

# Event-Driven Architecture

*Software Architecture*

Richard Thomas

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*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



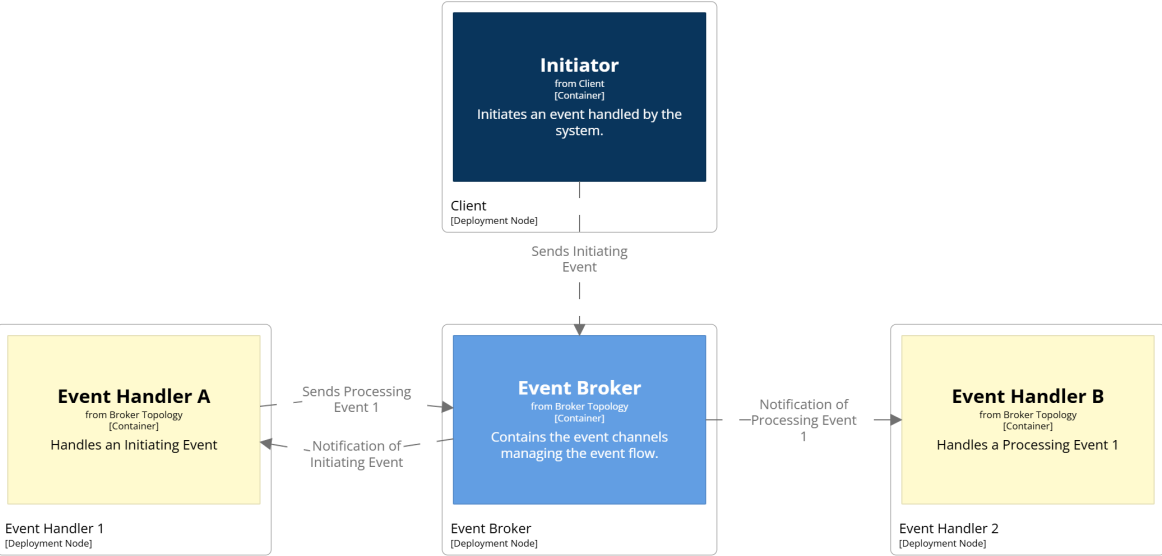
- Send message
- Continue processing
- *Optionally* receive response
- *Complex* error handling



*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

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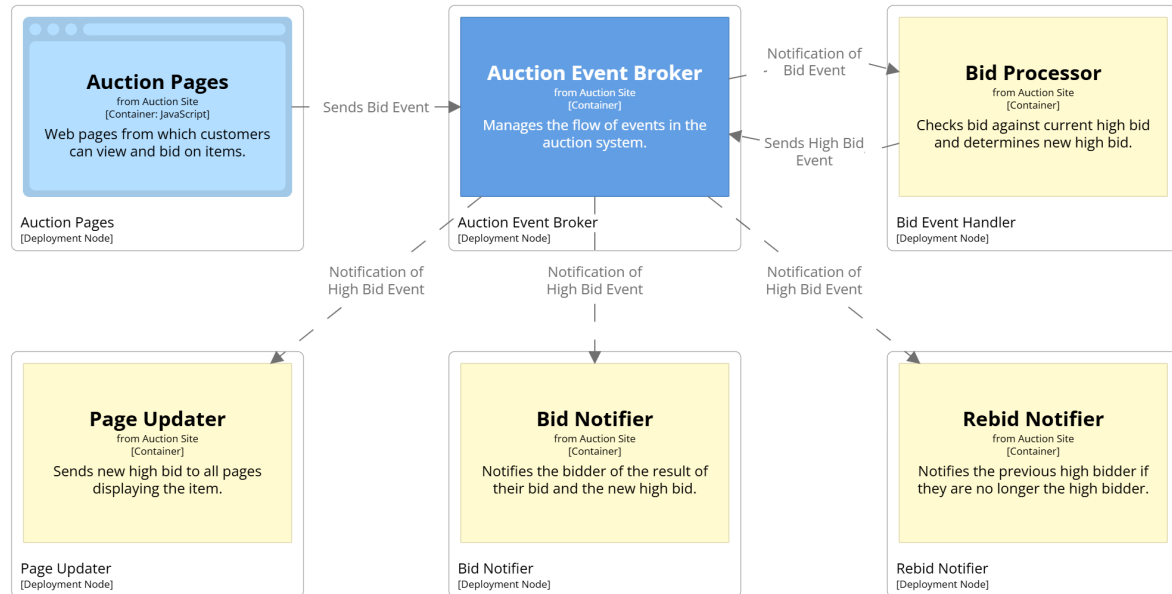
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Initiating Event	Starts the business process
Processing Event	Indicates next step in the process can be performed
Event Channel	Holds events waiting to be processed
Event Handler	Processes an event <ul style="list-style-type: none"><li>• Step, or part of a step, in the business process</li></ul>

