COMMAND-QUERY RESPONSIBILITY INTEGRATION (CQRS)

Motivation for Distribution

- Organizational
  - Bounded context
- Separation of Concerns
- Scalability
- Fault Tolerance

Motivation for Distribution

- Organizational
  - Bounded context
- Separation of Concerns
- Scalability
  - Asynchronous communication
  - Eventual consistency
- Fault Tolerance

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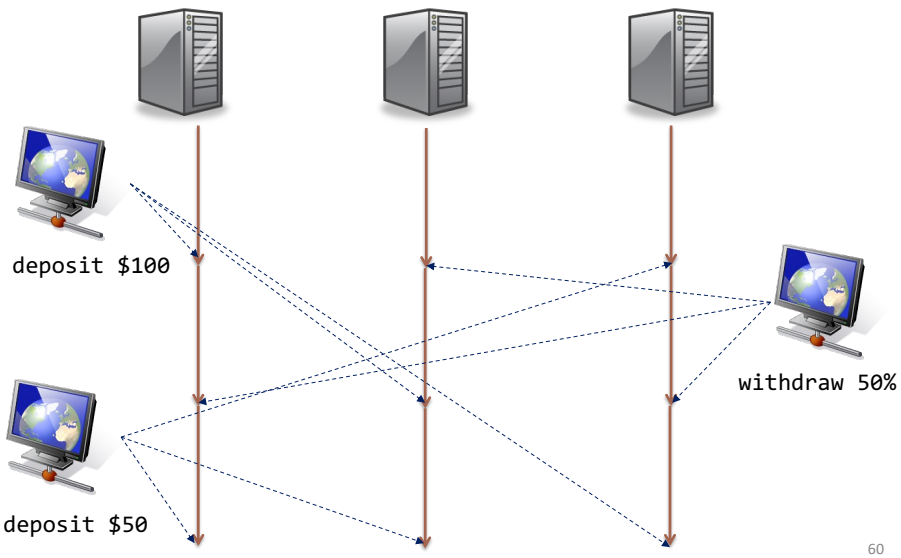
No Consistency



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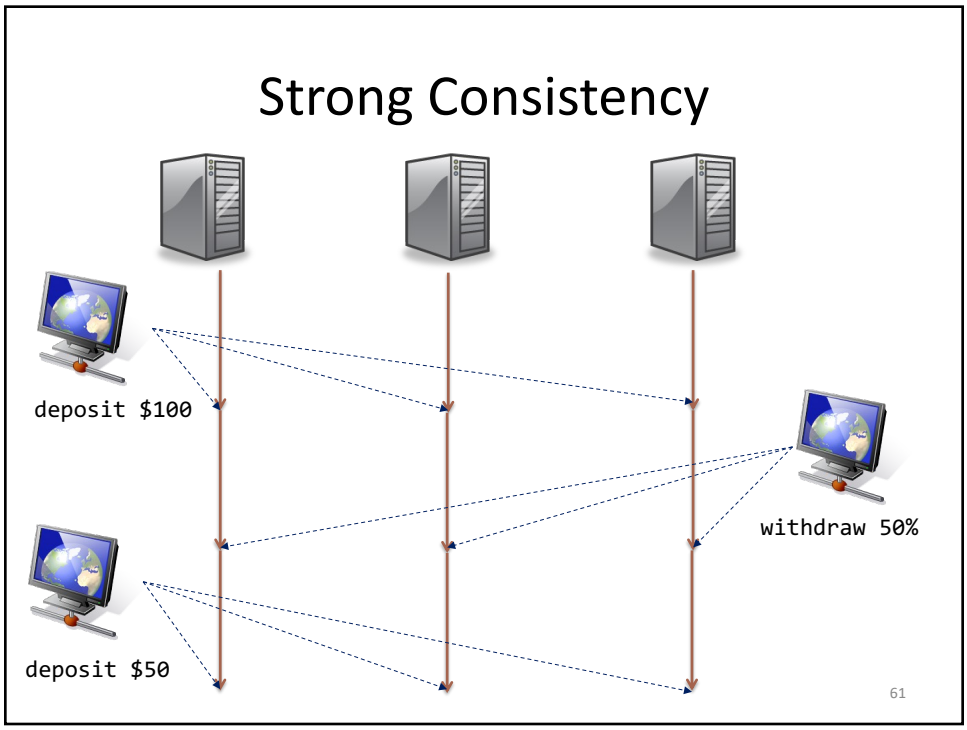
Strong Consistency
deposit $100
withdraw 50%
deposit $50
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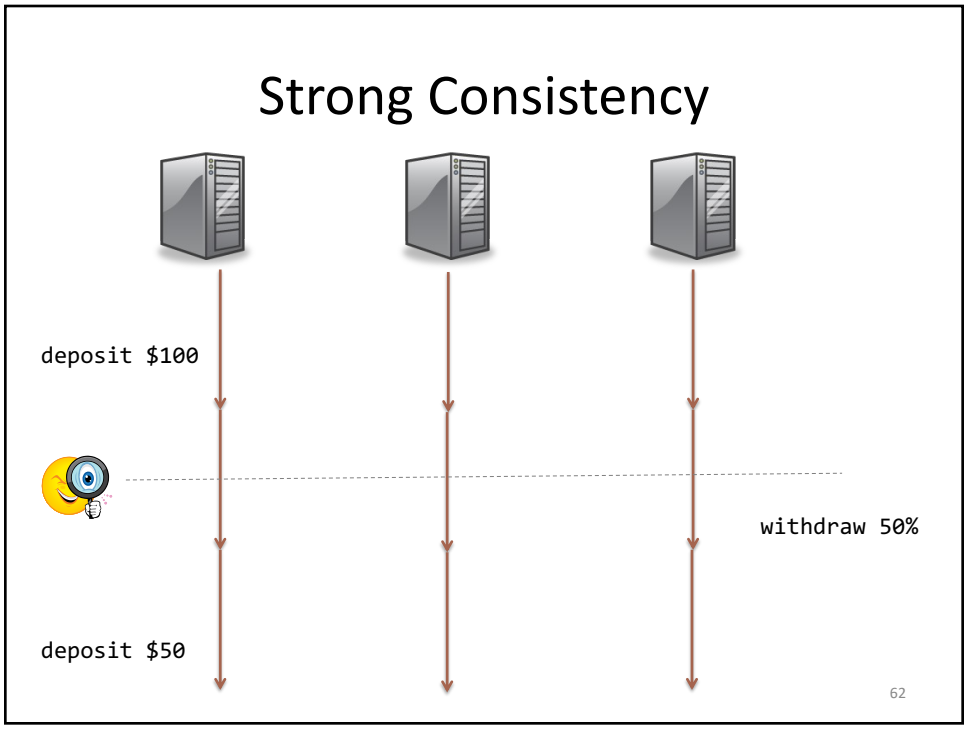
Strong Consistency
deposit $100
withdraw 50%
deposit $50
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Strong and Eventual Consistency

