Event-Driven Architecture

Software Architecture

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March 30, 2026

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.

Responsiveness

- Synchronous Communication
  - Send message
  - *Wait* for response
  - Continue processing

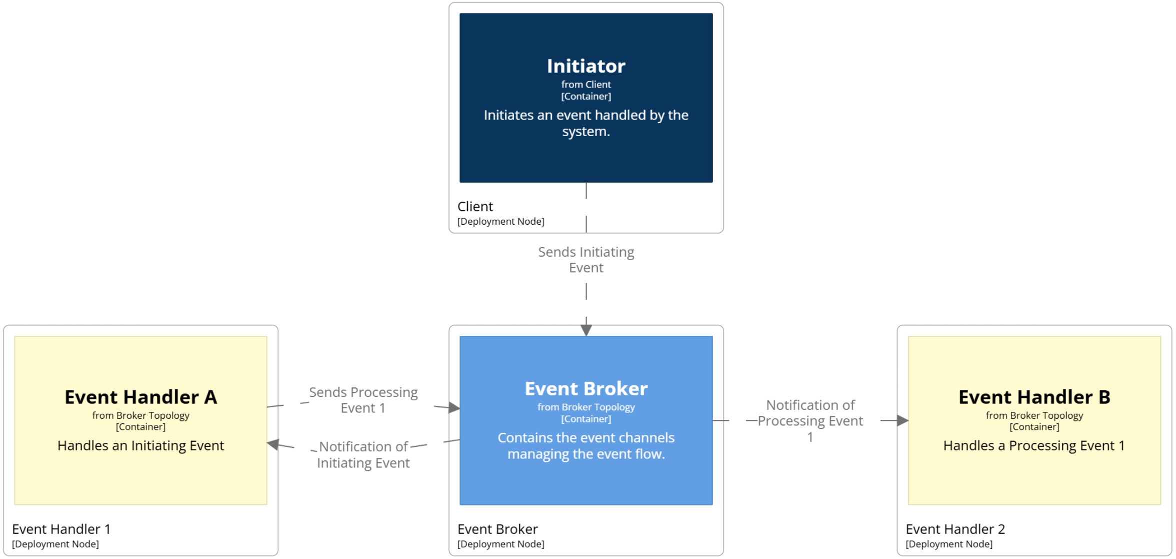
Responsiveness

- 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



Terminology

Initiating Event	Starts the business process

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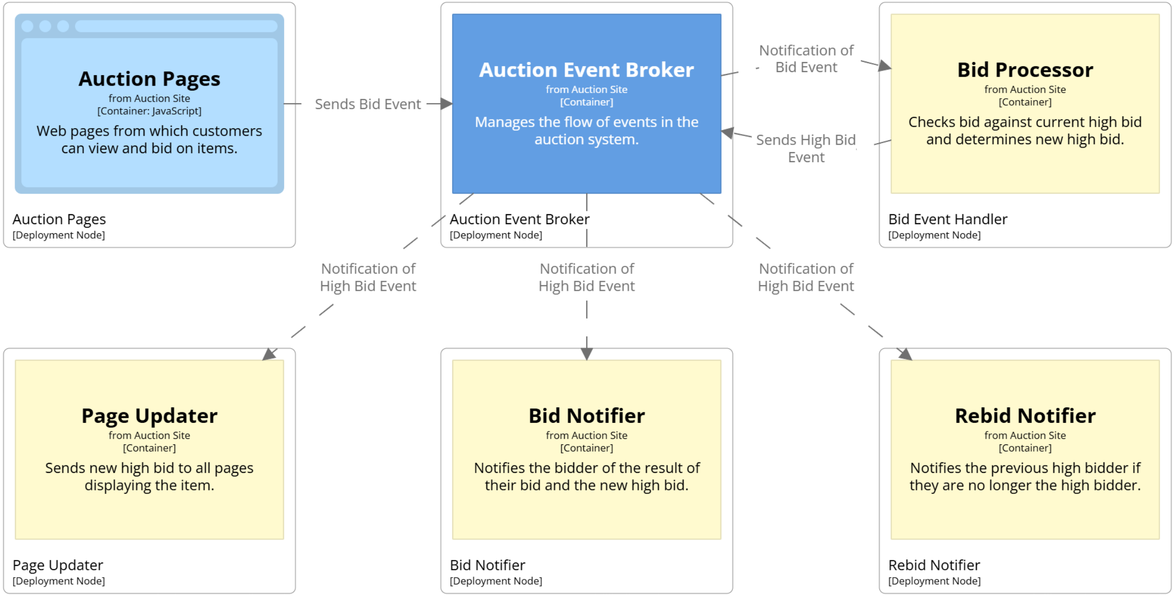
Initiating Event	Starts the business process
Processing Event	Indicates next step in the process can be performed
Event Channel	Holds events waiting to be processed
Event Handler	Processes an event • Step, or part of a step, in the business process