# Auction Example



- Auction Event Broker has an API Gateway component to receive client requests and components to manage the event channels.
- Step through event process.
- Highlight asynchronous messages and parallel processing.
- Bid Processor could send back a high bid event or an async message.

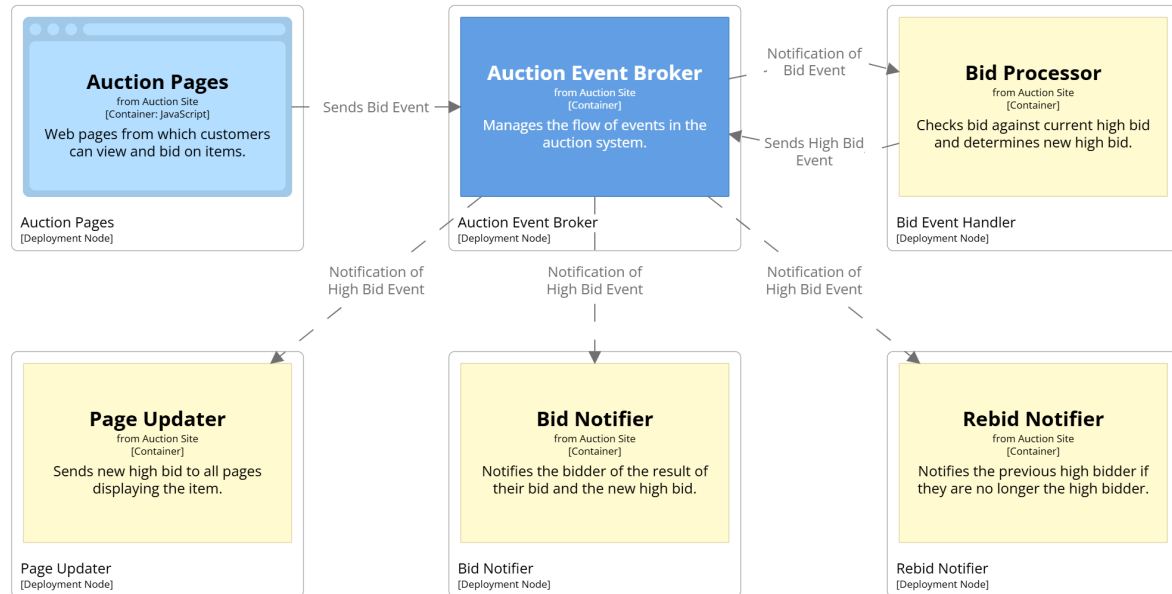
*Definition 0.* Event Handler Cohesion Principle

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



- Ask:
- How to handle Bid Processor failing?
  - Need to restart & recover
- How to handle Rebid Notifier failing?
  - Need to restart – Could losing events be acceptable?
- How to handle Event Broker failing?
  - Need to restart & recover – without losing events



