# What a modern mailman should know when delivering messages!

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BY ROB VAN PAMEL

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## Rob Van Pamel

- .NET Consultant for AXXES
- Developer since 2007
- AWS Community Builder since 2023
- Started in Winforms application ... till cloud
- Greenfield project: open vision AWS Selected

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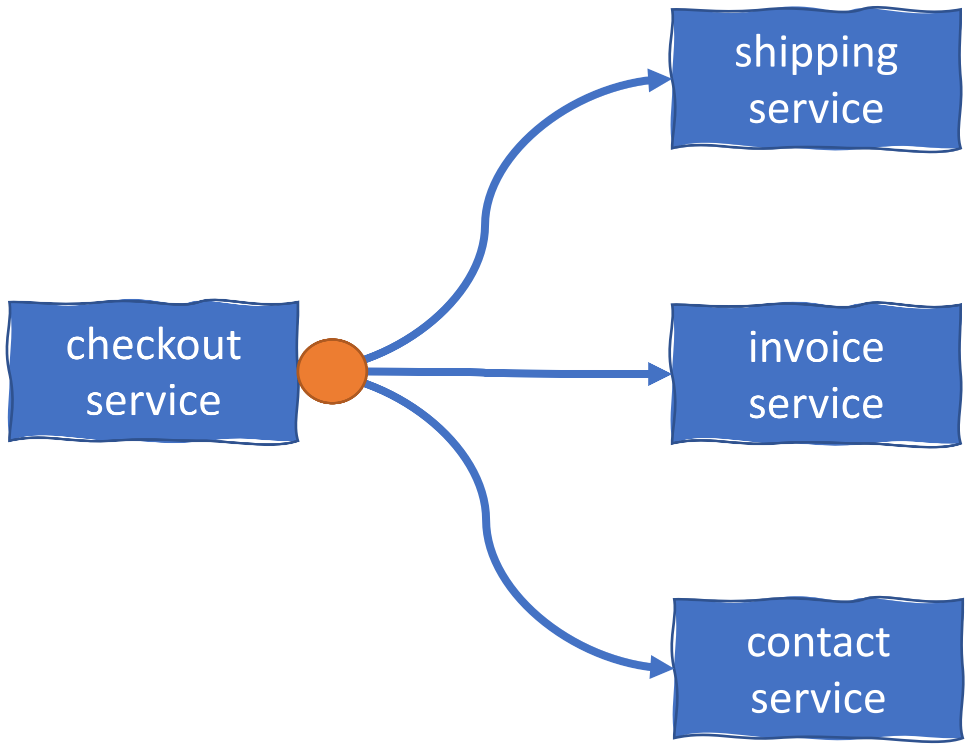
## Synchronious communication

- Request-response style
  - Create the Invoice!
- Services are coupled
- More services are added over time
- More responsibility for teams
- Latency increases



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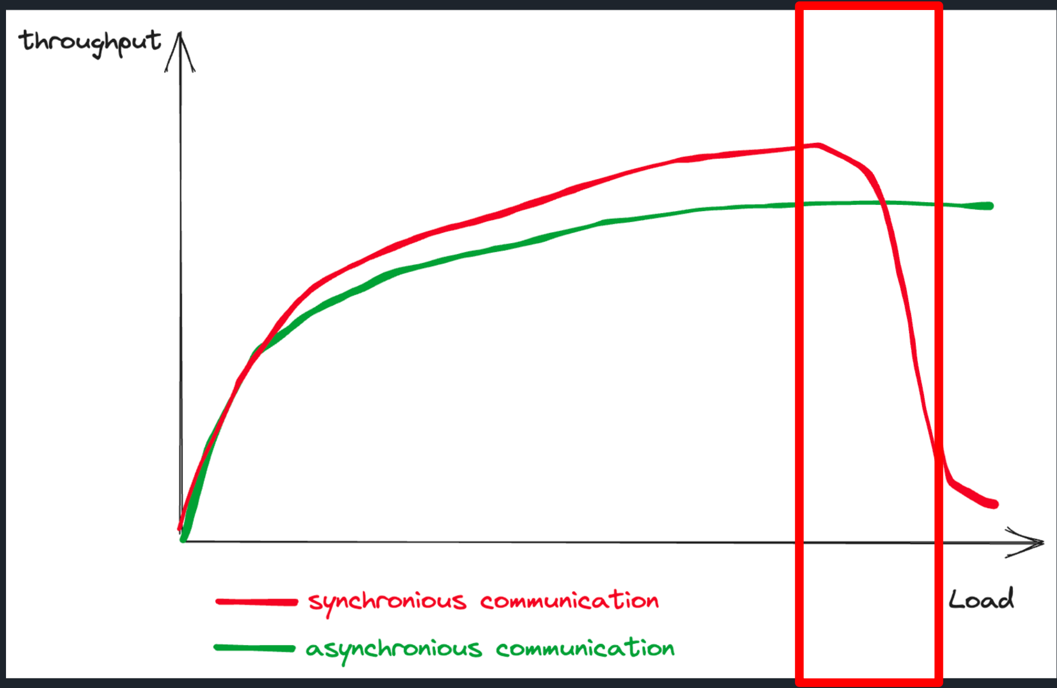
## Why bother with async communication?

- Evolution from monolitic applications to service oriented
- Use of REST / gRPC with retry mechanisms
- Scalabillity
- Performance / Throughput
  - Sync communication collapses after a given point
  - *Unable to connect to remote host: Connection refused*
- Decoupling



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## Why are you using messaging?

