Events

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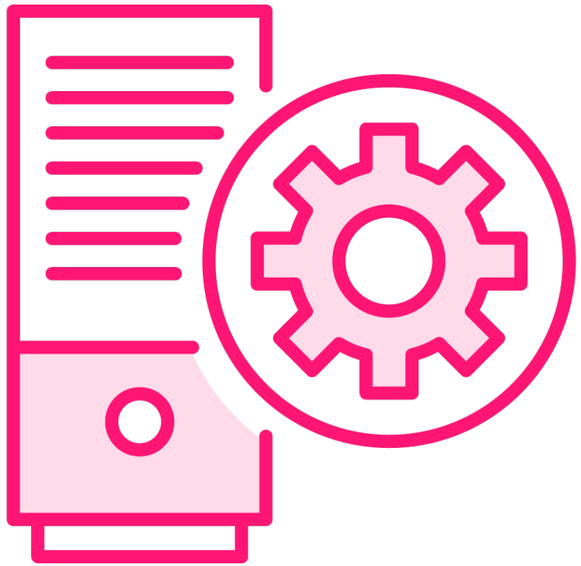
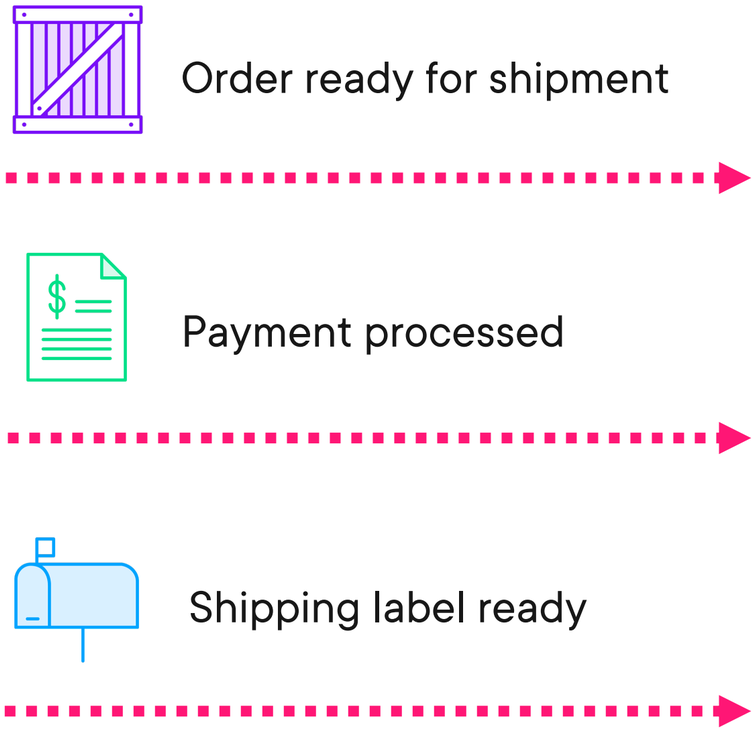
Broadcasting Events