## Topologies

**Broker** All events received by event broker

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

## Topologies

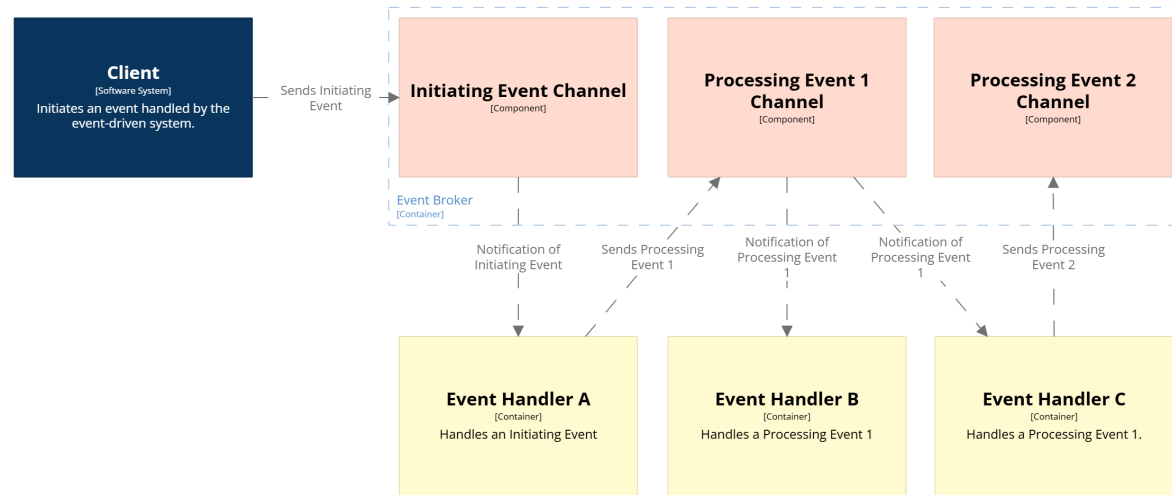
**Broker** All events received by event broker

- Notifies event handlers of events
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**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

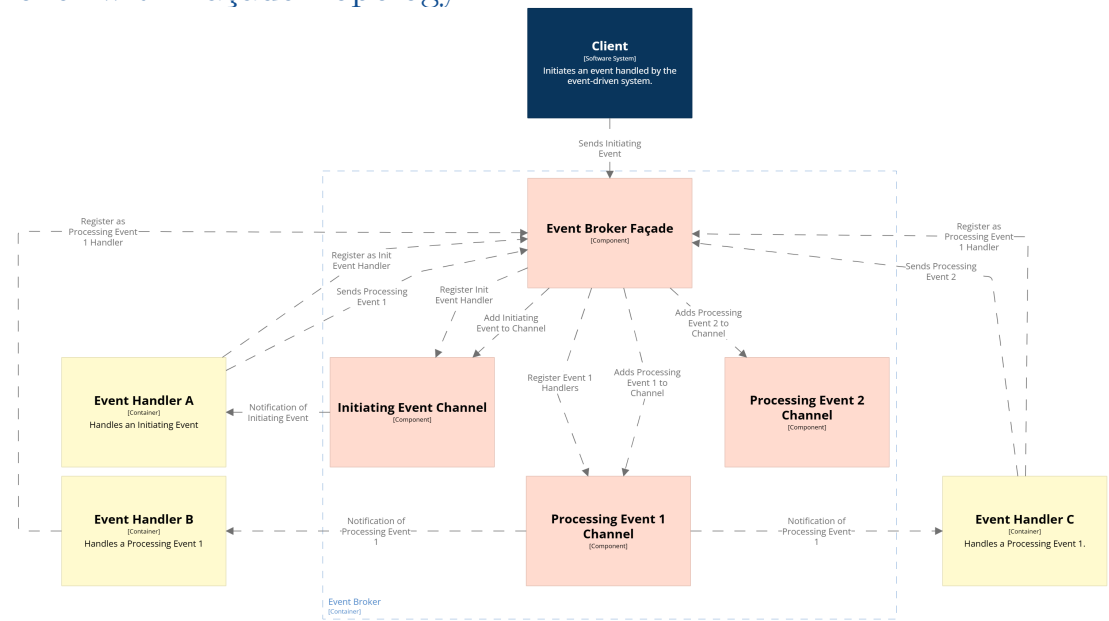


- Step through event process
- Channels facilitate message flow
  - Commonly a lightweight message broker (e.g. RabbitMQ, ...)
- Send final processing event, even if it is not handled
  - Easier to *extend* in the future