Waiting for responses

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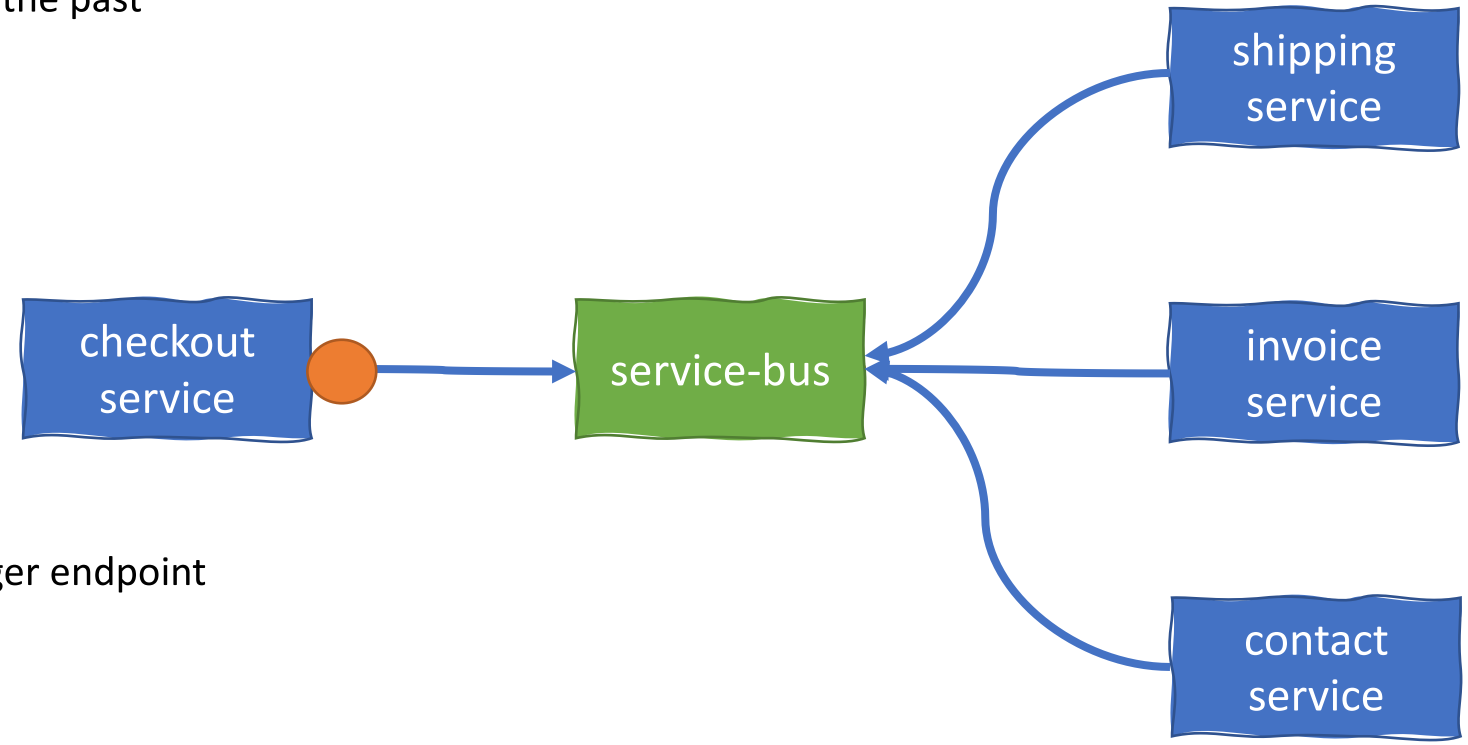
## Risks of sync communication ?

- Fallacies of Distributed Systems (Dr. Harvey)
    - The network is reliable
    - Latency is zero
    - Bandwidth is infinite
    - The network is secure
    - Topology doesn't change
    - There is one administrator
    - Transport cost is zero
    - Network is homogeneous

## Message Async Driven Architecture

- Introduce events
  - Change in state that happened in the past
  - Async
  - Decouple Services
- Focus on communication
  - Reverse the flow
  - Eg a service bus
  - ‘Broadcast the message’ and trigger endpoint



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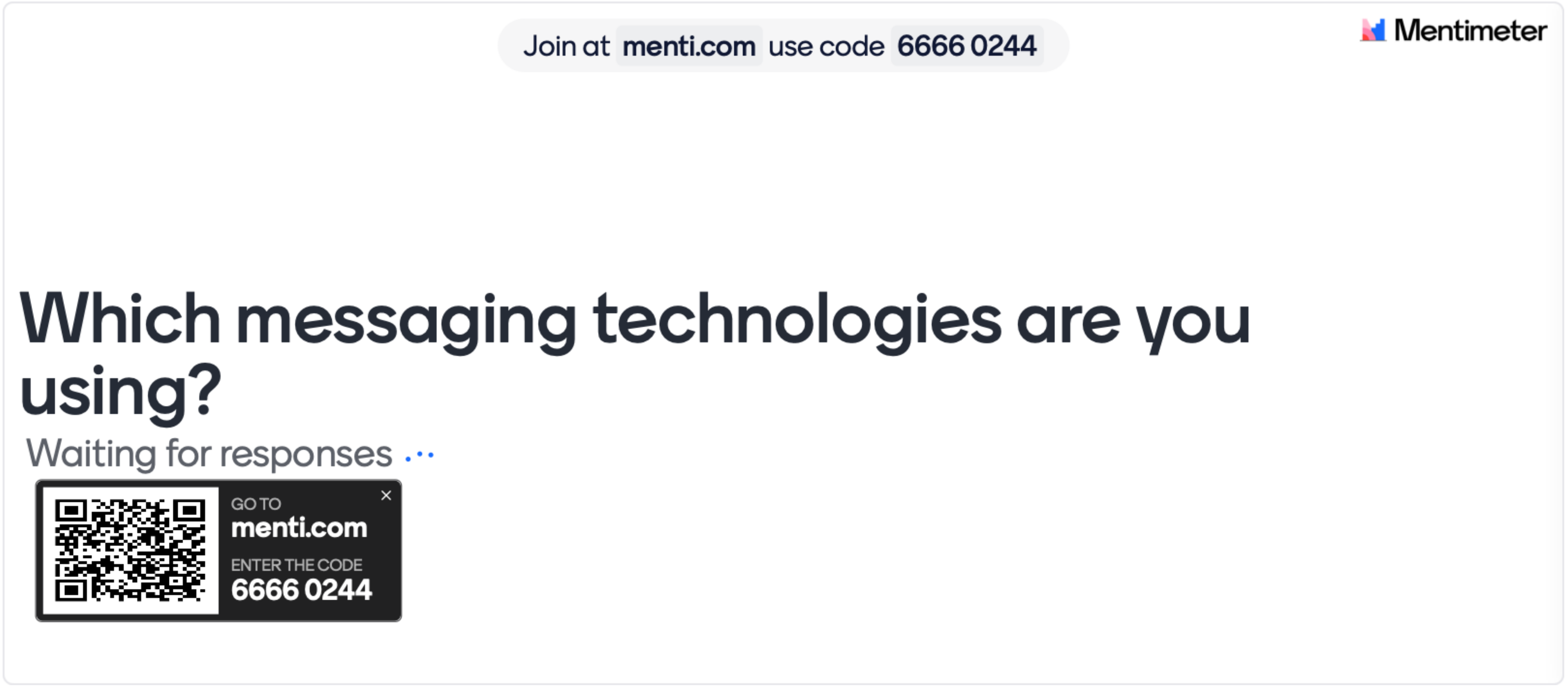
## Which messaging technology are you using ?



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Which messaging technologies are you using?