Order Processor

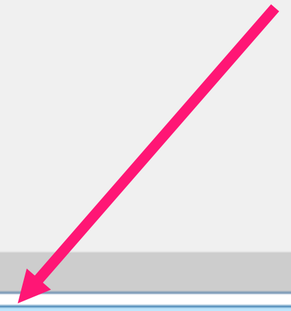


Subscribers of the events

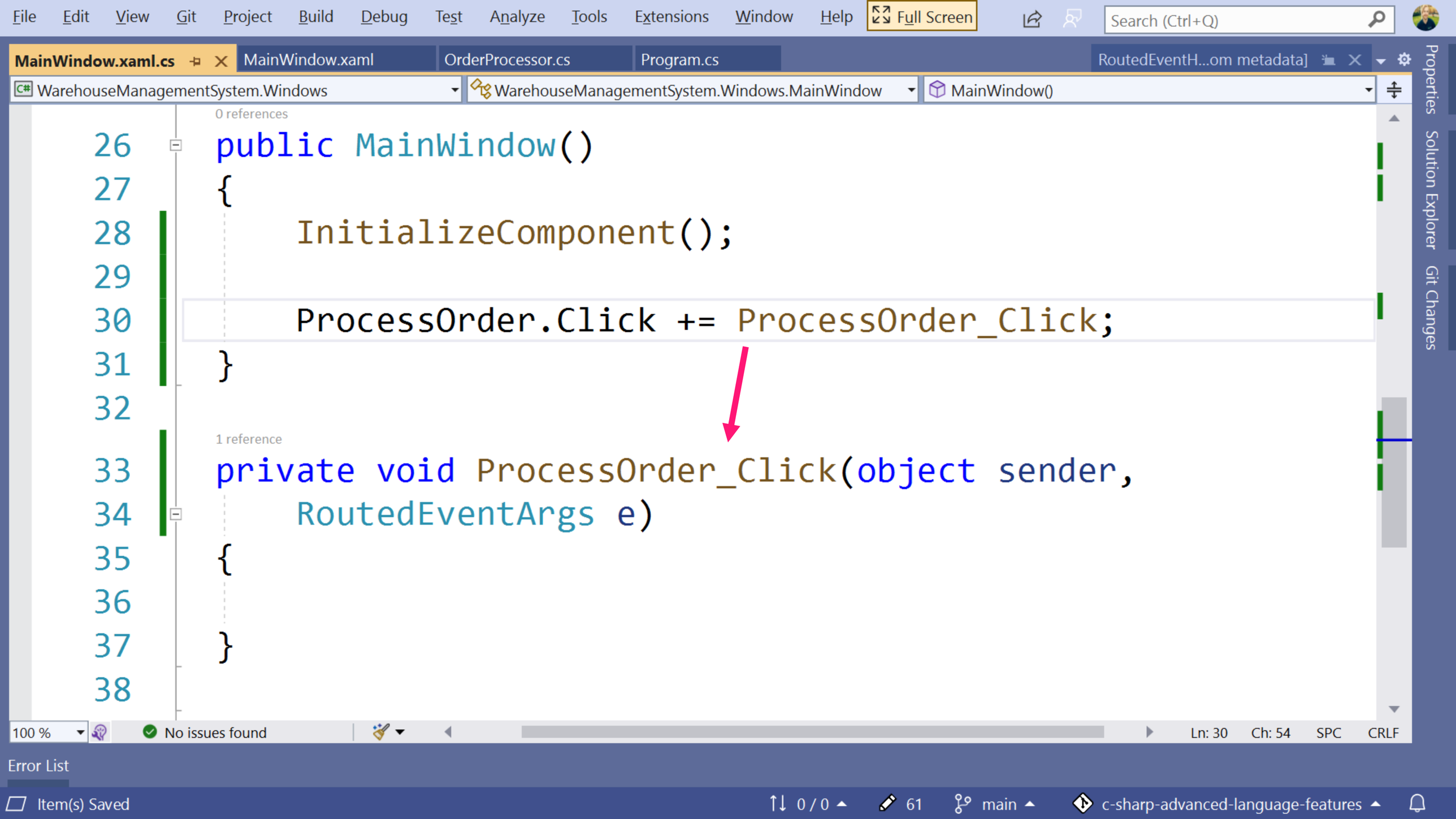
Warehouse Management System

OrderNumber	IsReadyForShipment	Total
8101e88e-ff6a-4eb7-af07-bdaef0b711e6	☑	0
0b7c7c69-c46a-4585-a3be-e4f3f0fe96d1	☑	0

Run a method when this **button** is **clicked**



Process Order


File Edit View Git Project Build Debug Test Analyze Tools Extensions Window Help Full Screen
Search (Ctrl+Q)
MainWindow.xaml.cs
MainWindow.xaml
OrderProcessor.cs
Program.cs
RoutedEventH...om metadata]
WarehouseManagementSystem.Windows
WarehouseManagementSystem.Windows.MainWindow
MainWindow()
0 references
public MainWindow()
{
InitializeComponent();
ProcessOrder.Click += ProcessOrder_Click;
}
1 reference
private void ProcessOrder_Click(object sender,
RoutedEventArgs e)
{
}
100 %
No issues found
Ln: 30
Ch: 54
SPC
CRLF
Error List
Item(s) Saved
0 / 0
61
main
c-sharp-advanced-language-features
Properties
Solution Explorer
Git Changes

Invoking a Publicly Exposed Delegate

```
class OrderProcessor
{
    public Func<Order, bool> OnOrderInitialized { get; set; }
}
```

```
var processor = new OrderProcessor();

processor.OnOrderInitialized();
```

Event

“The event keyword is used to declare an event in a publisher class.”