### *Event Broker Façade*

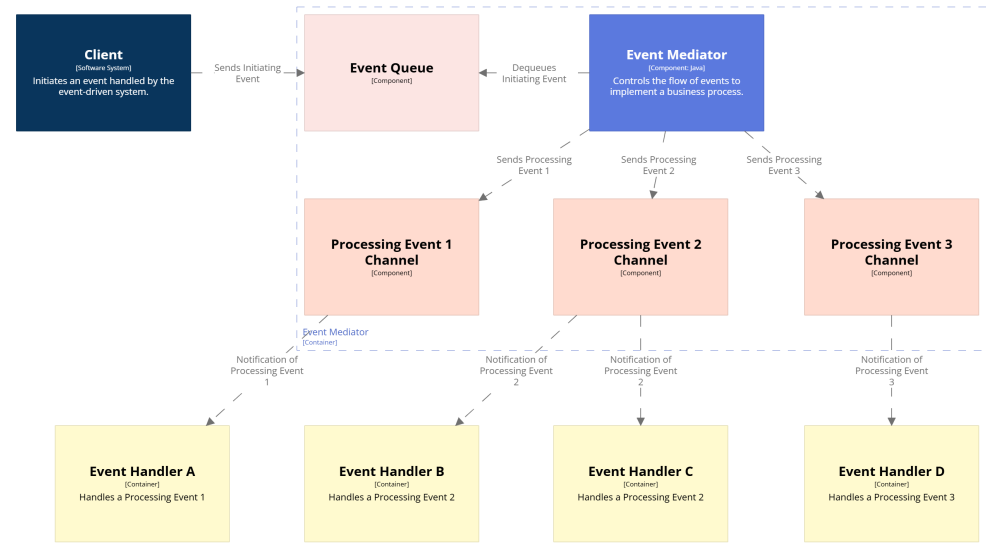
- Event handlers register to *listen* for events
- Receives events and *directs* them to the correct channel

# Broker with Façade Topology



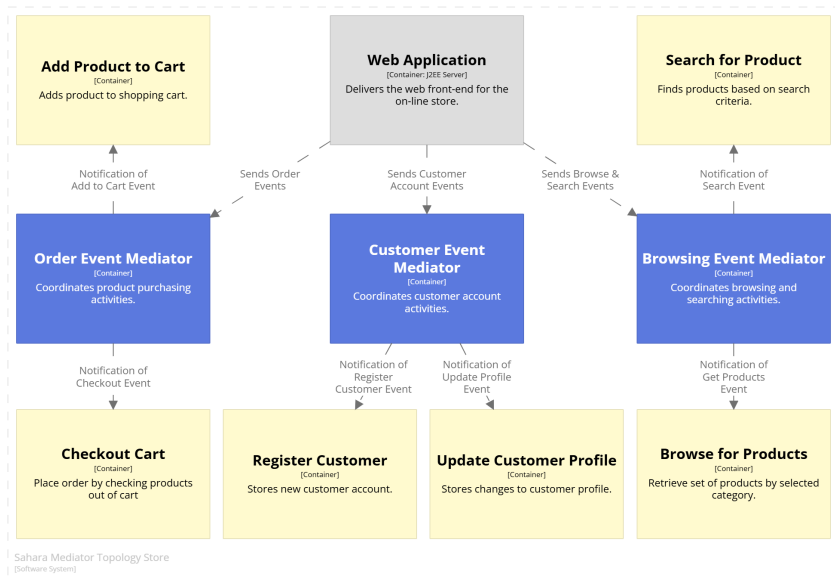
- Event processing & event handling are the same
- Event Handlers register to listen for events, rather than being connected directly to Channels
  - Additional layer of abstraction
- Step through event process

# Mediator Topology



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

# Sahara Mediator Topology



- Step through event processes.
  - Note that external clients are not shown in diagram
- 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

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  - Scaled independently to manage load

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- 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

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  - FIFO behaviour

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- 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



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  - 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

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- 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

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## *Broker Advantages*

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## *Mediator Advantages*

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

Emphasise that the *real* advantage of Broker is *low coupling* and slightly easier *extensibility*.

Pros & Cons

Modularity Event Handlers



Extensibility



Reliability Event Handlers



Interoperability Events



Scalability Event Handlers



Security



Simplicity



Deployability



Testability Complex Interactions



- Broker & Mediator are both *very* scalable
- Due to simple event management through message queues
  - Broker can handle a *slightly higher load*
  - Broker is *slightly easier to scale*
- Mediator has more *internal processing*, so requires greater *resources*