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EventBridge

NServicebus

Brighter

Amazon SQS

HTTP

Sagas

MQTT

RabbitMQ

QOS

Outbox

Amazon MQ

Amazon SNS

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## Patterns and principles

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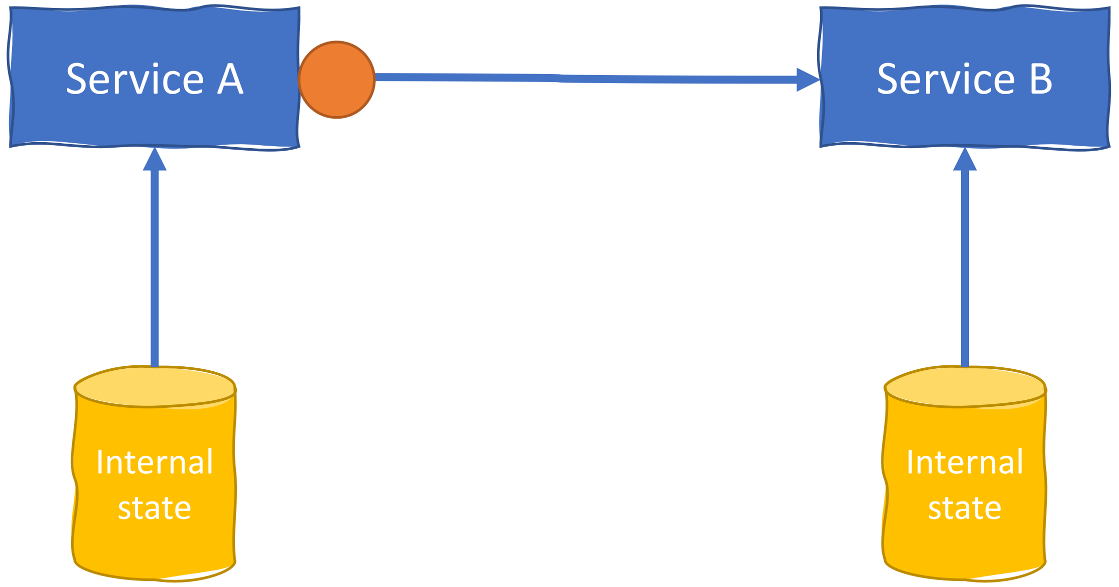
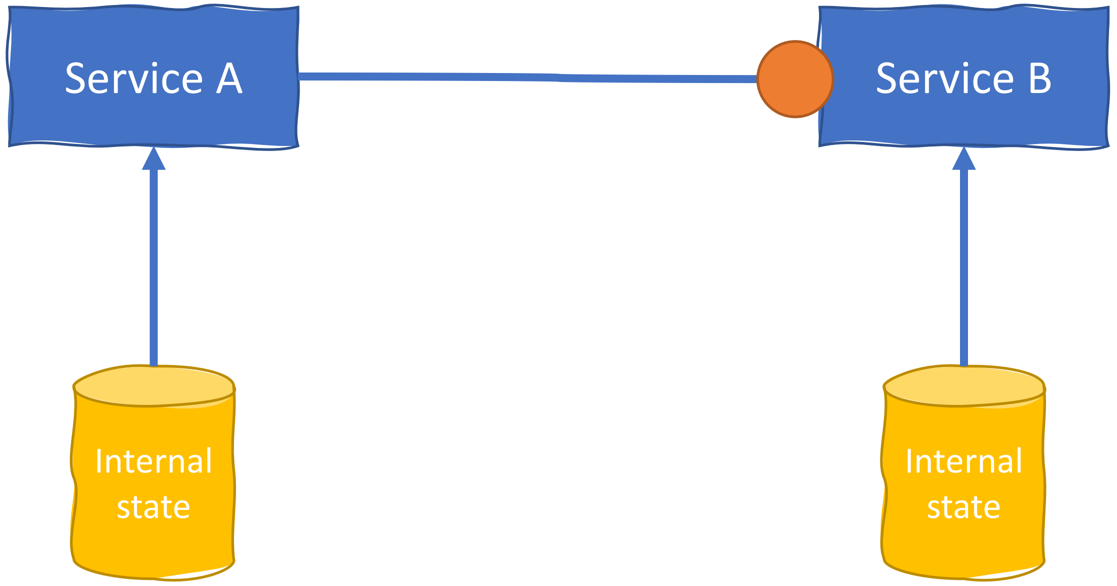
## Quality Of Service (QOS)



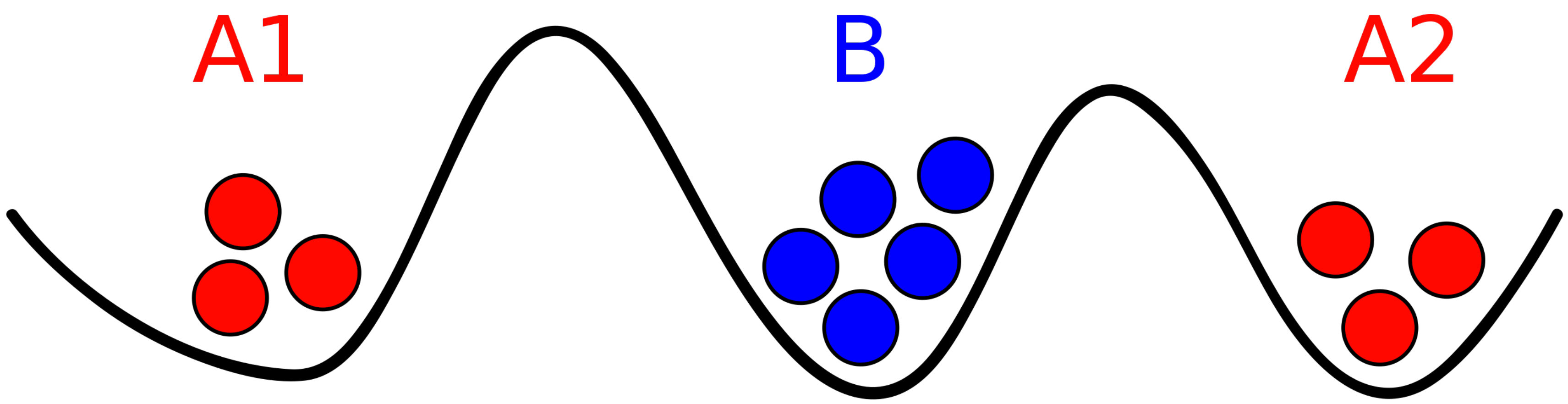
## Quality Of Service (QOS)

- Exactly Once ( QOS 2 )