Auction Example



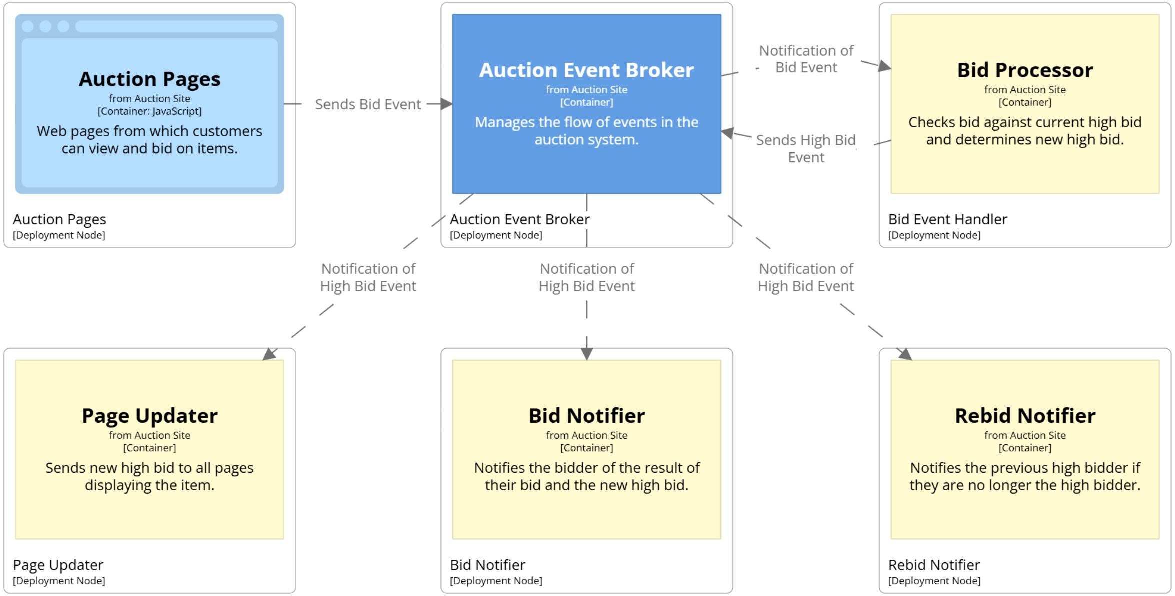
Definition 0. Event Handler Cohesion Principle

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



Topologies

Broker All events received by event broker

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

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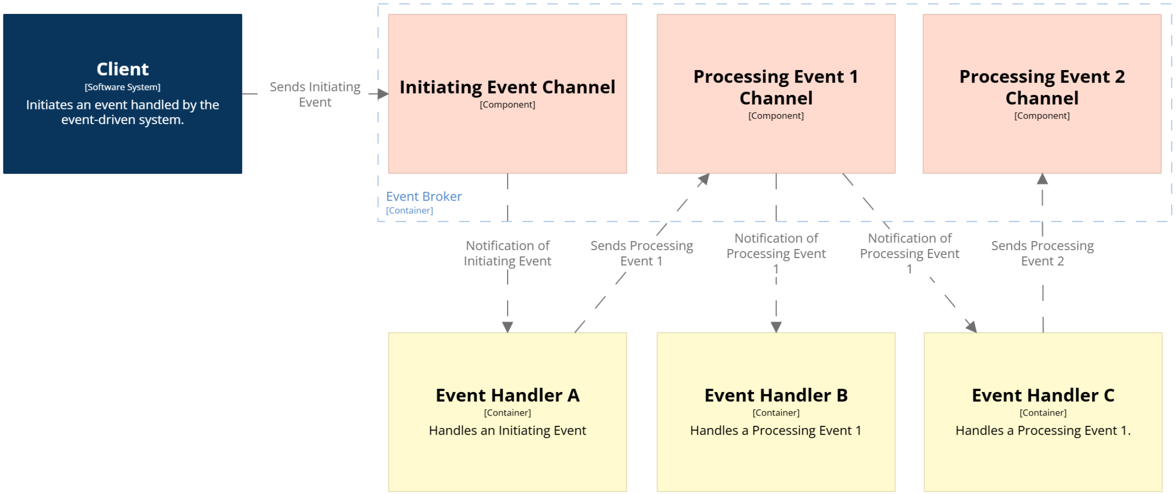
Mediator Manages business process

