



Temporal 102

=GO

# Temporal 102

## ► 00. About this Workshop

01. Understanding Key Concepts in Temporal
02. Improving Your Temporal Application Code
03. Using Timers in a Workflow Definition
04. Understanding Event History
05. Understanding Workflow Determinism
06. Testing Your Temporal Application Code
07. Debugging Workflow Execution
08. Deploying Your Application to Production
09. Conclusion

# Logistics

- Introductions
- Schedule
- Facilities
- WiFi (SSID: Replay2025, Password: Durable!)
- Asking questions and providing feedback
- Course conventions: “Activity” vs “activity”
- Prerequisite: Did *everyone* already complete Temporal 101?

# During this workshop, you will

- Evaluate what a **production deployment** of Temporal looks like
- Use **Timers** to introduce delays in Workflow Execution
- Capture runtime information through **logging** in Workflow and Activity code
- Leverage the SDK's **testing support** to validate application behavior
- Differentiate **completion, failure, cancelation, and termination** of Workflow Executions
- Interpret **Event History** and debug problems with Workflow Execution
- Recognize **how Workflow code maps to Commands and Events** during Workflow Execution
- Consider **why Temporal requires determinism** for Workflow code
- Observe **how Temporal uses History Replay** to achieve durable execution of Workflows

# Exercise Environment

- **We provide a development environment for you in this workshop**
  - It uses the GitPod service to deploy a private Temporal Cluster, plus a code editor and terminal
  - You access it through your browser (may require you to log in to GitHub)
  - Your instructor will now demonstrate how to access and use it

<https://t.mp/102-go-exercise-env>

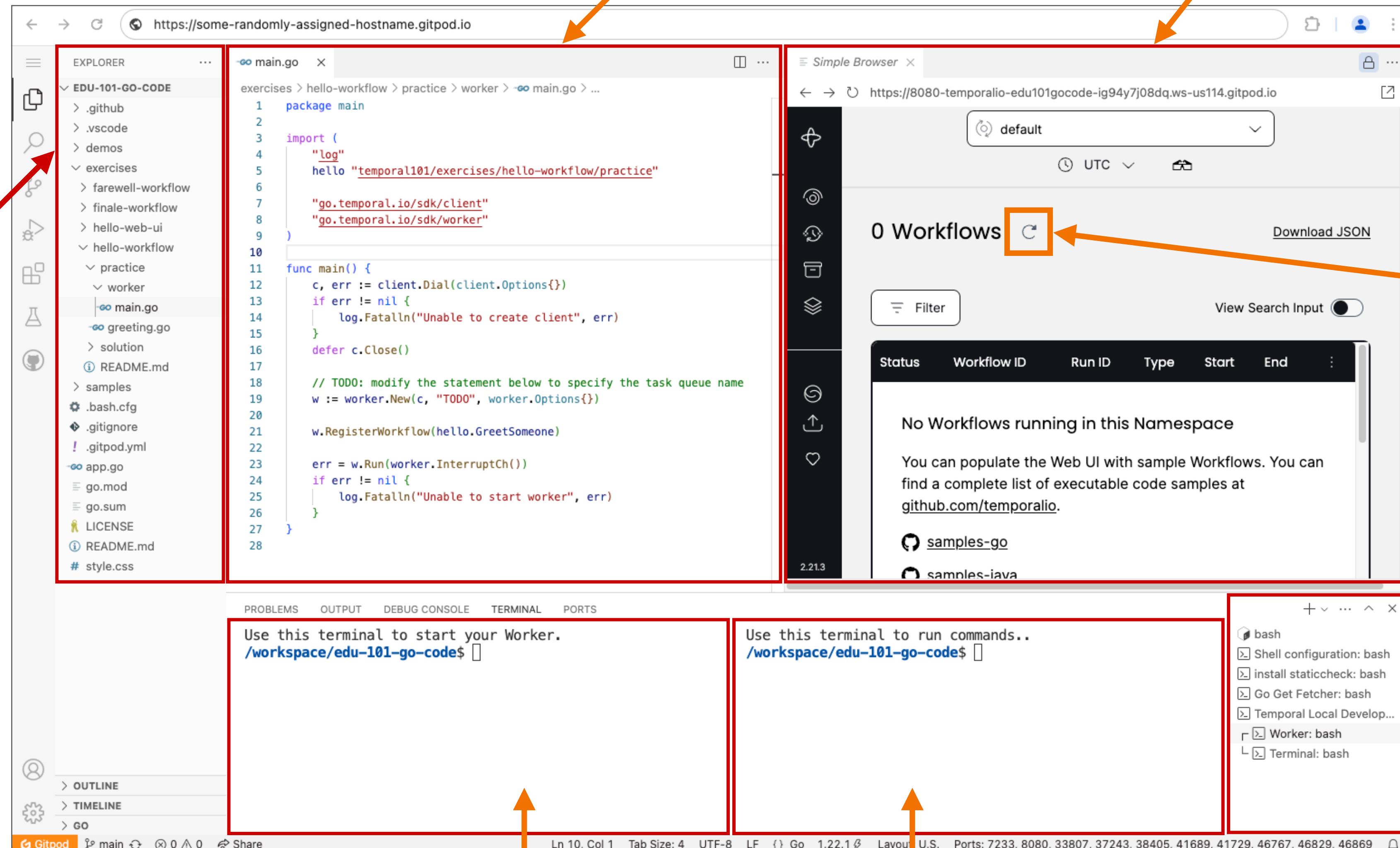
# GitPod Overview

**File browser**  
(source code  
for exercises)

**Code editor**

**Embedded browser**  
(shows Temporal Web UI)

**Refresh button**  
(for Web UI)



**Terminals**

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# Temporal: A Durable Execution System

- **What is a durable execution system?**
  - Ensures that your application runs reliably despite adverse conditions
  - Automatically maintains application state and recovers from failure
  - Improves developer productivity by making applications easier to develop, scale, and support

# Temporal Workflows

- **Workflows are the core abstraction in Temporal**
  - It represents the sequence of steps used to carry out your business logic
  - They are durable: Temporal automatically recreates state if execution ends unexpectedly
  - In the Go SDK, a Temporal Workflow is defined through a function
  - Temporal requires that Workflows are *deterministic*

< / > Workflow Definition

# Temporal Activities

- **Activities encapsulate unreliable or non-deterministic code**
  - They are automatically retried upon failure
  - In the Go SDK, Activities are defined through functions