Example:

```
public event EventHandler OrderCreated;
```

docs.microsoft.com/en-us/dotnet/csharp/language-reference/keywords/event

Event

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Example:

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Delegate

docs.microsoft.com/en-us/dotnet/csharp/language-reference/keywords/event

Events in .NET

Publisher

The class that owns the event and is in charge of raising it

Subscriber

The classes that subscribe to events exposed by the publisher

Creating an Event

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}
```

Creating an Event

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Creating an Event

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class OrderProcessor
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```

Choosing a Delegate for the Event

Don’t use your own delegates, Func or Action

An event delegate is always void and an event never returns a value

Creating an Event

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}
```

Use the delegates **EventHandler** or **EventHandler<T>**

EventHandler

Sender

The instance of the publisher that raised the event

EventArgs

Inherit from EventArgs to create a class that represents the event data

When you **add** the **event** keyword before a **delegate**, it can **only** be **invoked** from **that class**

Accessing the Event

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}

var processor = new OrderProcessor();

processor.OrderCreated = null; // Compiler error
```

Accessing the Event

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}

var processor = new OrderProcessor();

processor.OrderCreated = null; // Compiler error
```

EventHandler OrderProcessor.OrderCreated

CS0070: The event 'OrderProcessor.OrderCreated' can only appear on the left hand side of += or -= (except when used from within the type 'OrderProcessor')

Accessing the Event

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}

var processor = new OrderProcessor();

processor.OrderCreated += Processor_OrderCreated;
```

The **publisher should never care** about **what** the **subscriber does** when the event is raised

Subscribers Are Executed Sequentially

One slow subscriber?

This makes the whole method slow and impacts all the subscribers in the chain!

Always Unsubscribe!

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}

var processor = new OrderProcessor();

processor.OrderCreated += Processor_OrderCreated;

...

processor.OrderCreated -= Processor_OrderCreated;
```

Always Unsubscribe!

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}

var processor = new OrderProcessor();

processor.OrderCreated += Processor_OrderCreated;

...

processor.OrderCreated -= Processor_OrderCreated;
```

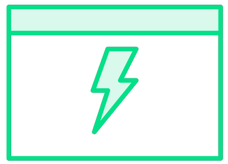
Don’t forget to **unsubscribe** when you are done with the **event**!

Event **handlers** are **executed sequentually** in the **order they were added**

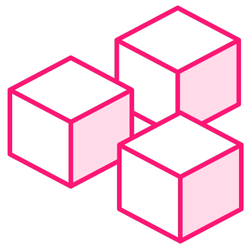
Multiple Events Are Not Uncommon

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
    public event EventHandler OrderReadyForShipment;
    public event EventHandler OrderCancelled;
    public event EventHandler PaymentProcessed;
}
```

Important Notes on Events



The publisher owns the invocation.
It cannot be invoked by anyone else.



Use a delegate that conforms with the .NET guidelines.
This is EventHandler or EventHandler<T>

Subscribers may be attached for a very long time.
This is especially true in UI applications.

Filip Ekberg

```
1
2
3
Processed 29fa8872-5d7c-4070-b51f-bc270d28ace5
```

Completing this process **took at least 3 seconds**!

EventArgs

```
class OrderCreatedEventArgs : EventArgs
{
    public Order Order { get; set; }
}
```

EventArgs

```
class OrderCreatedEventArgs : EventArgs
{
    public Order Order { get; set; }
}


// The event handler
void Processor_OrderCreated(object sender, EventArgs args)
{
    var eventData = args as OrderCreatedEventArgs;
}
```

Creating an Event with Event Data

```
class OrderProcessor
{
    public event EventHandler OrderCreated;

}
```

Creating an Event with Event Data

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
    public event EventHandler<OrderCreatedEventArgs> OrderCreated;
}
```

Creating an Event with Event Data

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
    public event EventHandler<OrderCreatedEventArgs> OrderCreated;
}
```

Does not have to **inherit** from **EventArgs**

The parameter support contravariance

A method using EventArgs could therefore be used as a delegate if the event data class inherits from it

Different parts of the system may **subscribe** to the **event** and **handle** it in **different ways**