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

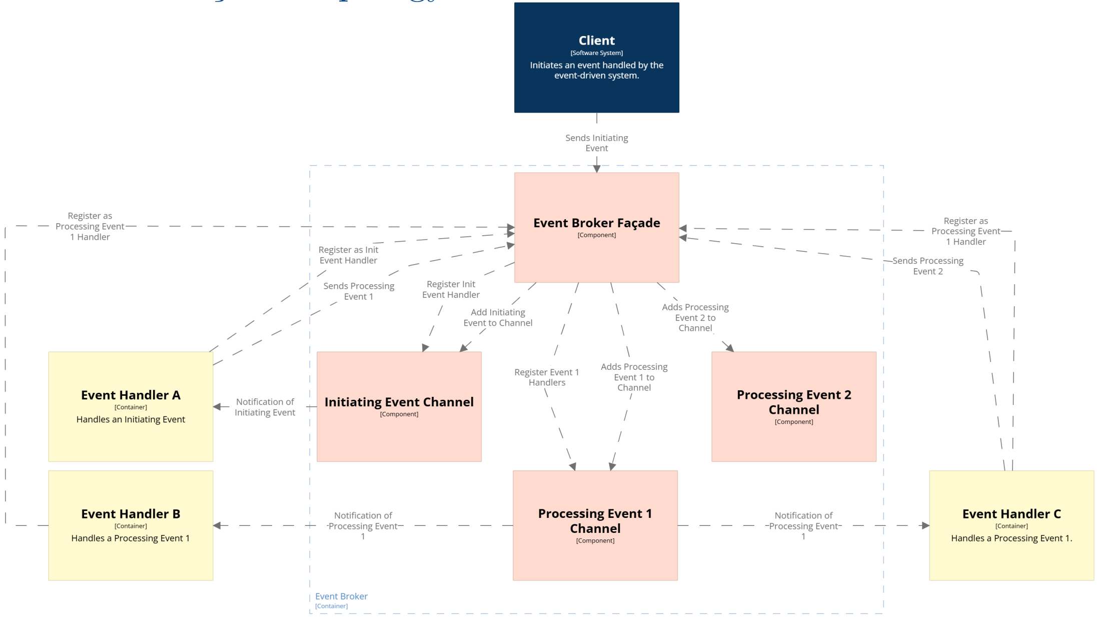
Broker Topology


Client
[Software System]
Initiates an event handled by the event-driven system.
Sends Initiating Event
Initiating Event Channel
[Component]
Processing Event 1 Channel
[Component]
Processing Event 2 Channel
[Component]
Event Broker
[Container]
Notification of Initiating Event
Sends Processing Event 1
Notification of Processing Event 1
Notification of Processing Event 1
Sends Processing Event 2
Event Handler A
[Container]
Handles an Initiating Event
Event Handler B
[Container]
Handles a Processing Event 1
Event Handler C
[Container]
Handles a Processing Event 1.

Event Broker Façade

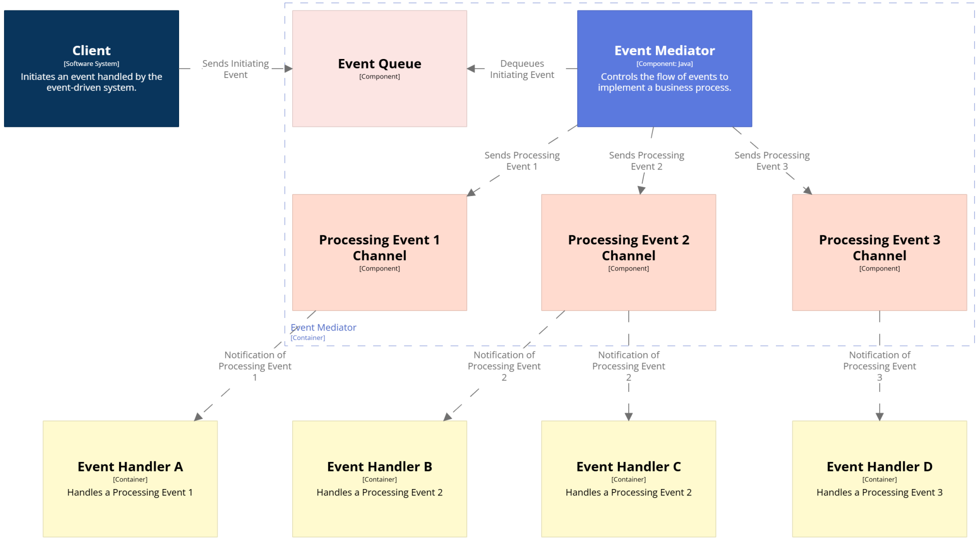
- Event handlers register to *listen* for events
- Receives events and *directs* them to the correct channel