- Strong Consistency: Effect of an update is visible by any operation that follows it
  - No stale reads
- Eventual Consistency
  - Consistent ordering: Updates are done in same order on all replicas
  - Total propagation: Updates are performed on all replicas *eventually*

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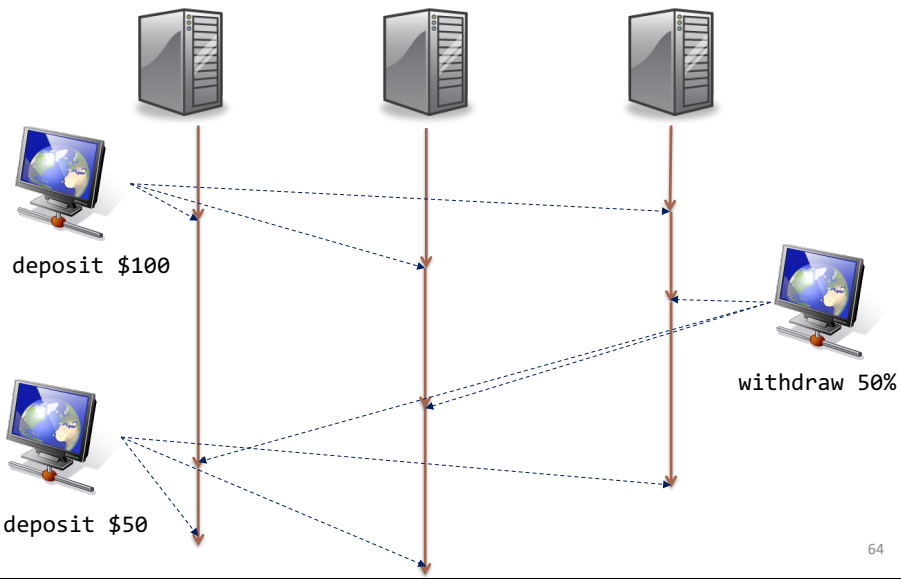
Eventual Consistency