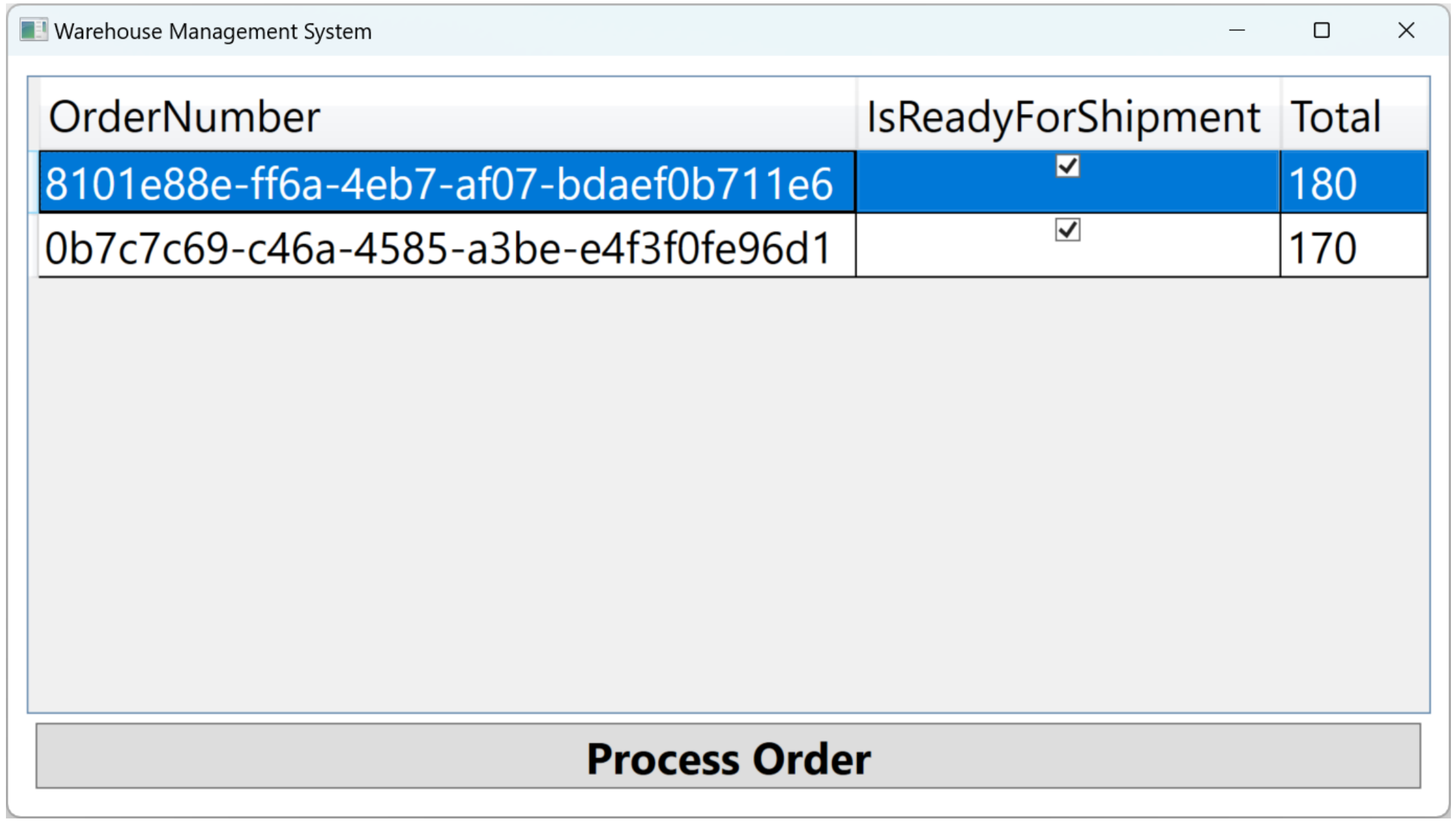
Event handlers are **delegates** and **execute** on the **same thread** as they were **called on**