## Quality Of Service (QOS)

- Exactly Once ( QOS 2 )
- Problem of 2 generals



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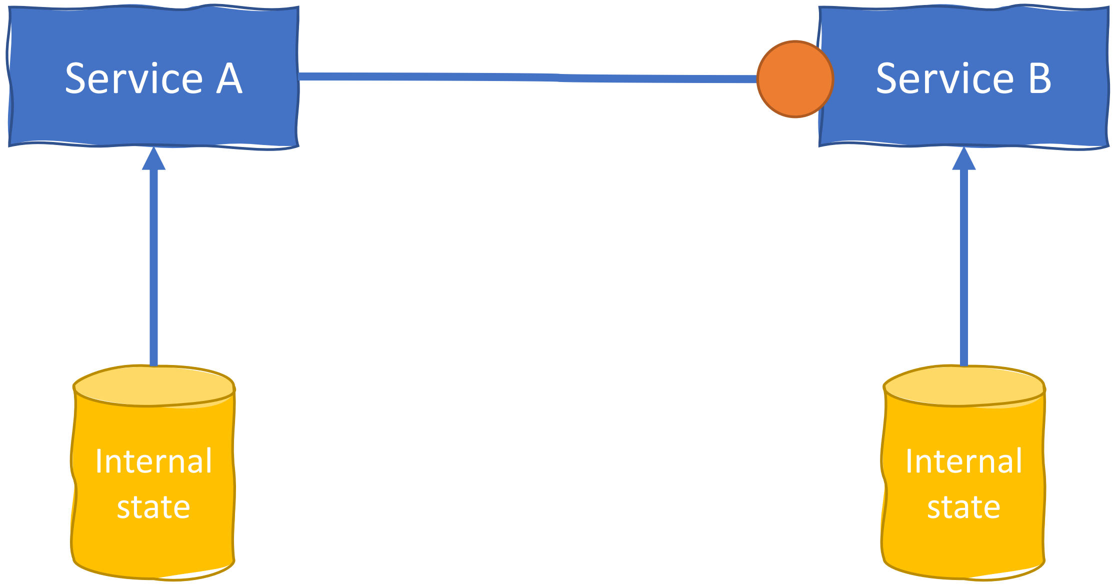
## Quality Of Service (QOS)

- Exactly Once ( QOS 2 ) ?
- At least once ( QOS 1)
- At most once  (QOS 0)



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## Idempotence

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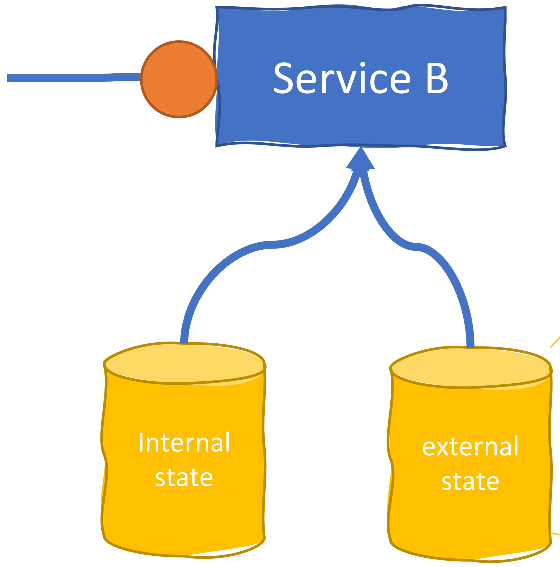
is the property of *certain operations* in mathematics and computer science, that can *be applied multiple times without changing the result beyond the initial application*.

## Exactly once processing – Idempotence (Receiving side)

- Internal state vs external state
- Adding unique message identifier



| MessageId | Outgoing Messages |
|---|---|
| F79a6822f5…7b6aa | [{ messageid: 2d73602b6ca31e messagetype: orderconfirmed body: { orderid: 23 productid: 89440 quantiy:4 } }] |
| 96a6bc22f5…7b6aa | |
| C4616c6e04be3c…fb06d | [{ messageid: 2d73602b6ca31e messagetype: ordercancelled body: { orderid: 23 } }] |

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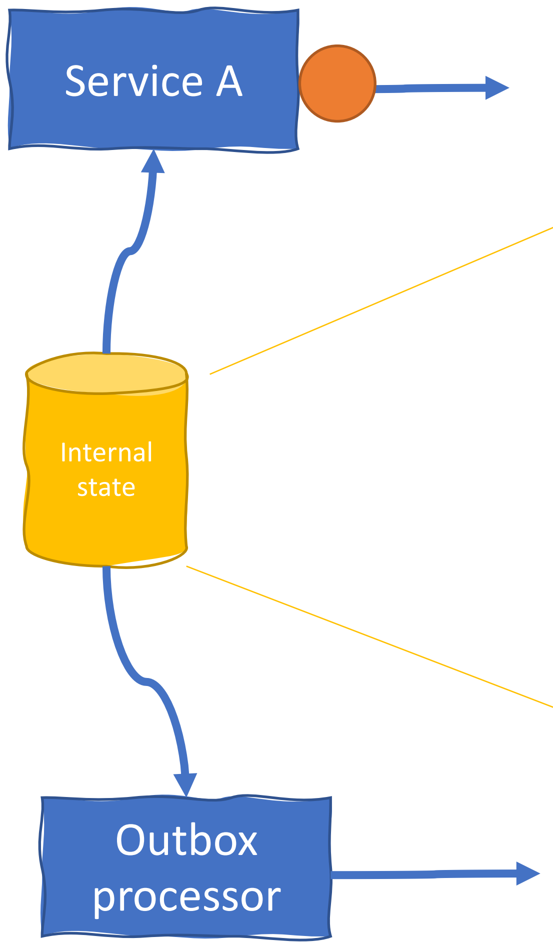
## Exactly once processing – Outbox (Sender side)

Outbox

- Process BL and send message atomically
- Single responsibility
- Store messages in along with BL
    - Identifier
    - Event type
    - OccuredAt
    - Payload
    - Sent
- Outbox processor publishes messages



| Id | payload | eventtype | occuredAt | sent |
|---|---|---|---|---|
| 456 | { orderid: 23 productid: 89440 quantiy:4 } | orderconfirmed | ... | 1 |
| 457 | body: { orderid: 23 } | ordercancelled | ... | 1 |
| 458 | { orderid: 24 productid: 34523 quantiy:2 } | orderconfirmed | ... | 0 |