< / > Activity Definitions

< / > Workflow Definition

# Temporal Workers

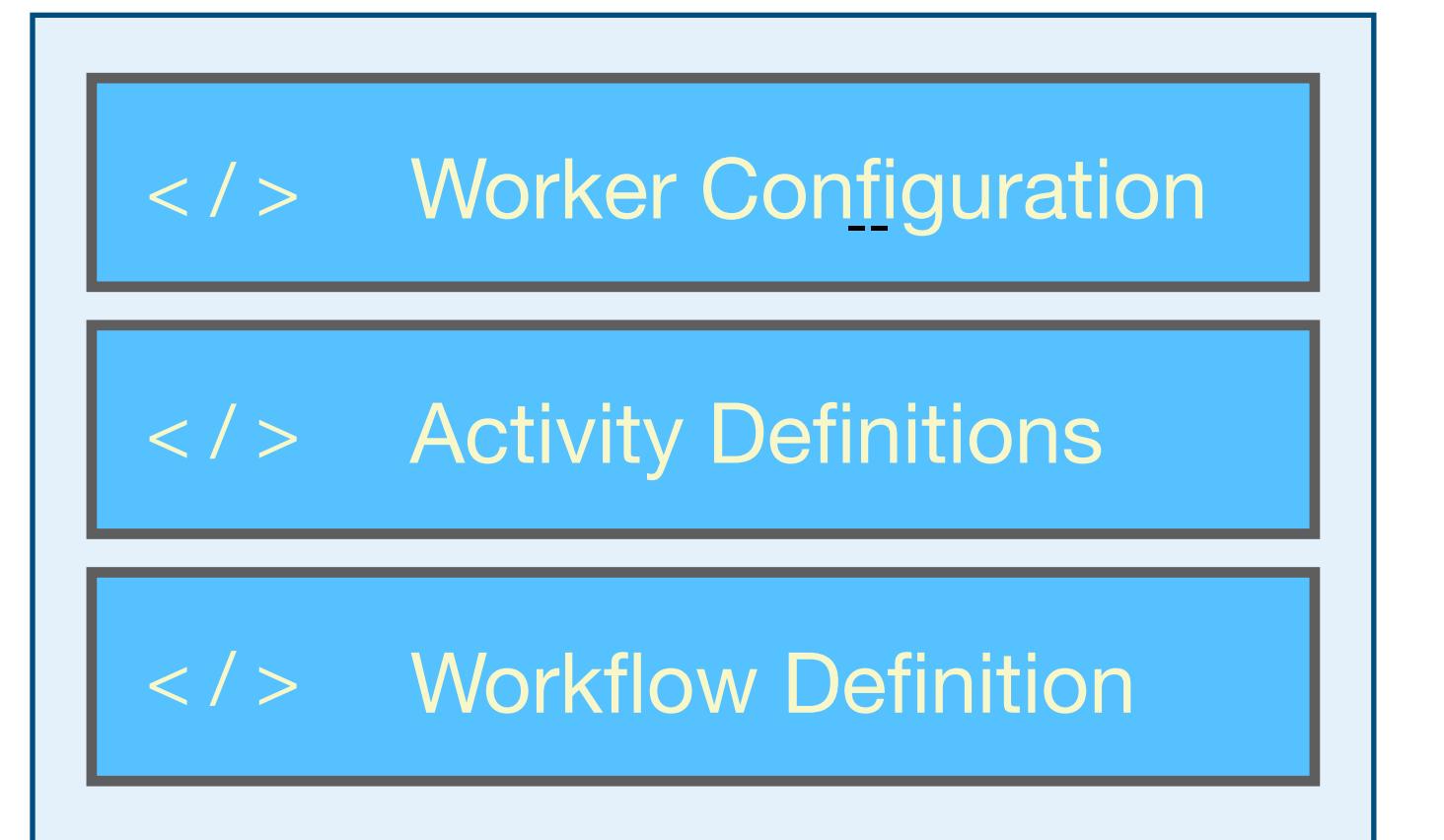
- **Workers are responsible for executing Workflow and Activity Definitions**
  - They poll a Task Queue maintained by the Temporal Service
- **The Worker implementation is provided by the Temporal SDK**
  - Your application will configure and start the Workers