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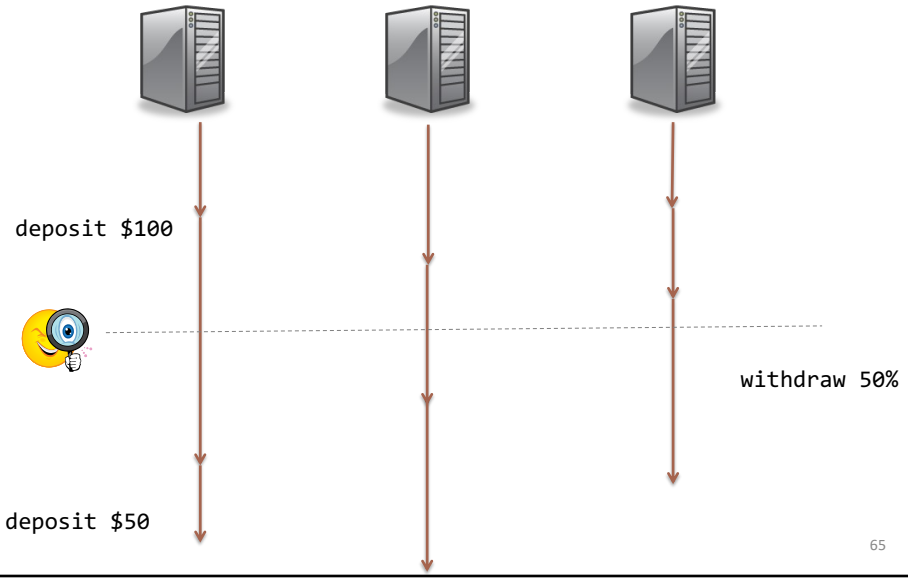
Eventual Consistency



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CRUD

- Strong consistency via transactions
- Shortcomings
  - Scalability
  - Transaction coordination
  - **Reproducibility** (audit logs)

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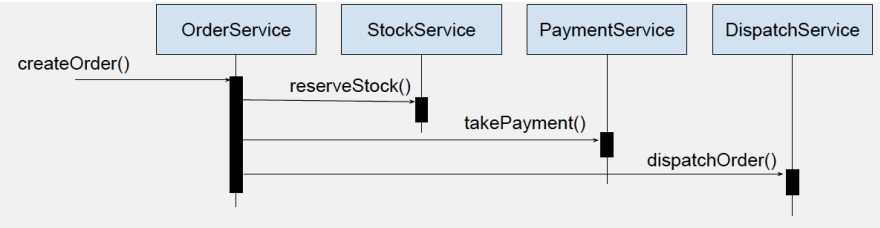
Synchronous Microservice

- `orderService` orchestrates microservices



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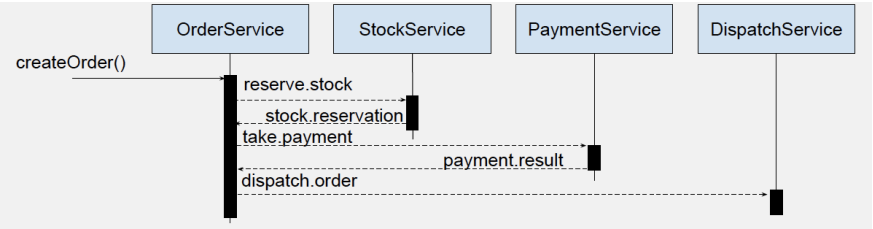
Asynchronous Microservice

- `orderService` **still** orchestrates microservices



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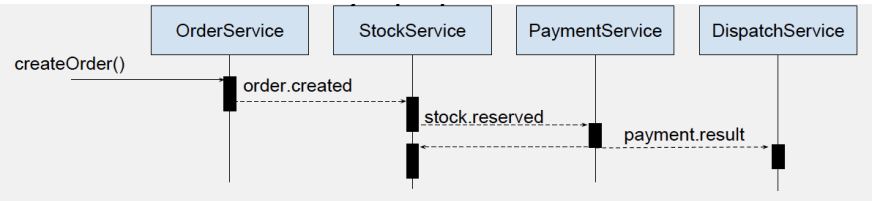
Choreography of Microservices

- Microservices react to events



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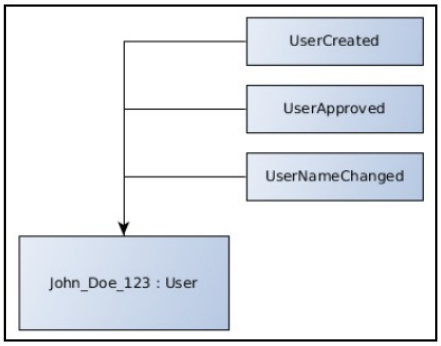
Event Sourcing

- Calculate current state from event log
- Events are immutable



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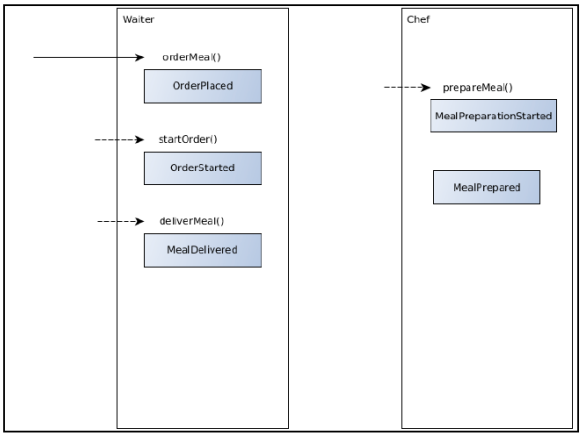
Eventual Consistency