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## Saga’s

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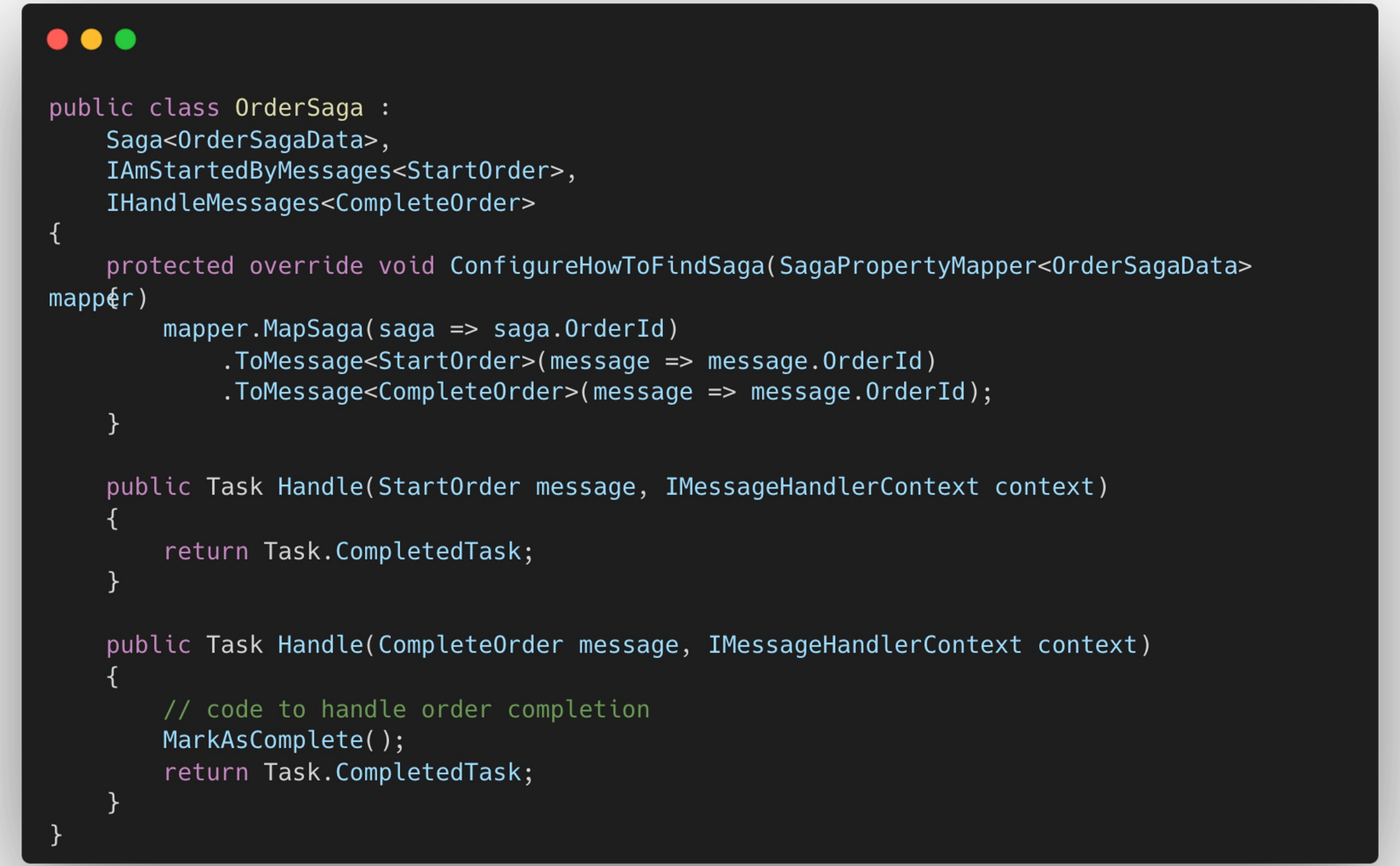
## Sagas: maintain intigrity over multiple services

- Long-running business processes - Business processes that span multiple services
- No distributed transactions ( 2PC )
- State machine
- Require storage for saga state
- Compensating actions for failures
- AWS Step Functions

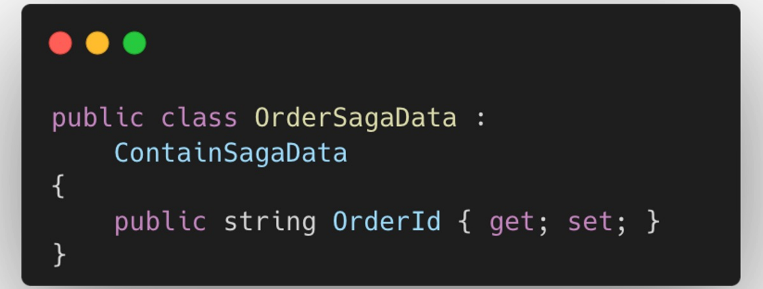
## Sagas



```
public class OrderSaga :
    Saga<OrderSagaData>,
    IAmStartedByMessages<StartOrder>,
    IHandleMessages<CompleteOrder>
{
    protected override void ConfigureHowToFindSaga(SagaPropertyMapper<OrderSagaData>
mapper)
        mapper.MapSaga(saga => saga.OrderId)
            .ToMessage<StartOrder>(message => message.OrderId)
            .ToMessage<CompleteOrder>(message => message.OrderId);
    }

    public Task Handle(StartOrder message, IMessageHandlerContext context)
    {
        return Task.CompletedTask;
    }

    public Task Handle(CompleteOrder message, IMessageHandlerContext context)
    {
        // code to handle order completion
        MarkAsComplete();
        return Task.CompletedTask;
    }
}
```



```
public class OrderSagaData :
    ContainSagaData
{
    public string OrderId { get; set; }
}
```

EventBridge

NServicebus

Brighter

Amazon SQS

HTTP

MQTT

RabbitMQ

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Amazon SNS

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MassTransit

## Application Messaging Frameworks

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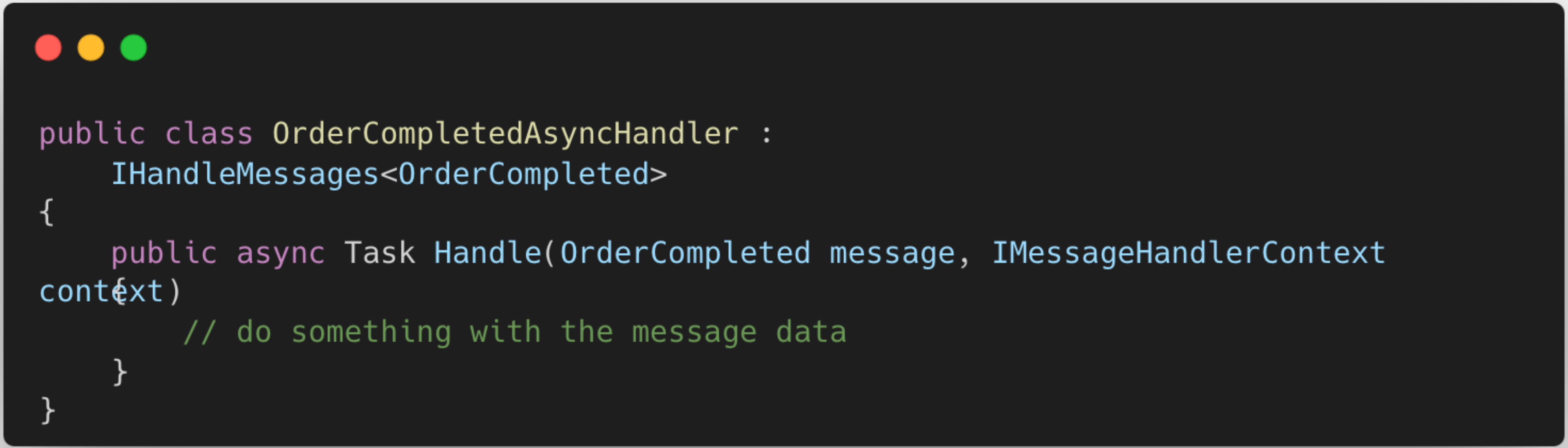
## Application Messaging Frameworks

