Lost in transaction?

Strategies to manage consistency in distributed systems

aberndruecker





Tackling Complexity in the Heart of Software







Atomicity (onsistency solation Durability

Aggregates = (onsistency Boundaries



Aggregates = (onsistency Boundaries



Aggregates = (onsistency Boundaries



Boundaries need to be designed carefully



But <u>no</u> implicit constraints!







Pat Helland

Distributed Systems Guru Worked at Amazon, Microsoft & Salesforce

Life beyond Distributed Transactions: an Apostate's Opinion

Position Paper

Pat Helland

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The positions expressed in this paper are personal opinions and do not in any way reflect the positions of my employer Amazon.com.

ABSTRACT

Many decades of work have been invested in the area of distributed transactions including protocols such as 2PC, Paxos, and various approaches to quorum. These protocols provide the application programmer a façade of global serializability. Personally, I have invested a nontrivial portion of my career as a strong advocate for the implementation and use of platforms Instead, applications are built using different techniques which do not provide the same transactional guarantees but still meet the needs of their businesses.

This paper explores and names some of the practical approaches used in the implementations of large-scale mission-critical applications in a world which rejects distributed transactions. We discuss the management of fine-grained pieces of application data which may be repartitioned over time as the application grows. We also discuss the design patterns used in sending messages between these repartitionable pieces of data



" Grown-Ups Don't Use Distributed Transactions

Pat Helland

Distributed Systems Guru Worked at Amazon, Microsoft & Salesforce

@berndruecker JAD 1000 S

Starbucks does not use two phase commit

https://www.enterpriseintegrationpatterns.com/ramblings/18_starbucks.html

Photo by John Ingle

Eric Brewer

But we forfeit "C" and "I" for availability, graceful degradation, and performance

This tradeoff is fundamental.

BASE:

- Basically Available
- Soft-state
- Eventual consistency

PODC Keynote, July 19, 2000

Atomicity Consistency Isolation Durability

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

@berndruecker





Photo by <u>Gerhard51</u>, available under <u>Creative Commons CC0 1.0 license</u>.





You



Pat Helland

"Building on Quicksand" Paper



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A



Pat Helland

"Building on Quicksand" Paper

Associative (ommutative Idempotent Distributed 2.0

(a + b) + c = a + (b + c)

a + b = b + a

 $f(x) = f(\overline{f(x)})$

Distributed 931466

Distributed systems



WIKIPEDIA The Free Encyclopedia

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Fallacies of distributed computing

From Wikipedia, the free encyclopedia

The fallacies of distributed computing are a set of assertions made by L Peter Deutsch and others at Sun Microsyste

Contents [hide]

1 The fallacies

2 The effects of the fallacies

3 History

4 See also

5 References

6 External links

The fallacies [edit]

The fallacies are:[1]

1. The network is reliable.

2. Latency is zero.

3. Bandwidth is infinite.

Network problems



Strategy: retry





Photo by <u>pixabay</u>, available under <u>Creative Commons CC0 1.0 license</u>.

Requirement: Idempotency of services!



Photo by pixabay, available under Creative Commons CC0 1.0 license.

Requirement: Idempotency of services!



Photo by <u>Chr.Späth</u>, available under <u>Public Domain</u>.

Distributed systems

It is impossible to differentiate certain failure scenarios: (lient Service Provider X

Independant of communication style!

Strategy: (leanup



Cancel charge cardNumber amount transactionId

Distributed systems



Some communication challenges require state.

Strategy: Stateful retry



Strategy: Stateful retry



Warning: Contains Opinion



Bernd Ruecker

(o-founder and Technologist of (amunda



Berlin, Germany



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Stateful retry


Stateful retry & cleanup



Architecture



@berndruecker Lightweight **S**amunda Architecture oss workflow engine Workflow Infrastructure Engine Application Domain Ę. Charge credit card (≥) Payment received no retries left (D) Refund (if charged) Payment Payment failed failed

Live hacking

https://github.com/flowing/flowing-retail/tree/master/rest



Embedded Engine Example (Java)