< / > Worker Configuration

< / > Activity Definitions

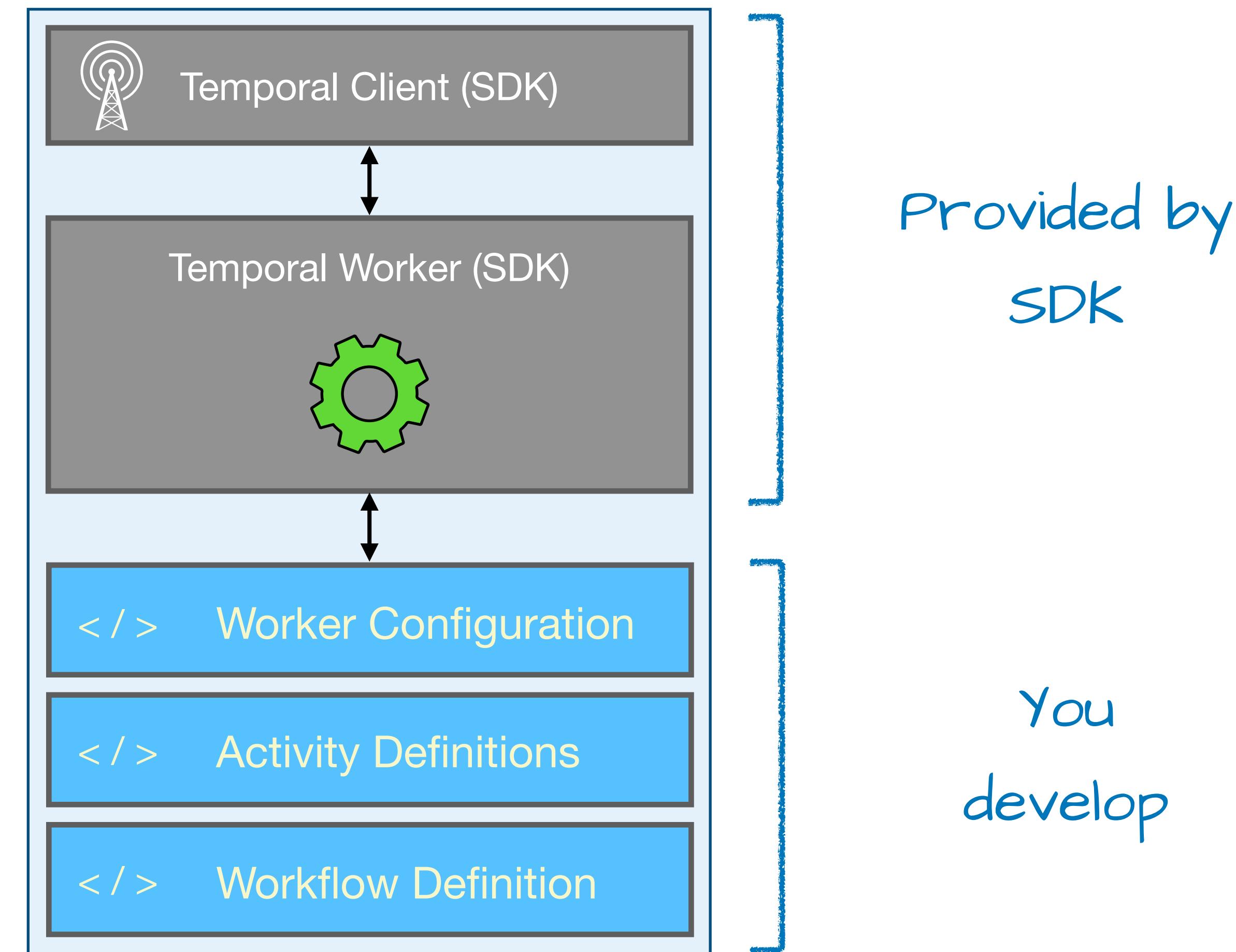
< / > Workflow Definition

# Code You Develop



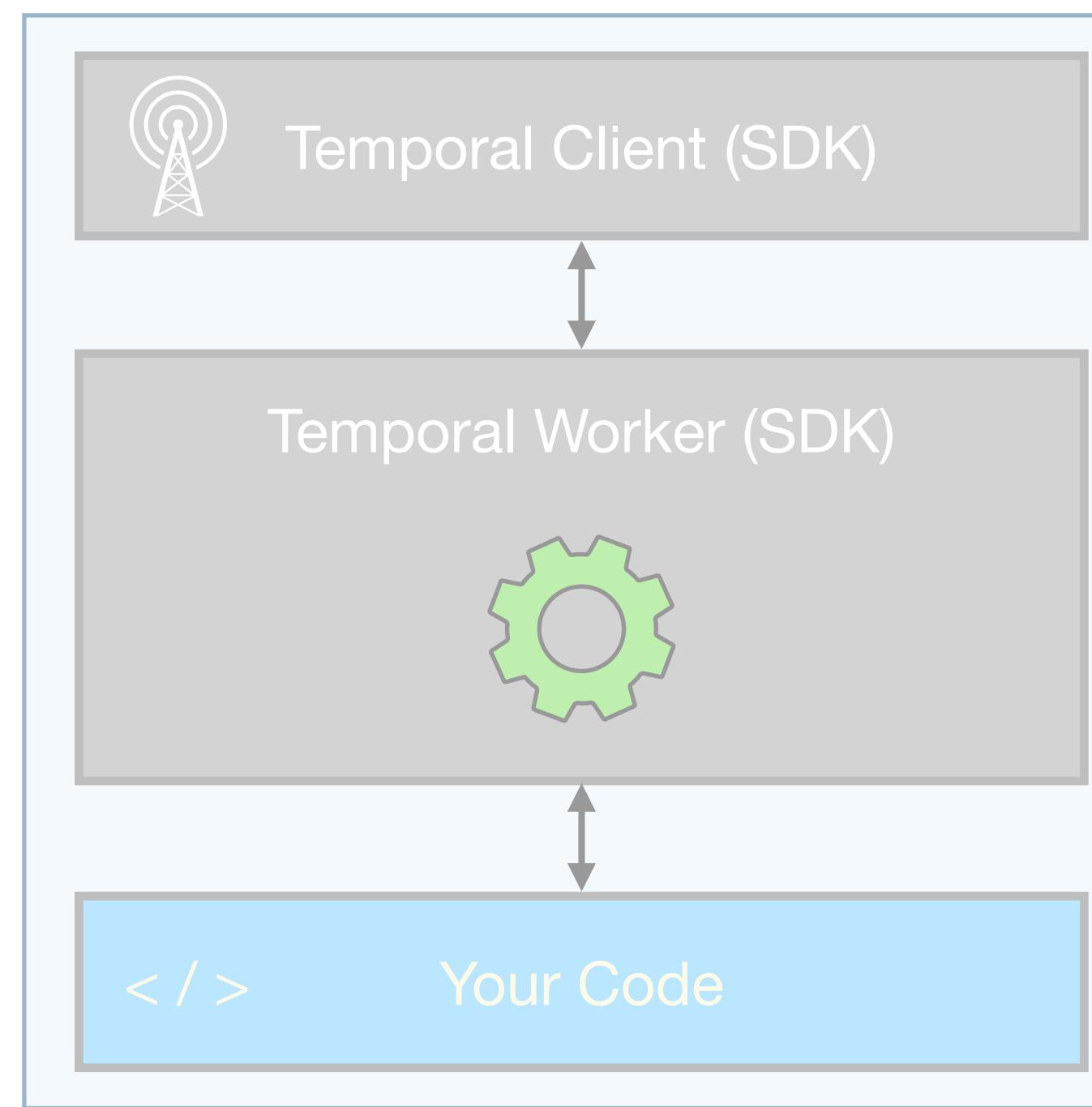