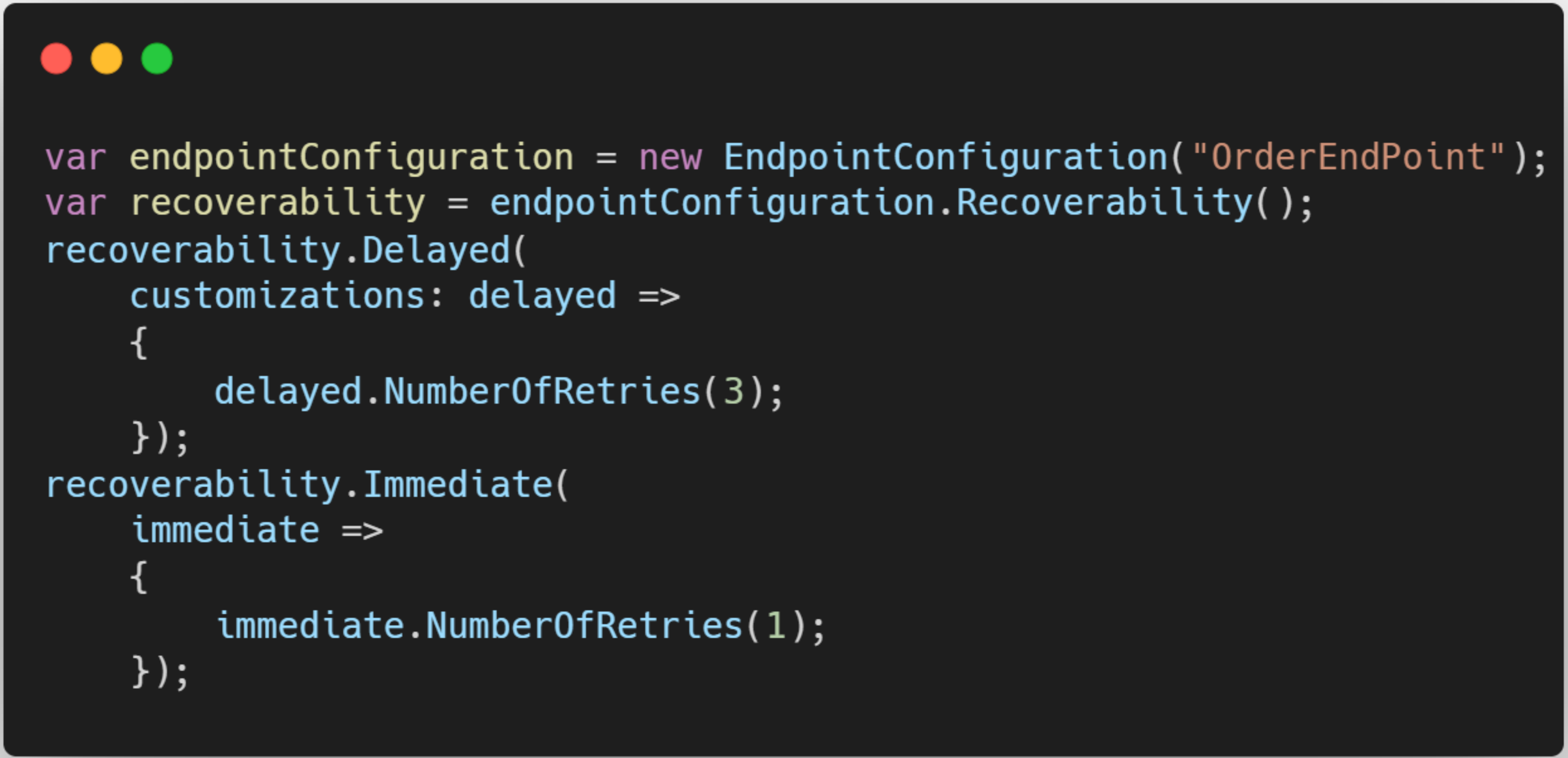
- Abstraction layer for message exchange
    - Transport details
    - Message handling



```
public class OrderCompletedAsyncHandler :
    IHandleMessages<OrderCompleted>
{
    public async Task Handle(OrderCompleted message, IMessageHandlerContext
context)
    {
        // do something with the message data
    }
}
```

## Application Messaging Frameworks

- Abstraction layer for message exchange
  - Transport details
  - Message handling
  - Routing
  - Serialisation
  - Exception Management
  - Retries & Poison Messages



```
var endpointConfiguration = new EndpointConfiguration("OrderEndPoint");
var recoverability = endpointConfiguration.Recoverability();
recoverability.Delayed(
    customizations: delayed =>
    {
        delayed.NumberOfRetries(3);
    });
recoverability.Immediate(
    immediate =>
    {
        immediate.NumberOfRetries(1);
    });
```

## Application Frameworks: NServiceBus

- Transport
  - RabbitMQ
  - SQS
  - MSMQ
  - Azure Service Bus / Azure Storage Queues
  - SQL Server
- Patterns
  - Outbox
  - Sagas
  - Idempotence
- Commercial License

## MASSTRANSIT

- Transport
  - RabbitMQ
  - SQS
  - Azure Service Bus
  - ActiveMQ
  - Kafka
- Patterns
  - Outbox
  - Sagas
  - Idempotence
- Apache 2.0 License

## REBUS

- Transport
  - RabbitMQ
  - MSMQ
  - SQS
  - SQSAndSNS
  - Azure Service Bus
- Patterns
  - Outbox
  - Sagas
  - Idempotence
- Apache 2.0 License

## Brighter

- Transport
  - RabbitMQ
  - Ports and Adapters
- Patterns
  - Outbox
  - Sagas
  - Idempotence
- Apache 2.0 License