Event with Event Data

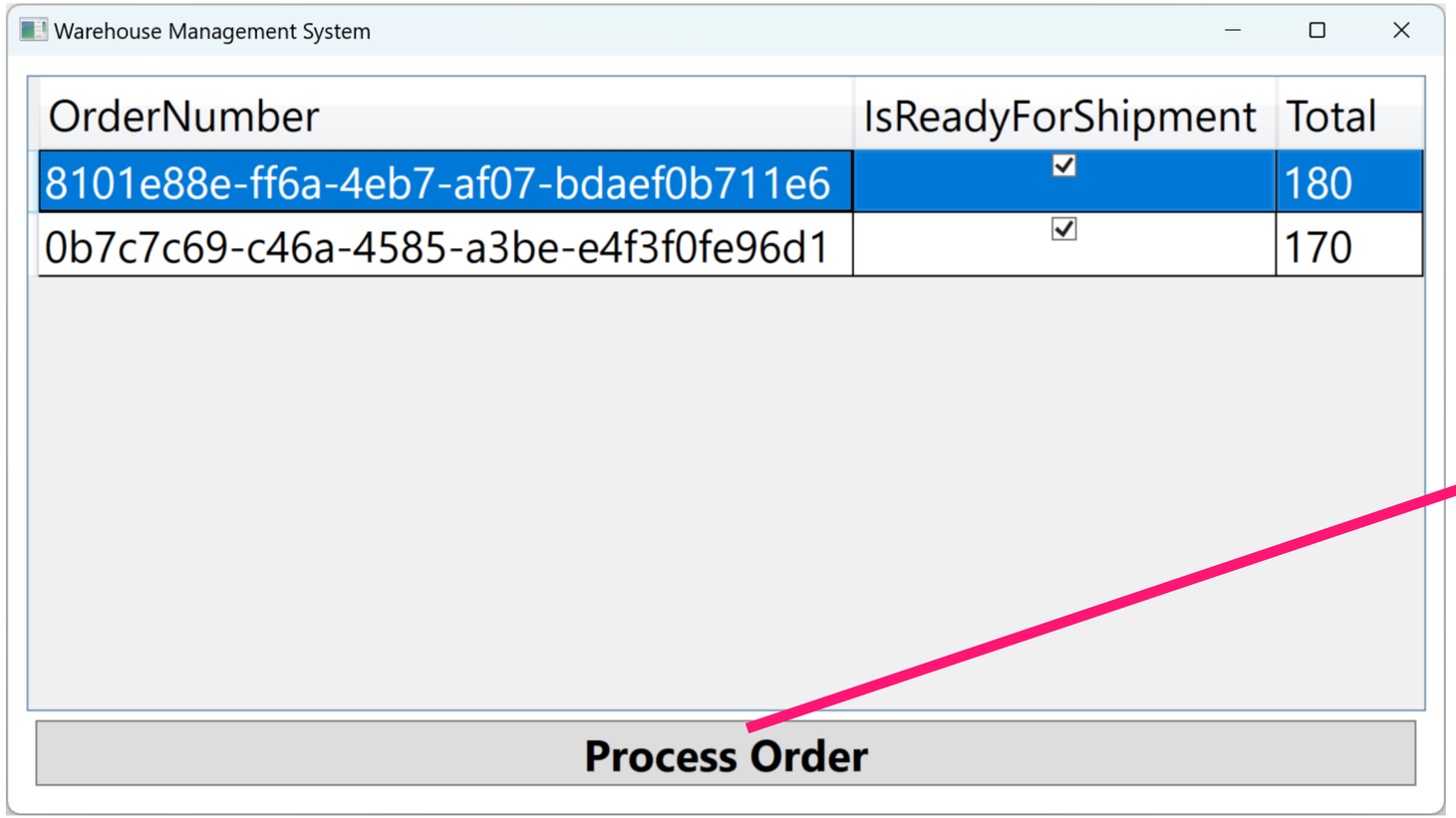
```
class OrderProcessor
{
    public event EventHandler<OrderCreatedEventArgs> OrderCreated;

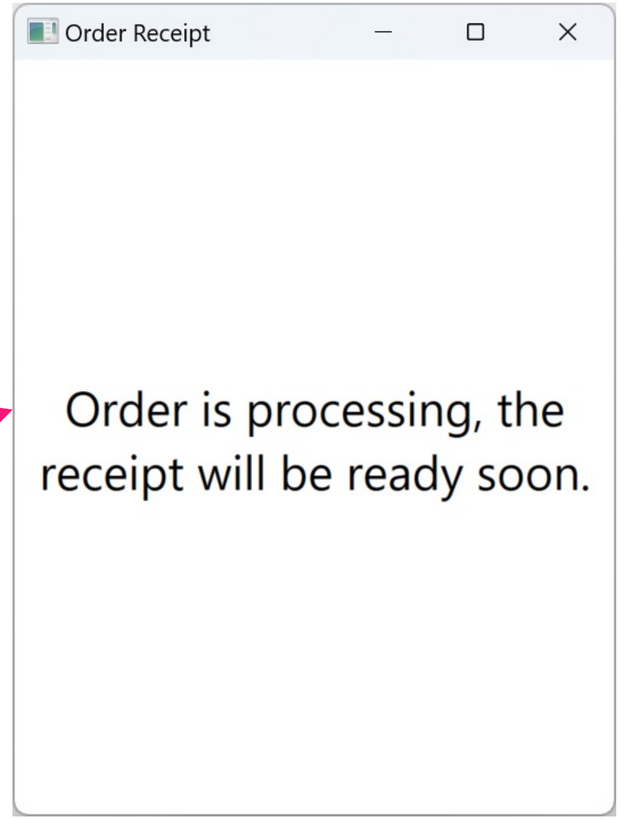
    protected virtual void OnOrderCreated(OrderCreatedEventArgs args)
    {
        OrderCreated?.Invoke(this, args);
    }
}
```

