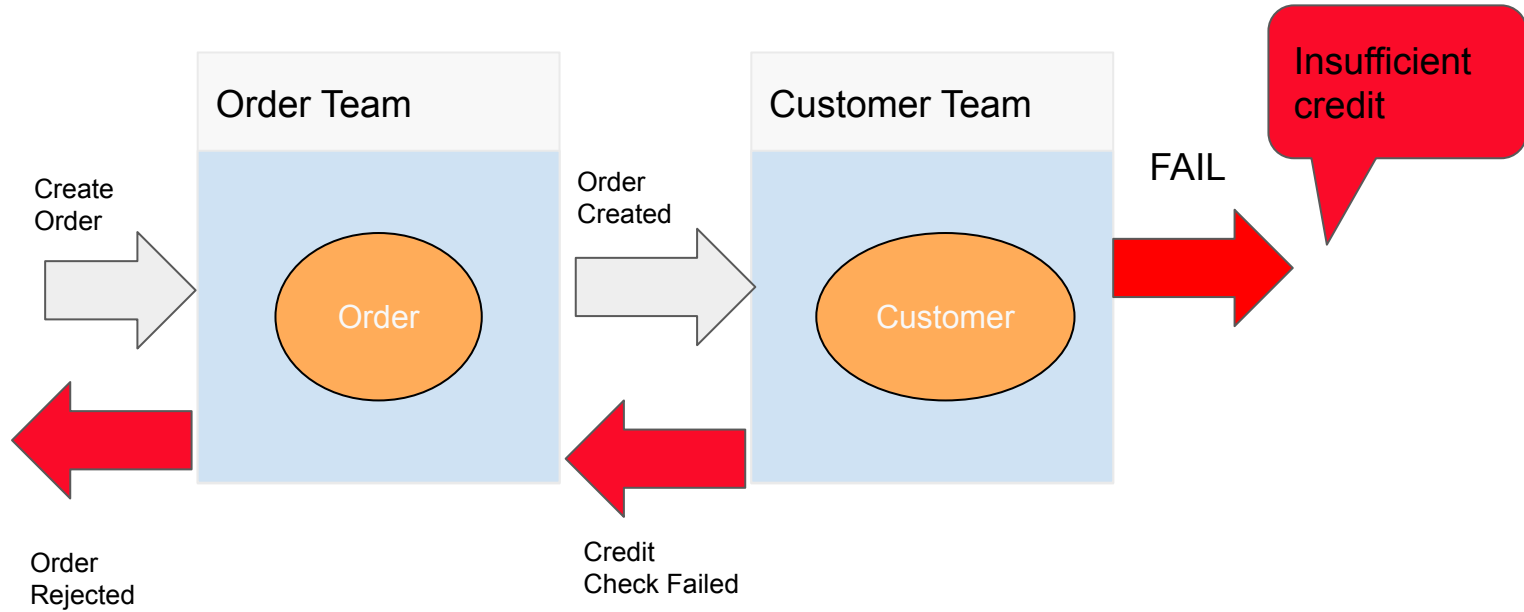


Saga: Every Ti has a Ci



<https://www.youtube.com/watch?v=YPbGW3Fnmbc>

Compensation



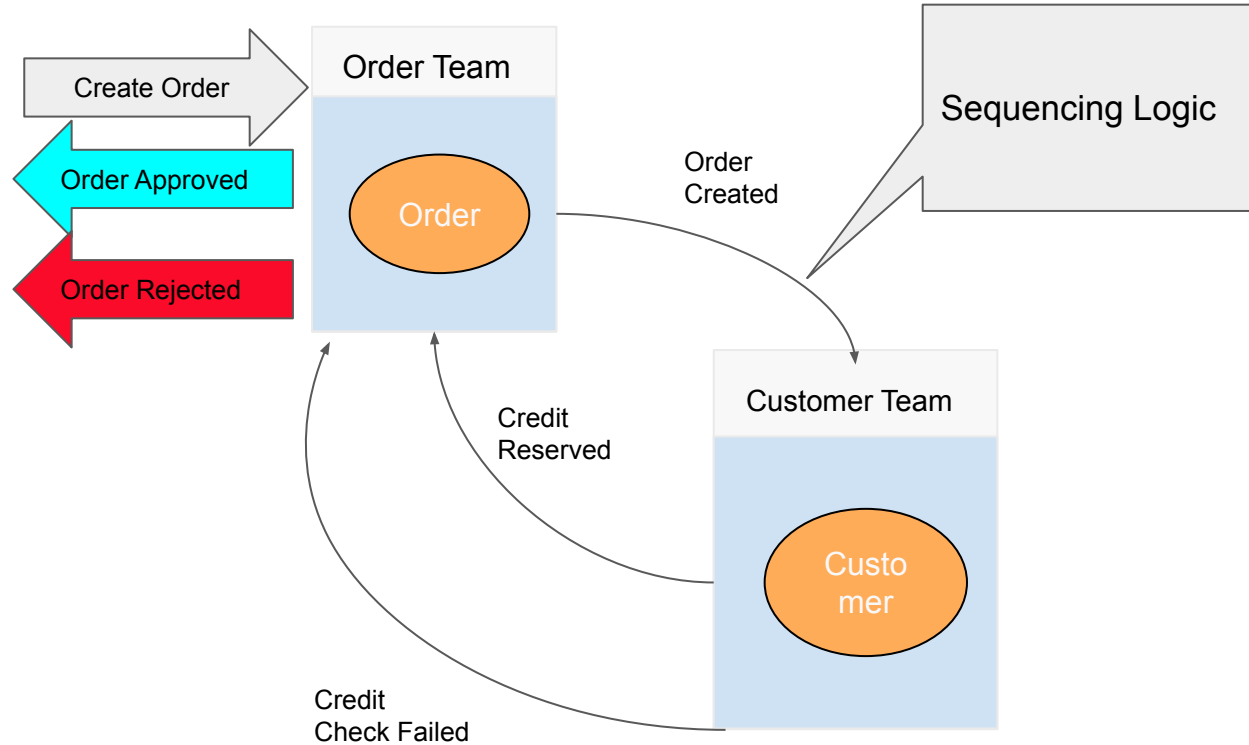
Saga Options

Choreography : distributed decision making

VS

Orchestration: centralized decision making

Option 1: Choreography



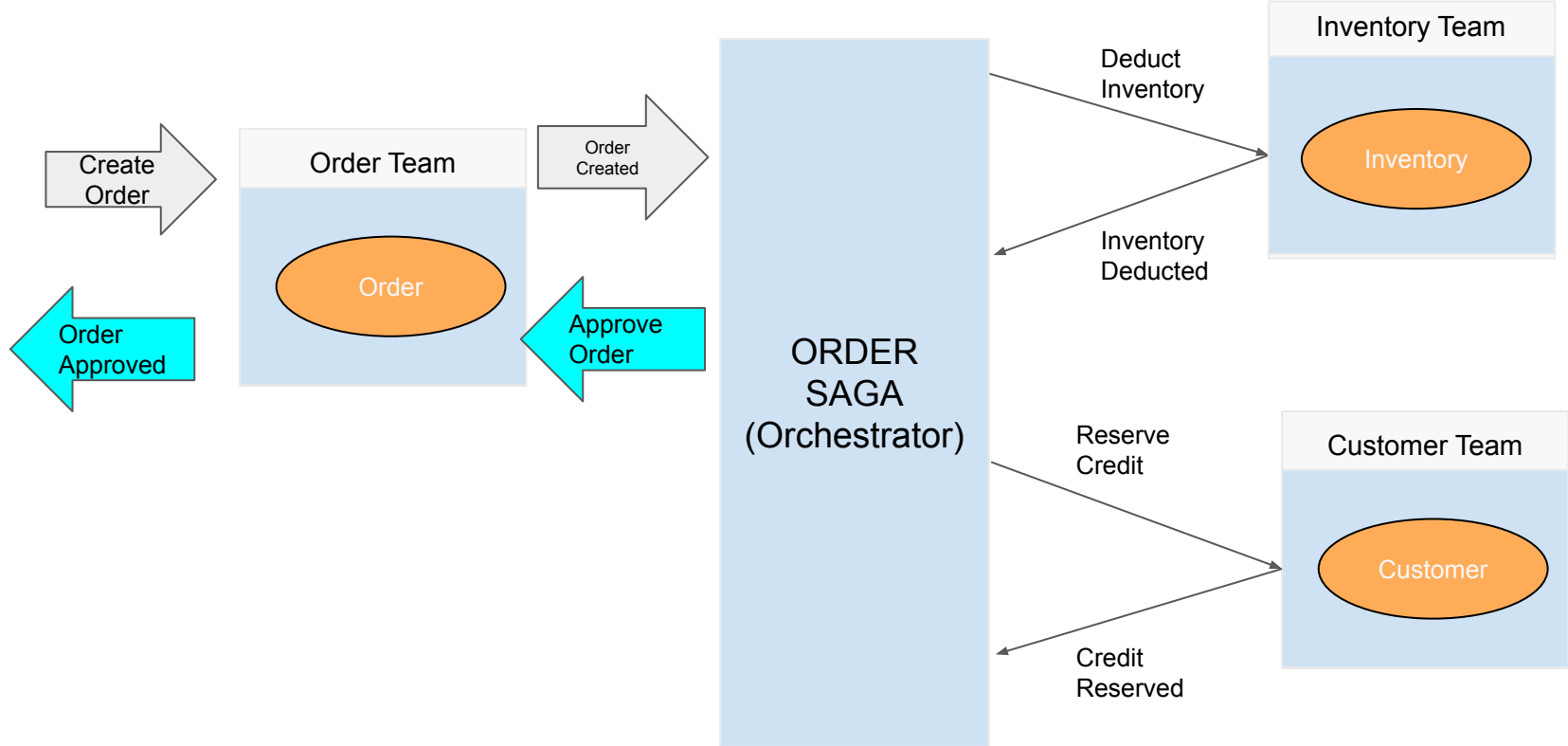
Option 1: Choreography

- ❑ It is good for if transaction contains few steps

BUT

- ❑ Adding more steps can make more confusing to understand big picture of flow.
- ❑ It is difficult to follow which services listens to which events
- ❑ Hard to change sequence of steps
- ❑ Cyclic dependency

Option 2: Orchestration



Business Process Model and Notation