## Application Messaging Frameworks

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Demo

EventBridge

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## Transports

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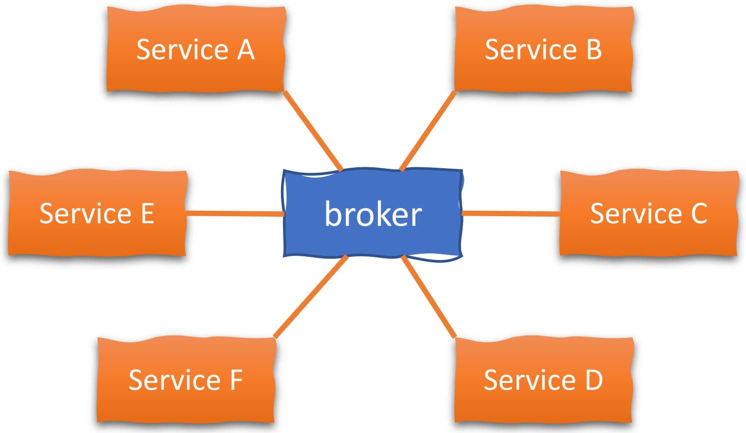
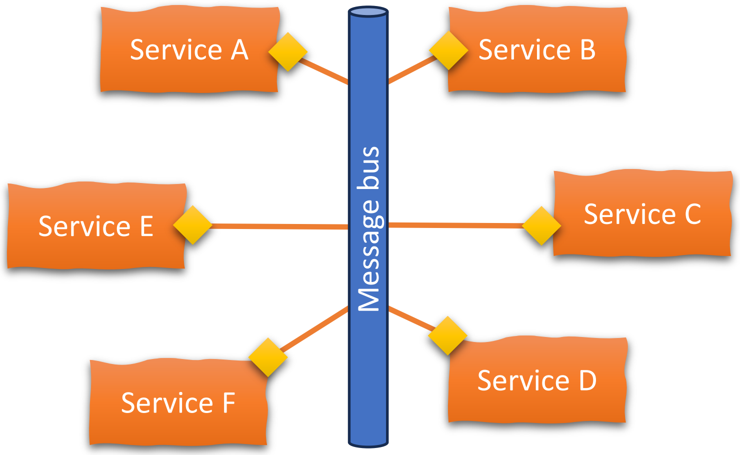
## Broker

- Centralised messaging system
- Receive from multiple sources
- Distribute to different system
- Routing included
- Always-on



## Bus

- Distributed
- Shared message agreed upon message schema
- Smart endpoint - dumb pipes
- Application Frameworks take care of routing
- Serverless



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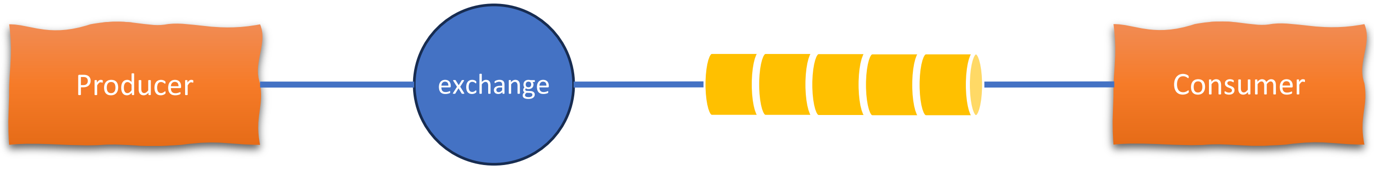
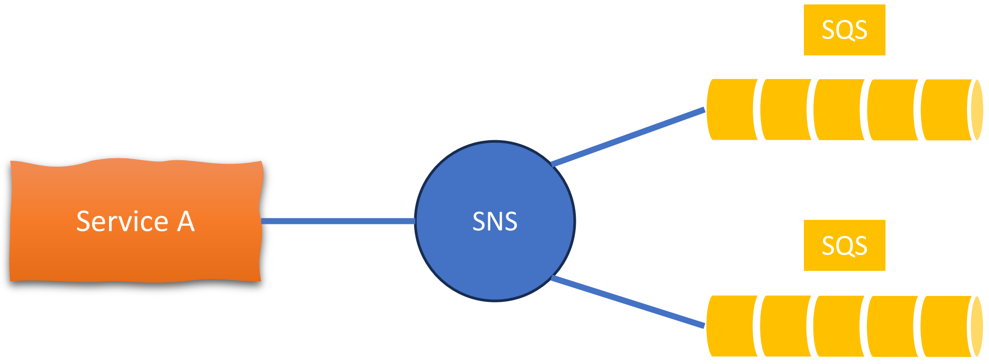
## Amazon MQ

- Managed service for broker systems RabbitMQ or ActiveMQ
- RabbitMQ
  - Supports multiple protocols*
  - AMQP 0-9-1 core protocol
  - Support for multiple scenario
    - Publish / Subscribe : Exchange type=Fanout
    - Routing: Exchange type=direct
    - Topics : Exchange type=topic
    - Competing consumers
    - Request / Reply
- ActiveMQ
  - Extensive Java support
- Clustering support



## Amazon SQS and SNS

- Bus systems
- Simple Notification System
  - Publish / Subscribe notification
  - Fan out system
  - Endpoints:
    - HTTP
    - SQS
    - Email
    - SMS
- Simple Queue System
  - Queue
  - Subscriptions
- Managed services by AWS
- Mostly used in combination ( Fanout by SNS – Queue Store by SQS )



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## Amazon EventBridge

- Serverless bus systems built on top of CloudWatch Events
- Event Bus – pipeline
    - Routing and filtering
    - Default custom vs partner
- Events
- Source and Targets
- Rules
- EventSchema

HTTP

MQTT

MSMQ

AMQP

## Protocols under the hood

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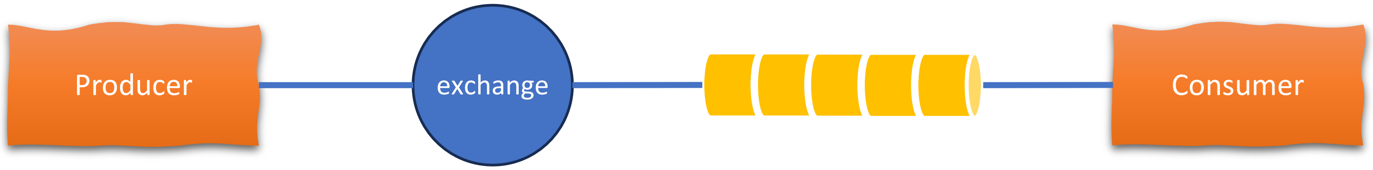
# Async Messaging Transports - Advanced Message Queuing Protocol (AMQP)

- Built specific for enterprise messaging
- Built in the banking industry
- Binary protocols
- Support for multiple scenario
  - Publish / Subscribe : Exchange type=Fanout
  - Routing: Exchange type=direct
  - Topics : Exchange type=topic
  - Competing consumers
  - Request / Reply