Temporal  
Application  
Code

# A Complete Temporal Application



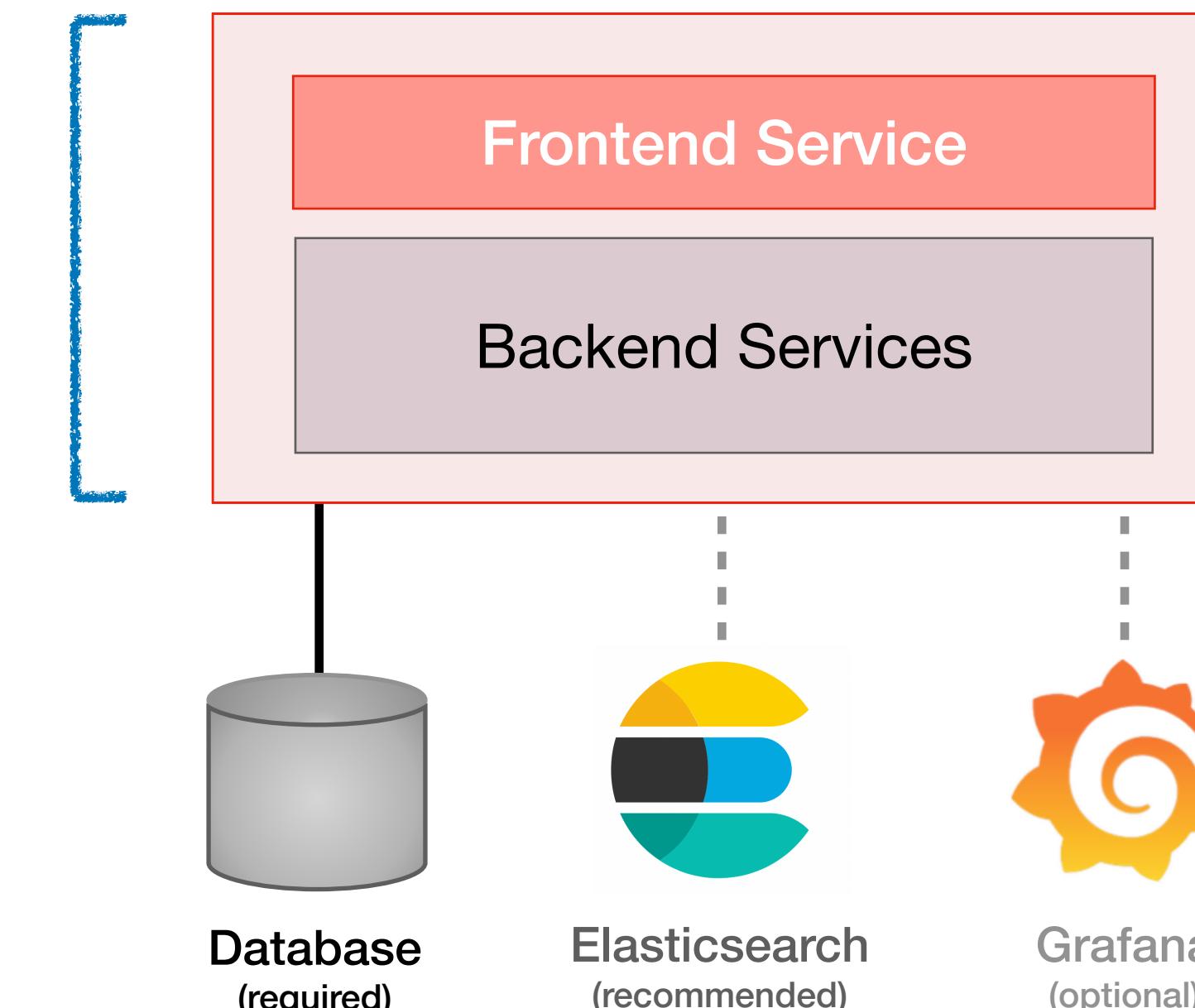
# The Role of Temporal Cluster

## Temporal Application