- Example: Restaurant Order



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CQRS: Command Query Responsibility Segregation

- Command:
  - Succeed or fail (no return value)
  - Produces events
- Query
  - Return data
  - Cannot modify state
- Applications update state by consuming events

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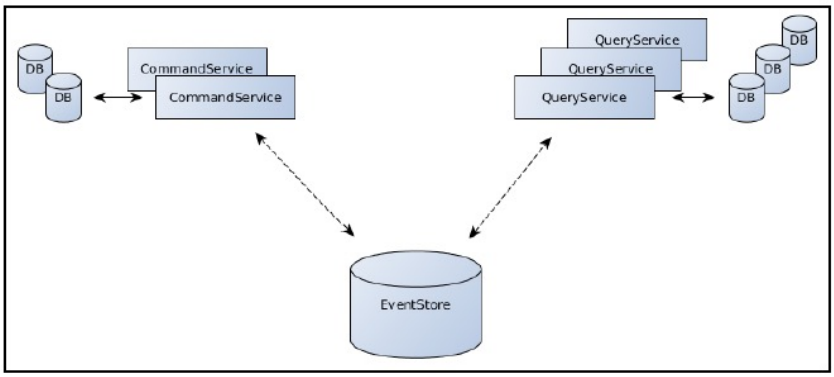
CQRS: Command Query Responsibility Segregation



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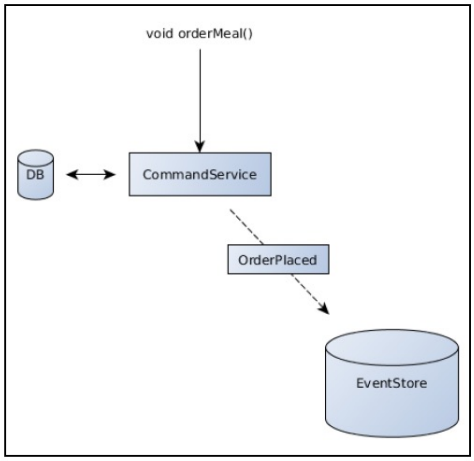
Example: Order a Meal



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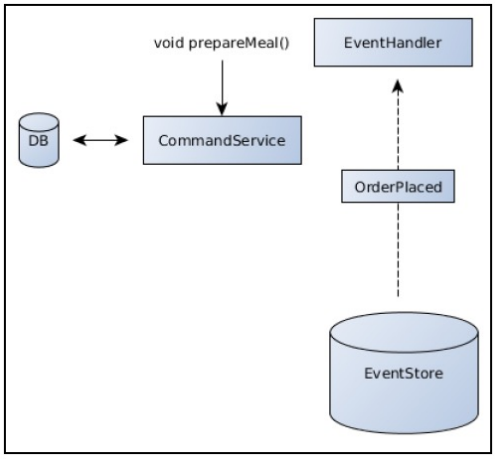

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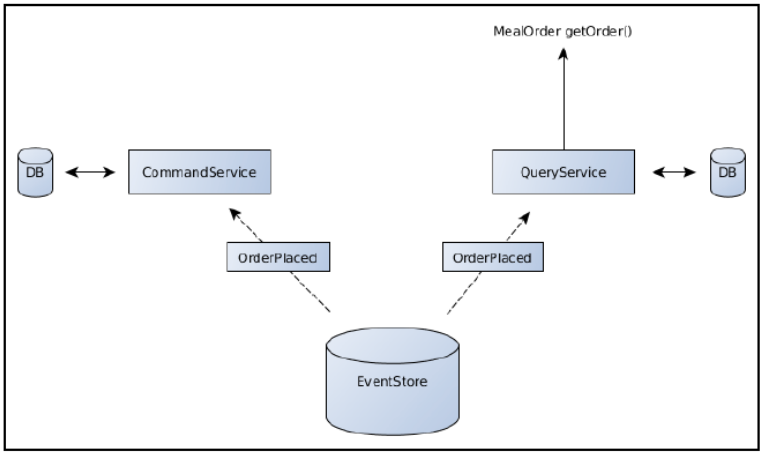
Example: Order a Meal



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CQRS Benefits

- Horizontal scaling
  - Different for command and query services
- Optimize state representations
  - Appropriate to the service
- Read-side failover availability
  - Handle queries with event log down
- Scalability of event-sourced systems

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