Broker with Façade Topology

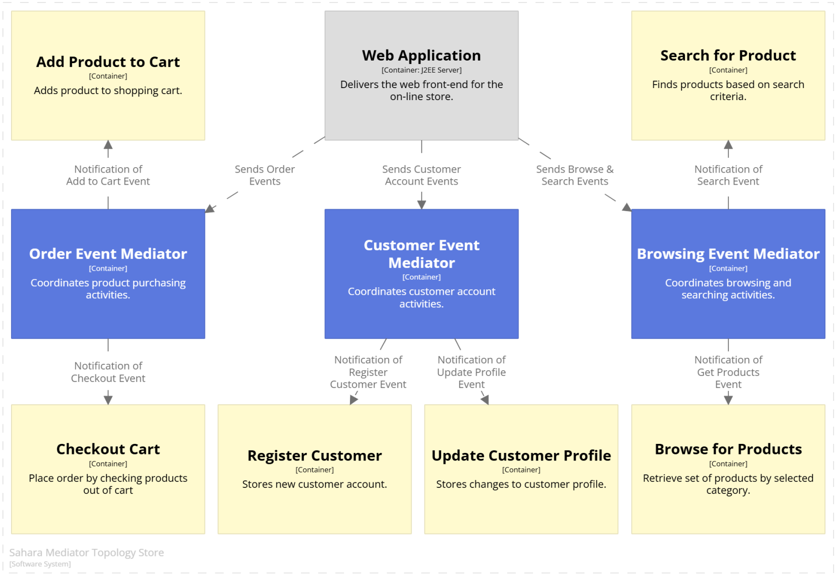


Client
[Software System]
Initiates an event handled by the event-driven system.
Sends Initiating Event
Event Broker Façade
[Component]
Register as Processing Event 1 Handler
Register as Init Event Handler
Sends Processing Event 1
Register Init Event Handler
Add Initiating Event to Channel
Register Event 1 Handlers
Adds Processing Event 1 to Channel
Adds Processing Event 2 to Channel
Register as Processing Event 1 Handler
Sends Processing Event 2
Event Handler A
[Container]
Handles an Initiating Event
Notification of Initiating Event
Initiating Event Channel
[Component]
Processing Event 2 Channel
[Component]
Event Handler B
[Container]
Handles a Processing Event 1
Notification of Processing Event 1
Processing Event 1 Channel
[Component]
Notification of Processing Event 1
Event Handler C
[Container]
Handles a Processing Event 1.
Event Broker
[Container]

Mediator Topology


Client
[Software System]
Initiates an event handled by the event-driven system.
Sends Initiating Event
Event Queue
[Component]
Dequeues Initiating Event
Event Mediator
[Component: Java]
Controls the flow of events to implement a business process.
Sends Processing Event 1
Sends Processing Event 2
Sends Processing Event 3
Processing Event 1 Channel
[Component]
Processing Event 2 Channel
[Component]
Processing Event 3 Channel
[Component]
Event Mediator
[Container]
Notification of Processing Event 1
Notification of Processing Event 2
Notification of Processing Event 2
Notification of Processing Event 3
Event Handler A
[Container]
Handles a Processing Event 1
Event Handler B
[Container]
Handles a Processing Event 2
Event Handler C
[Container]
Handles a Processing Event 2
Event Handler D
[Container]
Handles a Processing Event 3

Sahara Mediator Topology



Add Product to Cart
[Container]
Adds product to shopping cart.
Web Application
[Container: J2EE Server]
Delivers the web front-end for the on-line store.
Search for Product
[Container]
Finds products based on search criteria.
Notification of Add to Cart Event
Sends Order Events
Sends Customer Account Events
Sends Browse & Search Events
Notification of Search Event
Order Event Mediator
[Container]
Coordinates product purchasing activities.
Customer Event Mediator
[Container]
Coordinates customer account activities.
Browsing Event Mediator
[Container]
Coordinates browsing and searching activities.
Notification of Checkout Event
Notification of Register Customer Event
Notification of Update Profile Event
Notification of Get Products Event
Checkout Cart
[Container]
Place order by checking products out of cart
Register Customer
[Container]
Stores new customer account.
Update Customer Profile
[Container]
Stores changes to customer profile.
Browse for Products
[Container]
Retrieve set of products by selected category.
Sahara Mediator Topology Store
[Software System]

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

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Scalability

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  - 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

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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

Streams

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  - Events are saved permanently

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  - Observer pattern

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- 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

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- Scalability
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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	👎