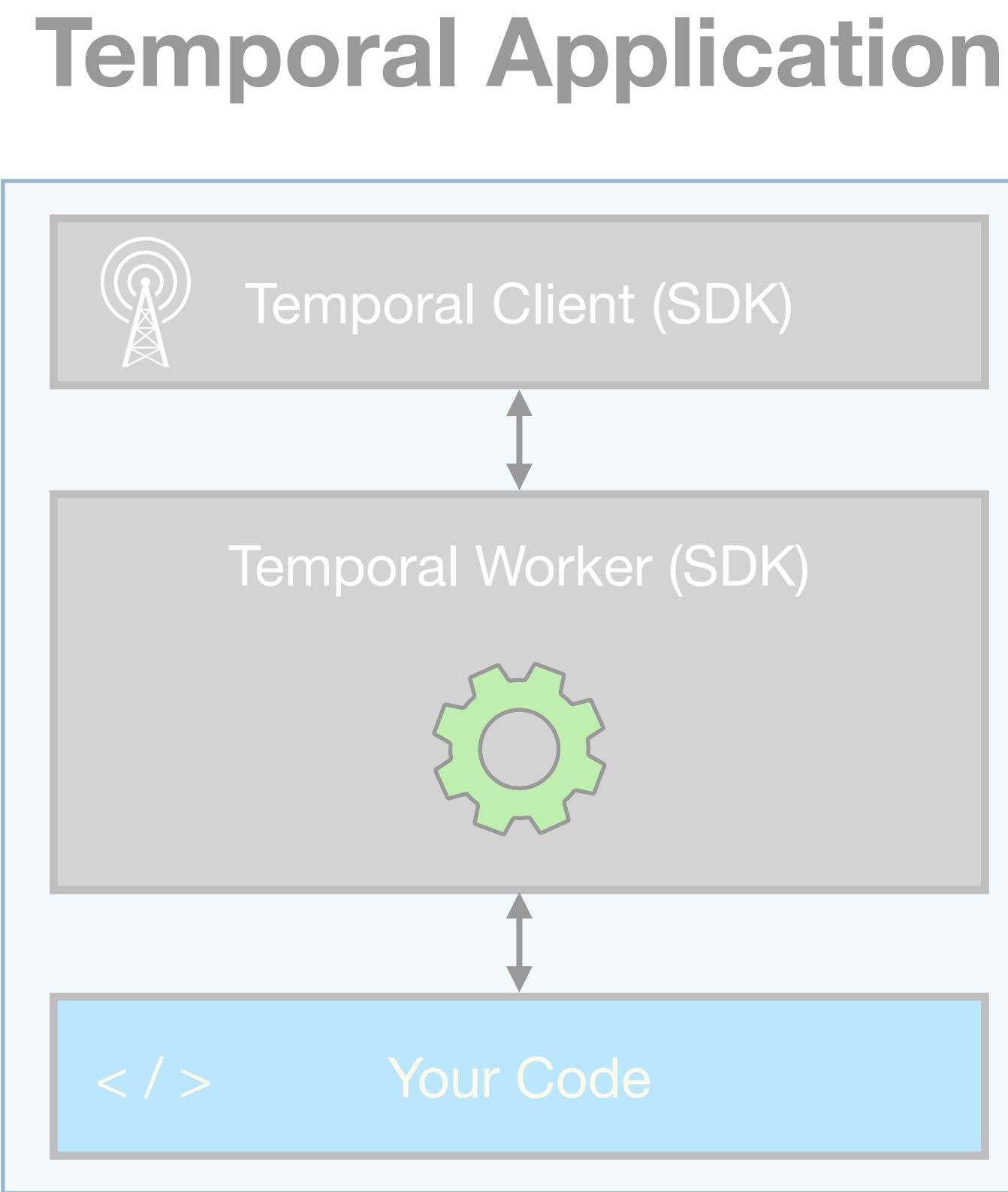


Temporal  
Server

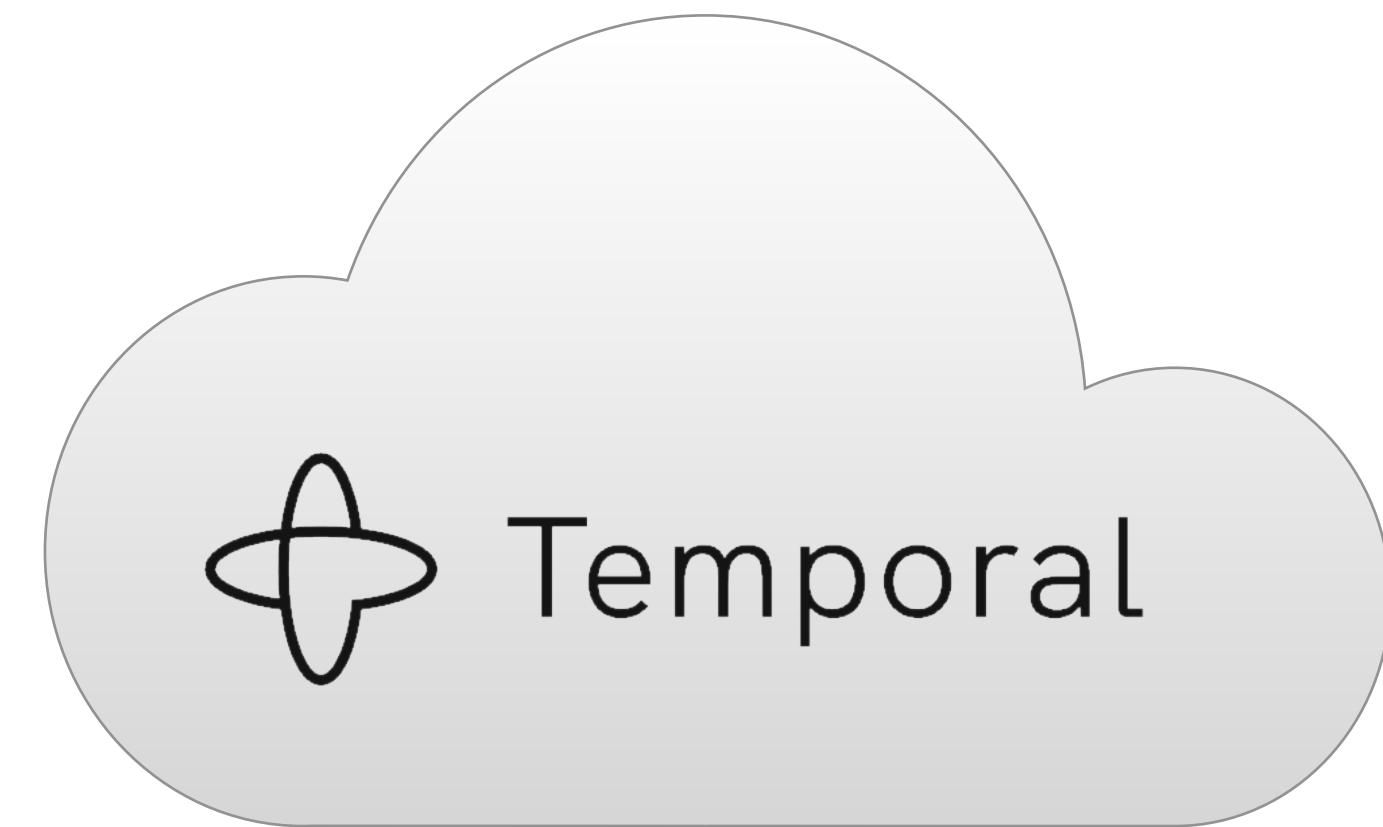
**Temporal Service**  
(provided by self-hosted Temporal Cluster)