From Wikipedia, the free encyclopedia



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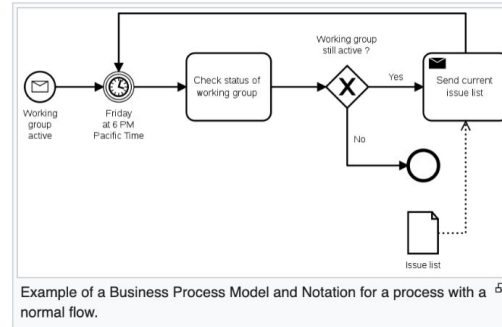
- A major contributor to this article appears to have a [close connection with its subject](#). (February 2019)
- This article [may rely excessively on sources too closely associated with the subject](#), potentially preventing the article from being [verifiable](#) and [neutral](#). (February 2019)

Business Process Model and Notation (BPMN) is a [graphical representation](#) for specifying [business processes](#) in a [business process model](#).

Originally developed by the [Business Process Management Initiative](#) (BPMI), BPMN has been maintained by the [Object Management Group](#) (OMG) since the two organizations merged in 2005. Version 2.0 of BPMN was released in January 2011,^[1] at which point the name was amended to **Business Process Model and Notation** to reflect the introduction of execution semantics, which were introduced alongside the existing notational and diagramming elements. Though it is an OMG specification, BPMN is also ratified as [ISO 19510](#). The latest version is BPMN 2.0.2, published in January 2014.^[2]

Contents [\[hide\]](#)

- 1 Overview
- 2 Topics
 - 2.1 Scope
 - 2.2 Elements
 - 2.3 Flow objects and connecting objects
 - 2.4 Swim lanes and artifacts



Example of a Business Process Model and Notation for a process with a normal flow.