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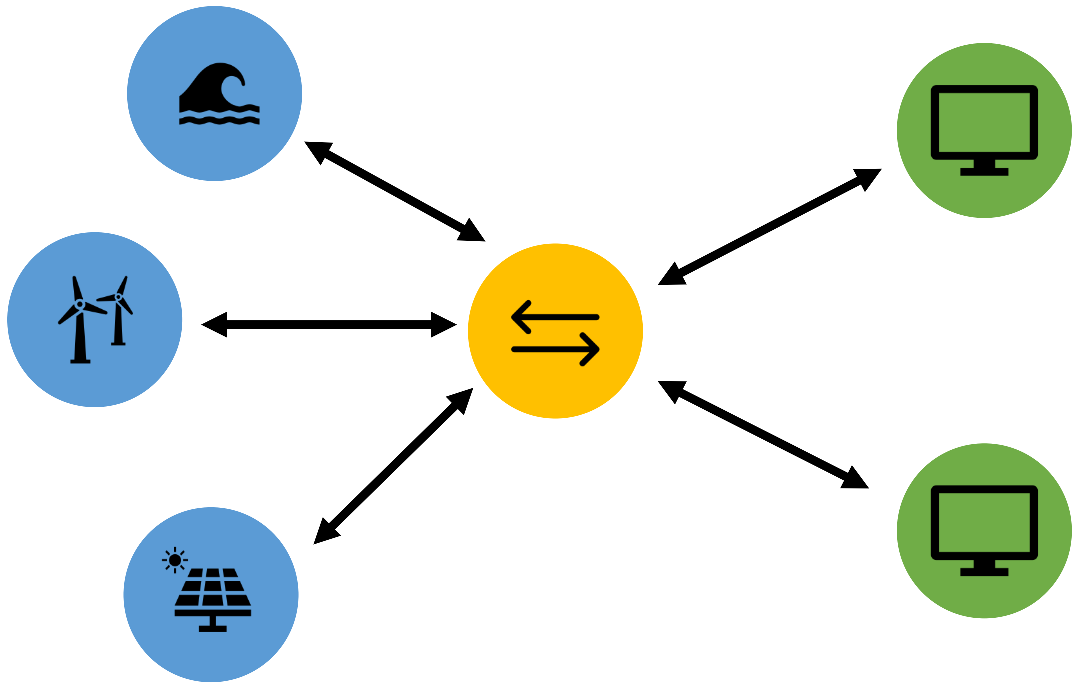
## Async Messaging Transports - HyperText Transfer Protocol (HTTP)

- Built “to serve the internet”
- Request – Response
- The oldest protocol (1991)
- Based on TCP by default
- Version 3
  - Major improvements
  - TLS improvements
  - Use of UDP and QUIC

## Async Messaging Transports - Message Queuing Telemetry Transport (MQTT)

- Built specific for Internet of Things (IoT) in the gas and oil industry
- Lightweight publish subscribe messaging protocol / Small devices
- Small bandwidth
- Requires broker eg AWS IoT



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## Async Messaging Transports – Microsoft Message Queuing (MSMQ)

- Message queue supported since Windows NT 4. ( Windows Only )
- Support for transactions (Distributed)
- Early “store and forward” principle ( similar to outbox )
- *Not recommended – discontinued*

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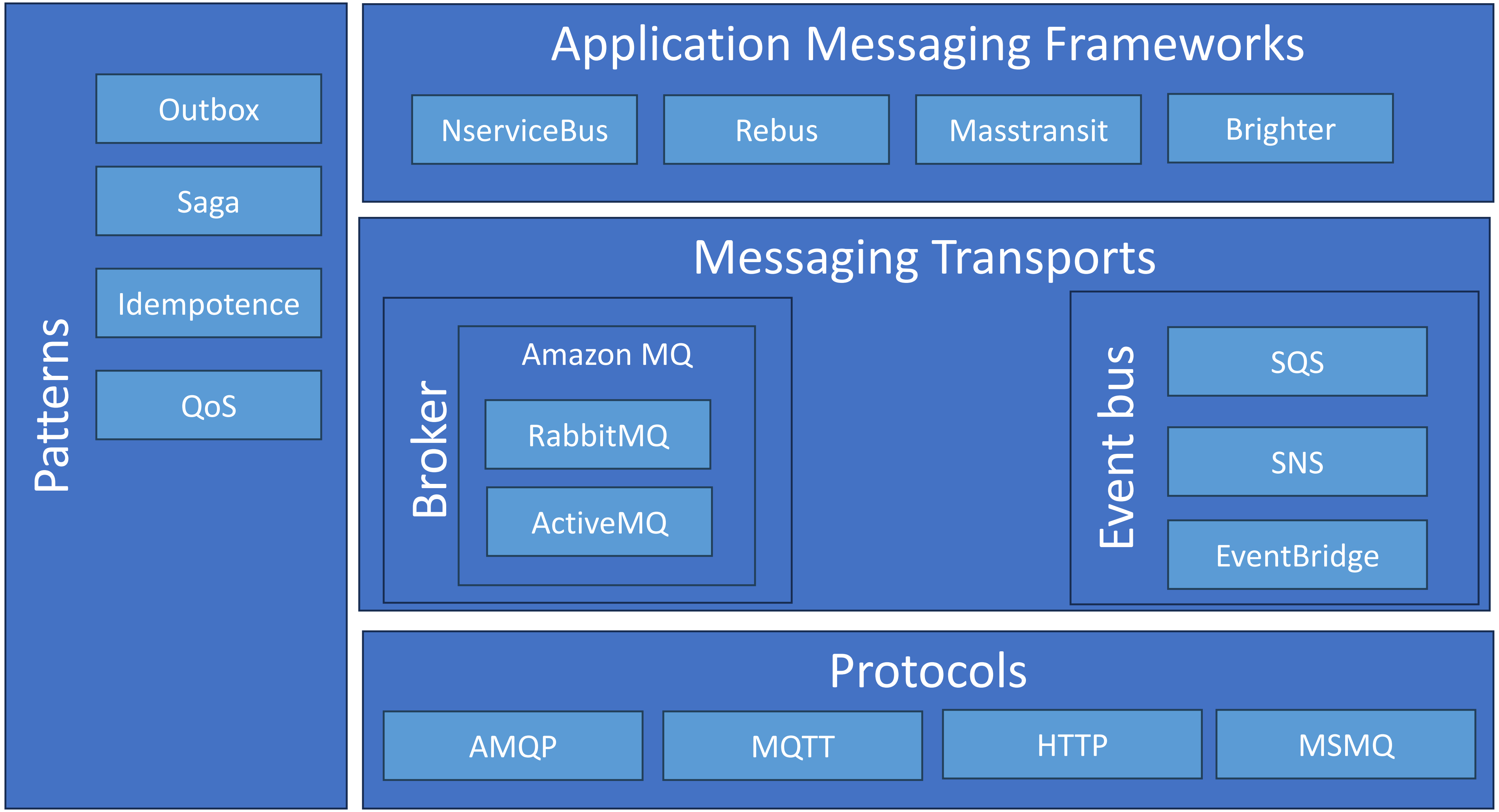
## Summary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