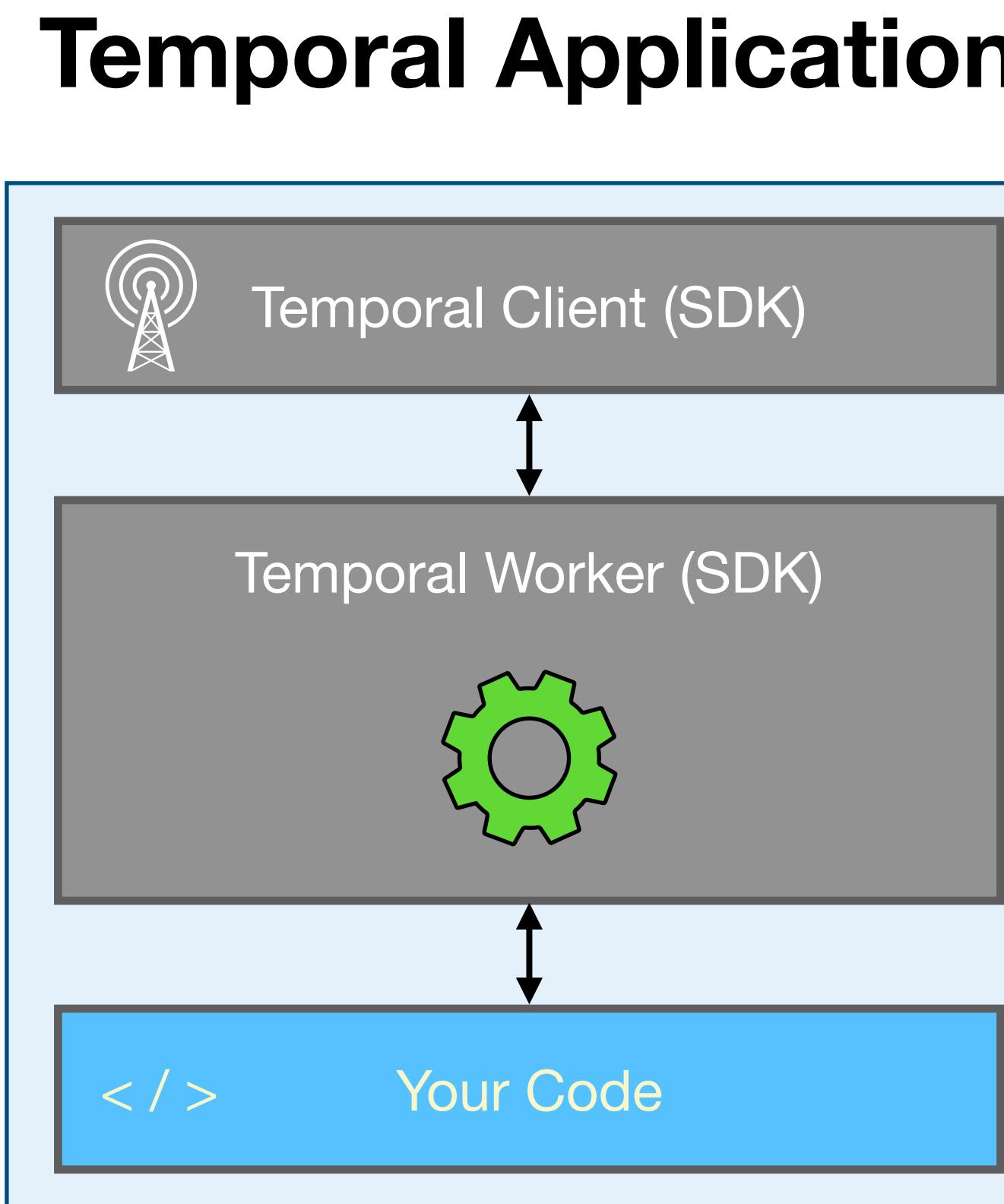
# The Role of Temporal Cloud



**Temporal Service**  
(provided by Temporal Cloud)

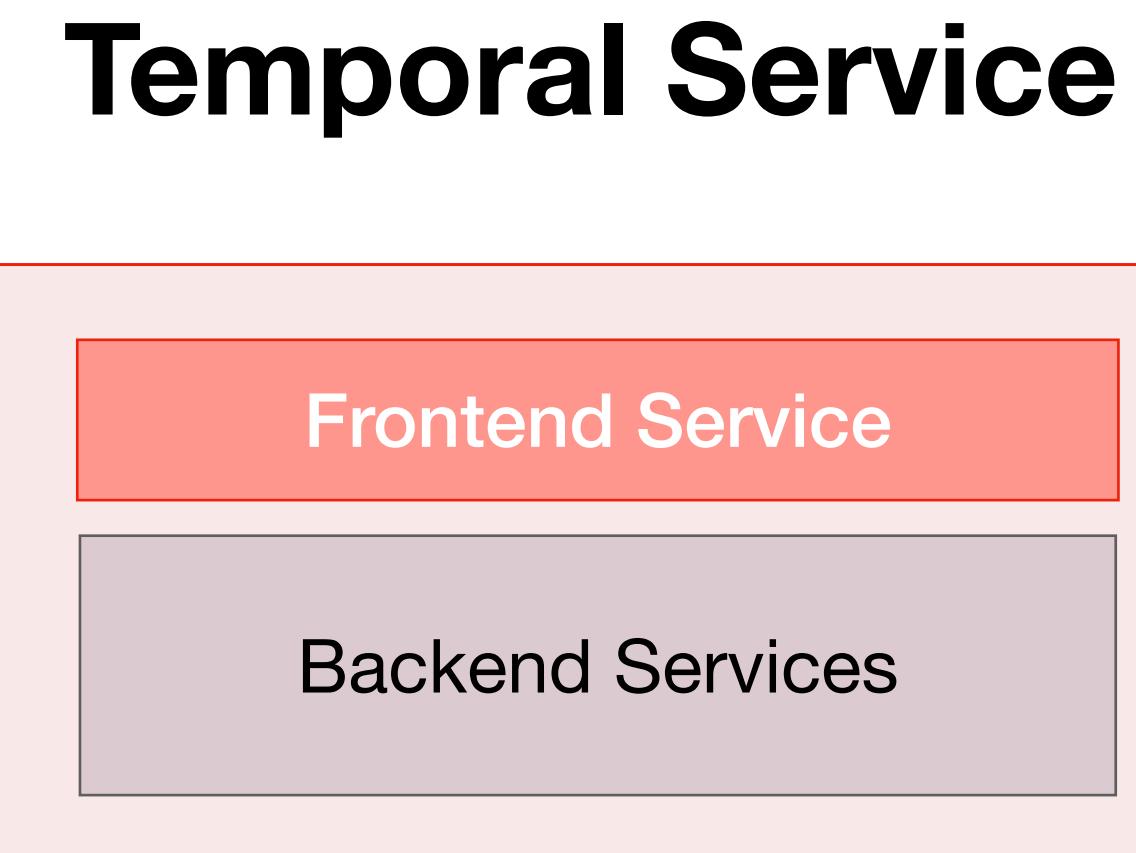


# Applications Are External to the Temporal Service

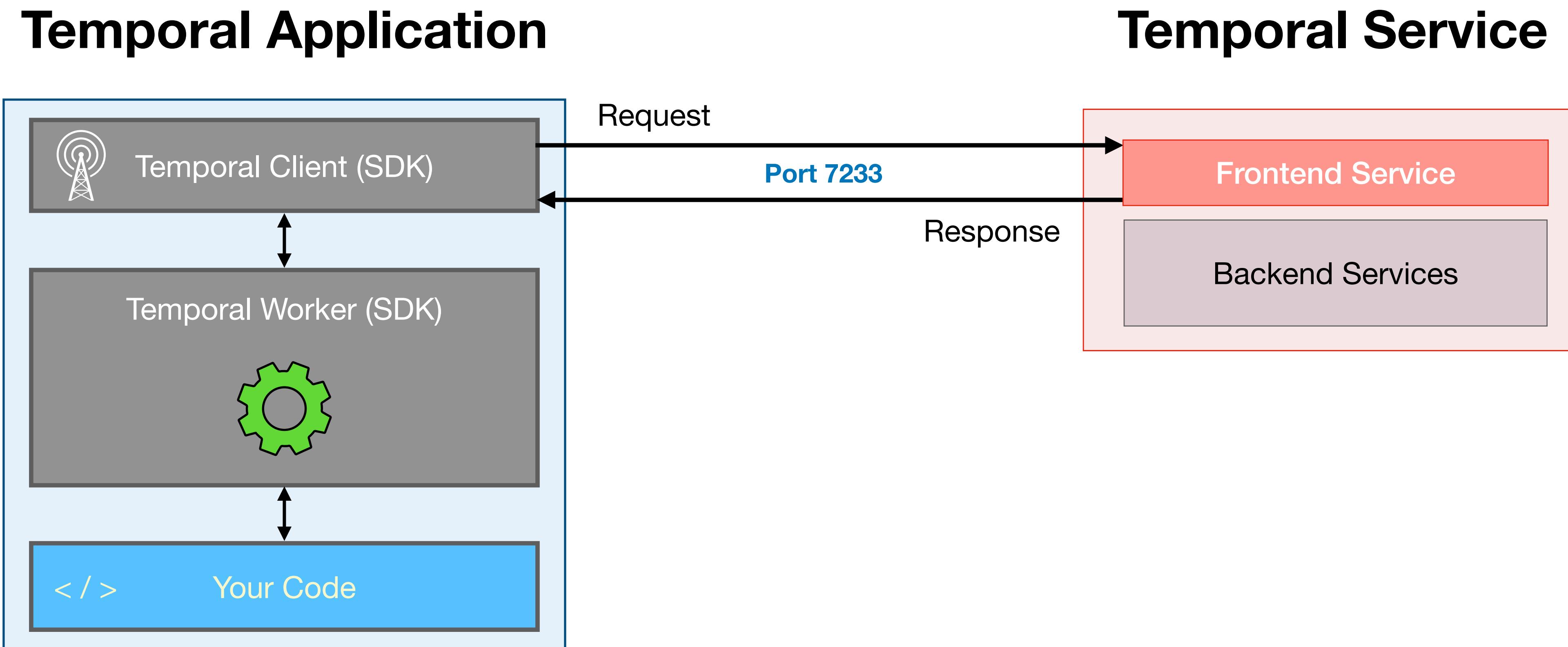


Execution

Orchestration



# Temporal Uses gRPC for Communication



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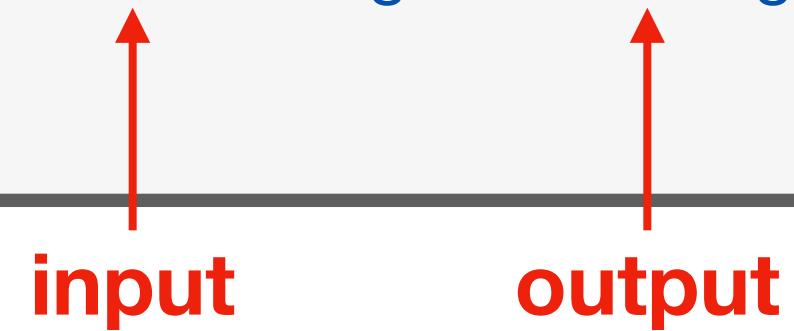
# Compatible Evolution of Input Parameters

- **Workflows and Activities can take any number of parameters as input**
  - Changing the number, position, or type of these parameters can affect backwards compatibility
- **It is a best practice to pass all input in a single struct**
  - Changes to the composition of this struct does not affect the function signature
- **This is also the recommended approach for return values**
  - Using structs in both places allows for evolution of input and output data

# Example: Using a struct in an Activity (1)

- **Imagine that you have the following Activity**

```
// This Activity returns a customized greeting in English, using the provided name
func CreateGreeting(ctx context.Context, name string) (string, error) {
    // implementation omitted for brevity
```



- **You later need to update it to support other languages, such as Spanish**
  - Changing what is passed into or returned from the function changes its signature
  - Changes to the struct composition don't affect the signature of the functions that use it

# Example: Using a struct in an Activity (2)

- The following code sample illustrates how you could support this

```
