

# Event-Driven Architecture

*Software Architecture*

Richard Thomas

March 31, 2025

*Definition 0.* Event

Something that has happened or needs to happen.

*Definition 0.* Event Handling

Responding to notification of an event.

*Definition 0. Asynchronous Communication*

Sending a message to a receiver and not waiting for a response.

Comment on how this enables parallel processing.

## Responsiveness

- Synchronous Communication



- Send message
- Wait for response
- Continue processing

## Responsiveness

- Synchronous Communication



- Send message
- Wait for response
- Continue processing

- Asynchronous Communication



- Send message
- Continue processing
- Optionally receive response
- Complex error handling



*Definition 0.* Event-Driven Architecture

Asynchronous distributed system that uses event processing to coordinate actions in a larger business process.

# Event-Driven Architecture



Comment on how each container is deployed in its own compute node.



## Terminology

**Initiating Event** Starts the business process

**Processing Event** Indicates next step in the process can be performed

**Event Channel** Holds events waiting to be processed

**Event Handler** Processes events

- Step, or part of a step, in the business process

# Auction Example



- Step through event process.
- Highlight asynchronous messages and parallel processing.
- Bid Processor could send back a high bid event or an async message.

*Definition 0.* Event Handler Cohesion Principle

Each event handler is a simple cohesive unit that performs a *single* processing task.

*Definition 0.* Event Handler Independence Principle

Event handlers should not depend on the implementation of any other event handler.

# Auction Example – Error Handling



- How to handle Bid Processor failing?
- How to handle Rebid Notifier failing?
- How to handle Event Broker failing?

## Topologies

**Broker** All events received by event broker

- Notifies event handlers of events
- Event handlers send processing events when they finish processing

## Topologies

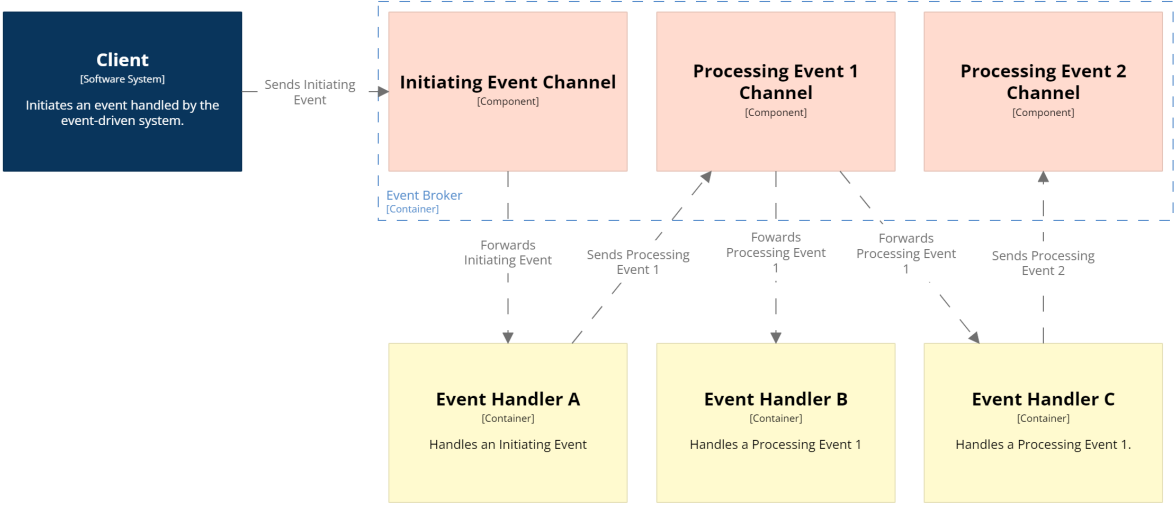
**Broker** All events received by event broker

- Notifies event handlers of events
- Event handlers send processing events when they finish processing

**Mediator** Manages business process

- Event queue of initiating events
- Event mediator sends processing events to event handlers
- Event handlers send async messages to mediator to report process finished