Warehouse Management System



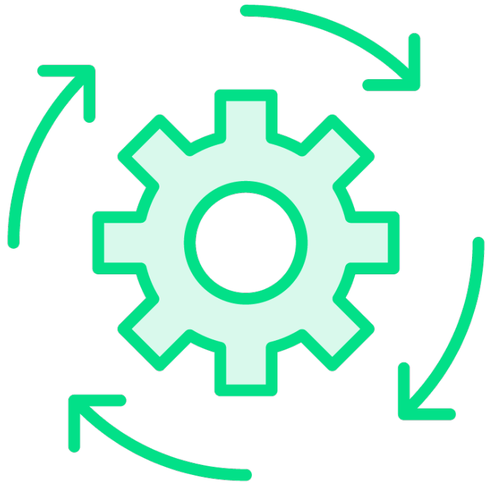
Warehouse Management System





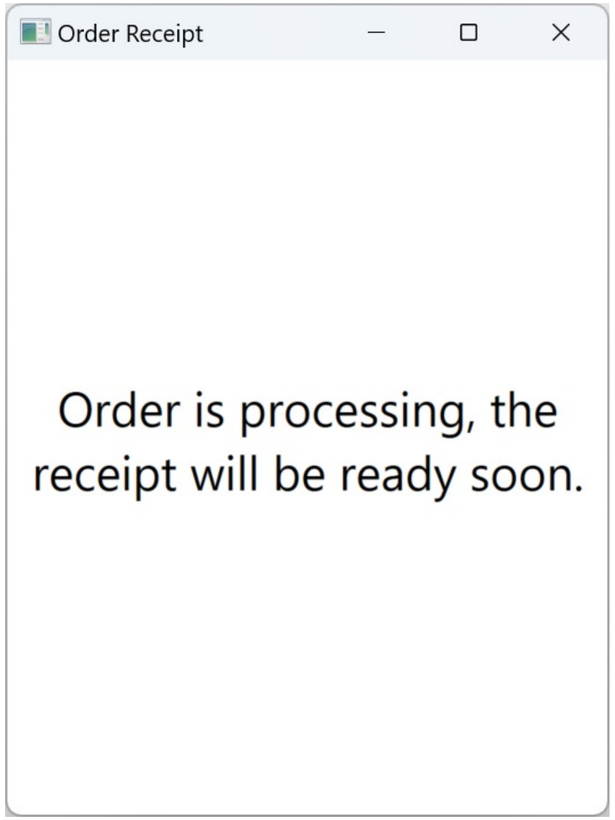
These windows share a reference to the OrderProcessor