// Define a struct to encapsulate all data passed as input for this Activity
type GreetingInput struct {
    Name      string
    LanguageCode string
}

// Define a struct to encapsulate the data returned by this Activity
type GreetingOutput struct {
    Greeting   string
}

// Specify these types for the input parameter and return value of the Activity
func CreateGreeting(ctx context.Context, input GreetingInput) (GreetingOutput, error) {

    // An example to show how to access input parameters and create the return value
    if input.LanguageCode == "fr" {
        bonjour := fmt.Sprintf("Bonjour, %s", input.Name)
        return new GreetingOutput{ Greeting: bonjour, }, nil
    }
    // support for additional languages would follow...
}
```

The diagram shows two red annotations pointing to specific parts of the code. A vertical arrow labeled 'input' points from the 'input' parameter in the `CreateGreeting` function signature to the `GreetingInput` struct definition. A curved arrow labeled 'output' points from the `(GreetingOutput, error)` return type to the `GreetingOutput` struct definition.

# Task Queues

- **Temporal Service coordinates with Workers through named Task Queues**
  - The name of this Task Queue is specified in the Worker configuration

```
w := worker.New(client, "translation-tasks", worker.Options{})
```

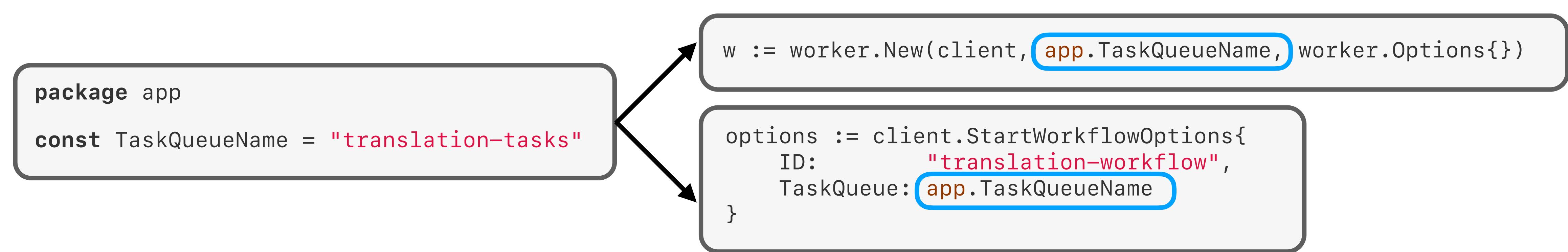
- The Task Queue name is also specified by a Client when starting a Workflow

```
options := client.StartWorkflowOptions{  
    ID:      "translation-workflow",  
    TaskQueue: "translation-tasks",  
}
```

- Task Queues are dynamically created, so a name mismatch does not result in an error!