# Broker Topology



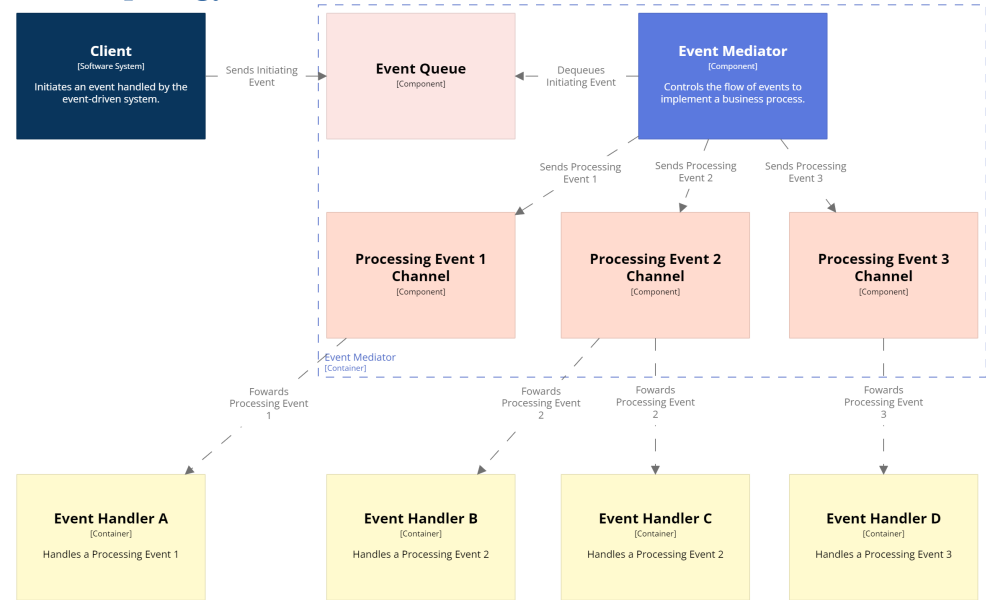
- Step through event process.
- Describe idea of channels.
- Send final processing event, even if it is not handled.
  - Easier to extend in the future.



### *Event Broker Façade*

- Event handlers can register to listen for events
- Receives events and directs them to the correct channel

# Mediator Topology



- Step through event process.
- Highlight process control performed by mediator.

# Sahara Mediator Topology



- Step through event process.
- Multiple mediators is common – *one* per domain.
- Discuss internals of mediators: event queue and event channels.

## Extensibility

- New behaviour for existing event
  - Broker** Implement event handler & register with broker
    - Existing ignored event hooks
  - Mediator** Implement event handler & modify mediator logic

## Extensibility

- New behaviour for existing event
  - Broker** Implement event handler & register with broker
    - Existing ignored event hooks
  - Mediator** Implement event handler & modify mediator logic
- New event
  - Broker** Implement event & event handler, create event channel, modify broker façade
  - Mediator** Implement event & event handler, modify mediator logic

# Scalability

- Event handlers deployed independently
  - Scaled independently to manage load

## Scalability

- Event handlers deployed independently
  - Scaled independently to manage load
- Event broker federated
  - Distributed across multiple compute nodes

## Scalability

- Event handlers deployed independently
  - Scaled independently to manage load
- Event broker federated
  - Distributed across multiple compute nodes
- Event mediators for different domains
  - Distributes loads by domain  
(e.g. browse & search, account, & order events)
    - Scaled independently to manage load



## Queues

- Channels can be implemented as queues
  - FIFO behaviour

## Queues

- Channels can be implemented as queues
  - FIFO behaviour
- Multiple front of queue pointers
  - For each event handler

## Queues

- Channels can be implemented as queues
  - FIFO behaviour
- Multiple front of queue pointers
  - For each event handler
- Event removed when event handlers finish
  - Retry if a handler fails

## Queues

- Channels can be implemented as queues
  - FIFO behaviour
- Multiple front of queue pointers
  - For each event handler
- Event removed when event handlers finish
  - Retry if a handler fails
- Events persist until removed
  - Recovery from broker failure

## Streams

- Channels can be implemented as streams
  - Events are saved permanently

## Streams

- Channels can be implemented as streams
  - Events are saved permanently
- Handlers notified when event added to stream
  - Observer pattern

## Streams

- Channels can be implemented as streams
  - Events are saved permanently
- Handlers notified when event added to stream
  - Observer pattern
- Handlers process events at their own pace
  - Cardiac arrest alarm vs. heart rate graph

## Streams

- Channels can be implemented as streams
  - Events are saved permanently
- Handlers notified when event added to stream
  - Observer pattern
- Handlers process events at their own pace
  - Cardiac arrest alarm vs. heart rate graph
- Events history
  - Redo processing
  - Review processing activities



## Queues vs Streams

- Queue
  - Known steps in business process
  - Easier sequencing of steps in business process
  - “Exactly once” semantics
  - eCommerce system

## Queues vs Streams

- Queue
  - Known steps in business process
  - Easier sequencing of steps in business process
  - “Exactly once” semantics
  - eCommerce system
- Stream
  - Very large number of events or handlers
  - Handlers can ignore events
  - Analysis of past activity
  - Event sourcing

# Broker vs Mediator Topologies

Broker dumb pipe

Broker events have occurred

# Broker vs Mediator Topologies

Broker dumb pipe

Broker events have occurred

Mediator smart pipe

Mediator events are commands to process

# Broker vs Mediator Topologies

## *Broker Advantages*

- Scalability
- Reliability
- Extensibility
- Low coupling

# Broker vs Mediator Topologies

## *Broker Advantages*

- Scalability
- Reliability
- Extensibility
- Low coupling

## *Mediator Advantages*

- Complex business process logic
- Error handling
- Maintain process state
- Error recovery

Pros & Cons

Modularity Event Handlers



Extensibility



Reliability Event Handlers



Interoperability Events



Scalability Event Handlers



Security



Simplicity



Deployability



Testability Complex Interactions