Warehouse Management System

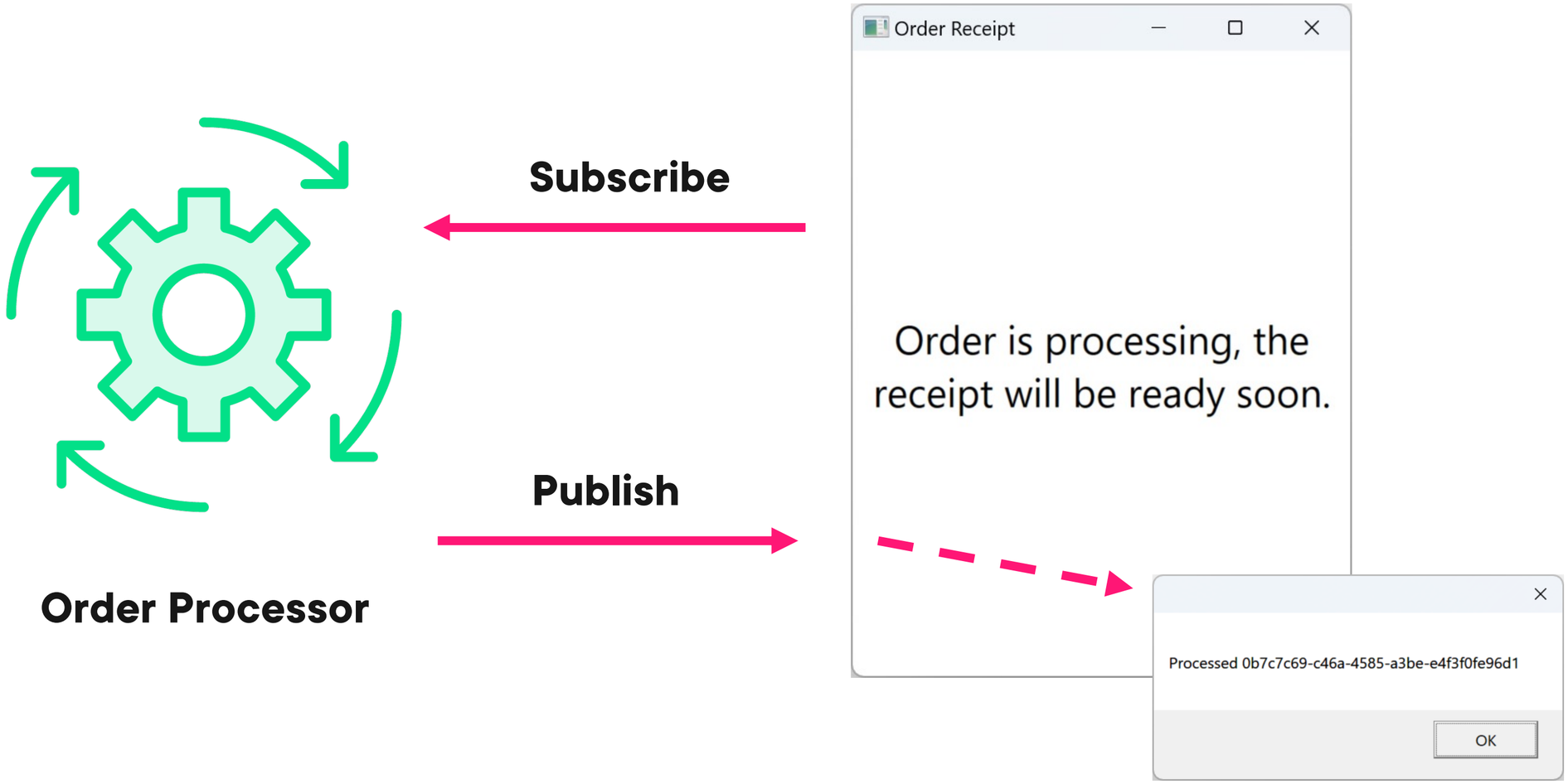


Subscribe

Order Processor



Warehouse Management System



Why was the event handler invoked three times?

We forgot to **unsubscribe**!

Avoid lambdas for event handlers

Event **handler leaks** can **happen** in **any type** of **application**

Event Handler Leaks

Always unsubscribe from events when the subscriber is no longer relevant

View closing? Unsubscribe from all events!

Where you unsubscribe will depend on the **type of application** and how the subscriber works

Alternative Approach

```
var processor = new OrderProcessor();
var logger = new Logger();

processor.OrderCreated += Processor_OrderCreated;

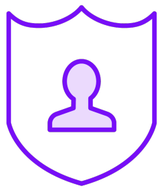
...

processor.OrderCreated -= Processor_OrderCreated;

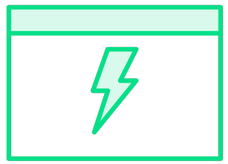
void Processor_OrderCreated(object sender, OrderCreatedEventArgs args)
{
    logger.Log(args.Order);
}
```

Understanding Events

Understanding of delegates is required



The publisher owns the invocation it cannot even be invoked by a sub-class



Use the event keyword with a delegate of type EventHandler or EventHandler<T>

The Event Keyword

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}
```

The Event Keyword

```
class OrderProcessor
{
    public event EventHandler OrderCreated;
}
```

External **access** is **limited** to **adding** and **removing** **delegates** from the invocation list

Raising the Event

```
class OrderProcessor
{
    public event EventHandler OrderCreated;

    protected virtual void OnOrderCreated()
    {
        OrderCreated?.Invoke();
    }
}
```

Raising the Event

```
class OrderProcessor
{
    public event EventHandler OrderCreated;

    protected virtual void OnOrderCreated()
    {
        OrderCreated?.Invoke();
    }
}
```

Always call the base class to raise the event!

Benefit of Inheriting from EventArgs