https://en.wikipedia.org/wiki/Business_Process_Model_and_Notation

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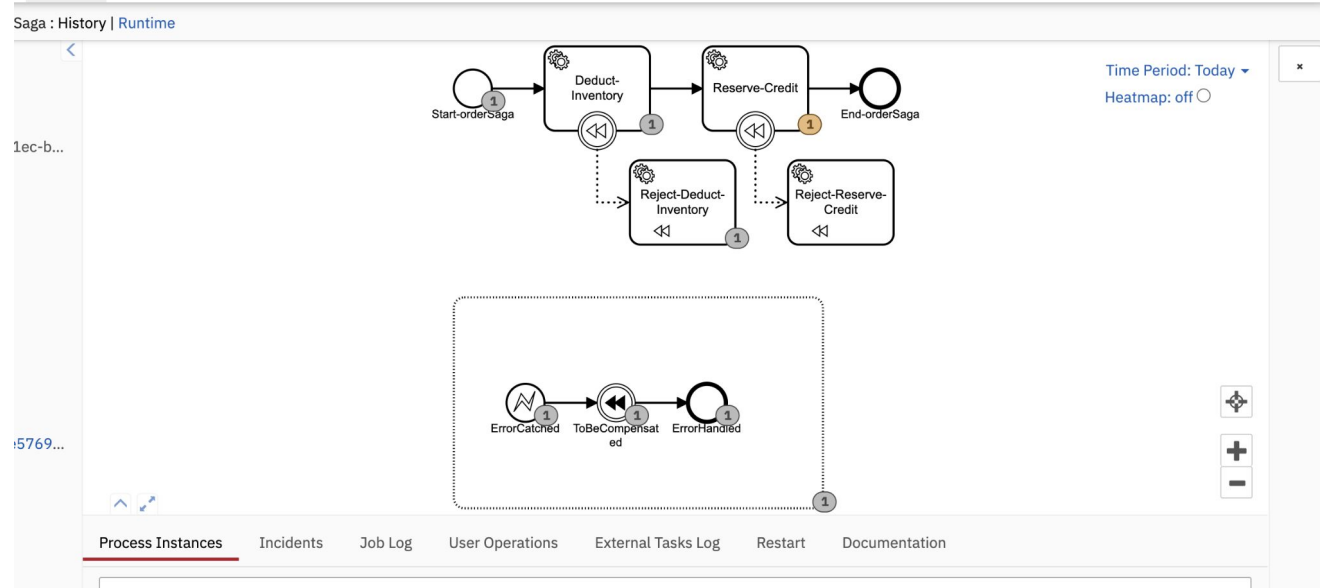
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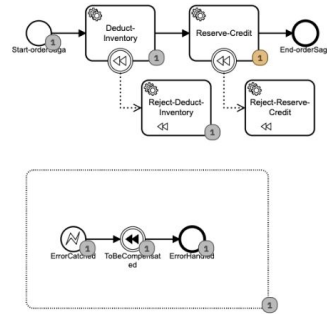
Bpmn Orchestration

ORDER
SAGA
(Orchestrator)



Bpmn Orchestration

se63d6-166c-11ec-bc0f-eae576920ac3 : History | Runtime



Audit Log

Variables

Called Process Instances

Called Case Instances

Executed Decision Instances

Incidents

User Tasks

User Operations

State	Activity	Start Time	End Time	Activity Instance ID
✓	Start-orderSaga	2021-09-15T23:35:13	2021-09-15T23:35:13	Start-orderSaga:cf6f7547-166c-11...
✓	Deduct-Inventory	2021-09-15T23:35:13	2021-09-15T23:35:13	Activity-Deduct-Inventory:cf701188...
✗	Reserve-Credit	2021-09-15T23:35:13	2021-09-15T23:35:13	Activity-Reserve-Credit:cf70d4da-1...
✓	ErrorCaught	2021-09-15T23:35:13	2021-09-15T23:35:13	ErrorCaught:cf71982d-166c-11ec...
✓	subProcess (subProcess_ab90ad9b...	2021-09-15T23:35:13	2021-09-15T23:35:13	cf71982c-166c-11ec-bc0f-eae576...
✓	ToBeCompensated	2021-09-15T23:35:13	2021-09-15T23:35:13	ToBeCompensated:cf71bf3f-166c-1...
✓	Reject-Deduct-Inventory	2021-09-15T23:35:13	2021-09-15T23:35:13	cf71e651-166c-11ec-bc0f-eae576...
✓	ErrorHandled	2021-09-15T23:35:13	2021-09-15T23:35:13	ErrorHandled:cf720d62-166c-11ec...

Bpmn Orchestration





THANK YOU

References

<https://www.youtube.com/watch?v=YPbGW3Fnmbc>

<https://www.youtube.com/watch?v=WRR26jJNh68>

http://pld.cs.luc.edu/courses/353/spr11/notes/brewer_keynote.pdf

https://en.wikipedia.org/wiki/Business_Process_Model_and_Notation

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