Service A	Service B
~~~~~	
Infrastructure	
(ockpit (amunda	(ockpit (amunda
Spring Boot	Spring Boot

https://blog.bernd-ruecker.com/architecture-options-to-run-a-workflow-engine-6c2419902d91

# A relatively common pattern





State can solve important basic problems Kafka / Rabbit . Send 4. Send additional events 1. Receive response 2 ACK 83 Service Emit further (e.g. Go) events Send Message response Do processed business logic  $(\square)$ 2. Business Logic Message received RDMS

"Yes." zeebe  $\infty$ by Camunda Workflow Instances Started / Second 1250K 1001000 750K 500K

@berndruecker







### Sept 25-26, 2015 thestrangeloop.com

### **O'REILLY**°









Sept 25-26, 2015 thestrangeloop.com

Without cross-service transactions: Compensating transactions) ~ abort/rollback at app level (Garcia-Molina & Salem, 1987) poloaies C (Helland & Campbell, 2009) after the fact, rather than proventing them)

# (ompensation - the classical example



# 2 alterntive approaches: choreography & orchestration

# Event-driven choreography



# Event-driven choreography





The danger is that it's very easy to make nicely decoupled systems with event notification, without realizing that you're losing sight of that larger-scale flow, and thus set yourself up for trouble in future years.

https://martinfowler.com/articles/201701-event-driven.html



The danger is that it's very easy to make nicely decoupled systems with event notification, without realizing that you're losing sight of that larger-scale flow, and thus set yourself up for trouble in future years.

https://martinfowler.com/articles/201701-event-driven.html



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https://martinfowler.com/articles/201701-event-driven.html



<u>Denis Rosa</u> Couchbase

If your transaction involves 2 to 4 steps, choreography might be a very good fit.

However, this approach can rapidly become confusing if you keep adding extra steps in your transaction as it is difficult to track which services listen to which events. Moreover, it also might add a cyclic dependency between services as they have to subscribe to one another's events.

https://blog.couchbase.com/saga-pattern-implement-business-transactions-using-microservices-part/

We have a new basic agreement with the car rental agency and can cancel for free within I hour – do that first!



Implementing changes in the process





Implementing changes in the process

You have to adjust all services and redeploy at the same time!



Photo by Lijian Zhang, available under Creative Commons SA 2.0 License and Pedobear19 / CC BY-SA 4.0

# orchestration



We have a new basic agreement with the car rental agency and can cancel for free within I hour – do that first!



# orchestration

# Describe orchestration with BPMN





# The workflow is domain logic as part of the service



# The workflow is domain logic as part of the service



### **Modular Services** with Distributed Sagas



Caitie McCaffrey | @caitie

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THE BEACH

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# Graphical models?





### <u>Clemens Vasters</u> Architect at Microsoft

http://vasters.com/archive/Sagas.html

#### Sagas 02 modes

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**Clemens Vasters** Architect at Microsoft

http://vasters.com/archive/Sagas.html

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### <u>Clemens Vasters</u> Architect at Microsoft

http://vasters.com/archive/Sagas.html

### Sagas

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# BPMN

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# Living documentation for long-running behaviour



# Visual HTML reports for test cases



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# Fancy a DSL? Just do it!

```
SagaBuilder saga = SagaBuilder.newSaga("trip")
    .activity("Reserve car", ReserveCarAdapter.class)
    .compensationActivity("Cancel car", CancelCarAdapter.class)
    .activity("Book hotel", BookHotelAdapter.class)
    .compensationActivity("Cancel hotel", CancelHotelAdapter.class)
    .activity("Book flight", BookFlightAdapter.class)
    .compensationActivity("Cancel flight", CancelFlightAdapter.class)
    .end()
    .triggerCompensationOnAnyError();
```

```
camunda.getRepositoryService().createDeployment()
    .addModelInstance(saga.getModel())
    .deploy();
```

https://github.com/berndruecker/flowing-trip-booking-saga

The visual get auto-generated...
# Thoughts on the state machine | workflow engine market



## Thoughts on the state machine | workflow engine market

Stack Vendors, Pure Play BPMS Low (ode Platforms

PEGA, IBM, SAG, ...

(amunda, zeebe, jBPM, Activiti, Mistral, ...

> oss Workflow or orchestration Engines

### Integration Frameworks

Apache (amel, Balerina, ...

Homegrown frameworks to scratch an itch

Vber, Netflix, AirBnb, ING, ...

(loud offerings

AWS Step Functions, Azure Durable Functions, ... Data Pipelines

Apache Airflow, Spring Data Flow, ...



## My personal pro-tip for a shortlist ;-)



# Recap

- Aggregates = (onsistency boundaries
- Grown ups don't use distributed transactions but eventual consistency
- Idempotency is super important
- Some consistency challenges require state
  - Stateful retry & cleanup
  - Saga / (ompensation



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    - Blog: <u>https://medium.com/berndruecker</u>
  - Code: <u>https://github.com/berndruecker</u>



https://www.infoworld.com/article/3254777/ application-development/ 3-common-pitfalls-of-microservicesintegrationand-how-to-avoid-them.html

Info

https://www.infoq.com/articles/eventsworkflow-automation



https://thenewstack.io/5-workflow-automationuse-cases-you-might-not-have-considered/