```
public void Log(object sender, EventArgs args) {}

public void Log(object sender, OrderCreatedEventArgs args)
{}
```

Benefit of Inheriting from EventArgs

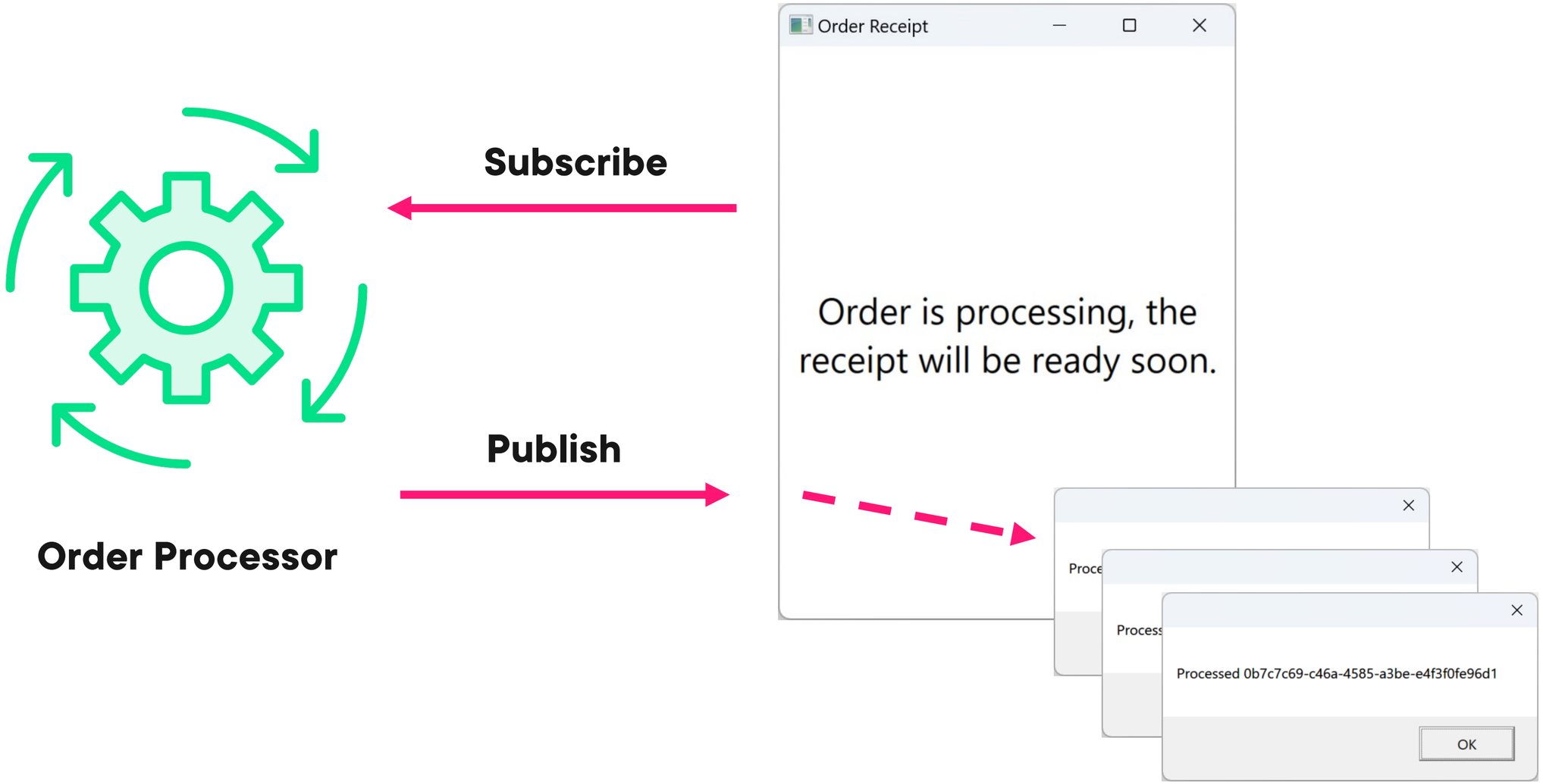
```
public void Log(object sender, EventArgs args) {}

public void Log(object sender, OrderCreatedEventArgs args)
{}
```

If this inherits from **EventArgs** it could be **used with any** event that uses **EventHandler** or **EventHandler<T>**

Using events in user interfaces are very common

Warehouse Management System



Up Next:

Overloading and Extension Methods