# Recommendations for Task Queues

- Use a shared constant to avoid hardcoding the name in multiple places



- Avoid mixed case: Task Queue names are case sensitive
- Use descriptive names, but make them as short and simple as practical
- Plan to run *at least* two Worker Processes per Task Queue
  - Improves scalability: Load will be distributed among multiple Workers
  - Improves availability: If one Worker crashes, other Workers can take over for it

# Workflow IDs

- You specify a Workflow ID when starting a Workflow Execution
  - This should be a value that is meaningful to your business logic

```
// Example: An order processing Workflow might include order number in the Workflow ID
options := client.StartWorkflowOptions{
    ID:      "process-order-number-", + input.OrderNumber
    TaskQueue: app.TaskQueueName,
}

run, err := c.ExecuteWorkflow(context.Background(), options, ProcessOrderWorkflow, input)
```

- Must be unique among all *running* Workflow Executions in the namespace
  - This constraint applies across *all* Workflow Types, not just those of the *same Type*
  - This is an important consideration for choosing a Workflow ID

# How Errors Affect Workflow Execution

- **An Activity that returns an error is considered as failed**
  - It may or may not be retried, based on the Retry Policy associated with its execution
  - By default, Activity Execution is associated with a Retry Policy
    - The default policy results in retrying until execution succeeds or is canceled
- **A Workflow that returns an error is also considered as failed**
  - By default, Workflow Execution is *not* associated with a Retry Policy
  - Failing an Activity is common, but failing a Workflow is considered unusual
    - It is considered a better practice to fix the Workflow

# How to Return Errors in Application Code

- You can return errors as necessary in Workflows or Activities

```
resp, err := http.Get(url)
if err != nil {
    return "", errors.New("request failed")
}
```

```
resp, err := http.Get(url)
if err != nil {
    // rethrow the error from the failed HTTP request
    return "", err
}
```

- Developers are not *required* to use a Temporal-specific API for errors
  - Application errors are automatically converted into a language neutral format

# Logging in Temporal Applications

- **The recommended way of logging is via the interface in the Go SDK**
  - The SDK also provides a very basic logging implementation, which you can replace
- **This interface defines four log levels, in increasing order of importance**
  - Debug
  - Info
  - Warn
  - Error

# Using the Logger Interface

- **Accessing and using the Workflow logger**
  - Log statements can include any number of key-value pairs

```
logger := workflow.GetLogger(ctx)

logger.Debug("Preparing to execute an Activity")
logger.Info("Calculated cost of order", "Tax", tax, "Total", total)
```

- **Accessing and using the Activity logger is similar**

```
logger := activity.GetLogger(ctx)

logger.Info("Looking up customer in the database", "Key", customerID)
logger.Error("Database connection failed")
```

# The Default Logging Implementation

- **Limitations of the default logger**
  - Writes messages to the Client's standard output stream
  - Does not support setting a minimum level
  - Does not support customizing the output

# Integrating Another Logging Implementation

- You can integrate a different logging system into Temporal
  - Provide this when creating a Client, via the Logger attribute in client.Options

```
// Override the default implementation and use some other logger
customLogger := NewAlternateLogger()
c, err := client.Dial(client.Options{
    Logger: customLogger,
})
```

- It must conform to the Go SDK's log.Logger interface
  - It's common to use an adapter to integrate with third-party logging packages
  - See the zapadapter subdirectory in the samples-go repository

# Long-Running Executions

- **Temporal Workflows may have executions that span several years**
  - Activities may also run for long periods of time
- **Workflow and Activity Executions are asynchronous operations**
  - The following calls simply submit *execution requests* to the Temporal Service
  - They do not block while waiting for execution to complete

```
// Use a Temporal Client to request Workflow execution
future, err := client.ExecuteWorkflow(context.Background(), options, MyWorkflow, input)
```

```
// Request Activity Execution from within a Workflow
future := workflow.ExecuteActivity(ctx, MyActivity, input)
```

# Waiting on Execution Results

- **It is common to chain the Execution request and result retrieval**
  - Many Temporal APIs use a Future to provide access to results from asynchronous execution
  - Calling **Get** on this value blocks until the execution is complete

```
// This chained call blocks until Activity Execution returns a result or error
var result string
err := workflow.ExecuteActivity(ctx, MyActivity, input).Get(ctx, &result)
```

# Deferring Access to Execution Results

- **Deferring access to results *may* reduce overall execution time**
  - This is a good strategy when a Workflow needs to call unrelated Activities
  - It allows these Activities to execute in parallel, blocking only while accessing their results

```
// Request execution of multiple Activities: these calls do not block
futureA := workflow.ExecuteActivity(ctx, MyActivityA, inputA)
futureB := workflow.ExecuteActivity(ctx, MyActivityB, inputB)
futureC := workflow.ExecuteActivity(ctx, MyActivityC, inputC)

// The following lines block until their respective executions have finished
var resultA string
errA := futureA.Get(ctx, &resultA)

var resultB string
errB := futureB.Get(ctx, &resultB)

var resultC string
errC := futureC.Get(ctx, &resultC)
```

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# What is a Timer?

- **Timers are used to introduce delays into a Workflow Execution**
  - Code that awaits the Timer pauses execution for the specified duration
  - The duration is fixed and may range from seconds to years
  - Once the time has elapsed, the Timer fires, and execution continues
- **Workflow code must not use Go's built-in timers (non-deterministic)**

# Use Cases for Timers

- **Execute an Activity multiple times at predefined intervals**
  - Send reminder e-mails to a new customer after 1, 7, and 30 days
- **Execute an Activity multiple times at dynamically-calculated intervals**
  - Delay calling the next Activity based on a value returned by a previous one
- **Allow time for offline steps to complete**
  - Wait five business days for a check to clear before proceeding

# Timer APIs Provided by the Go SDK

- The Go SDK offers two Workflow-safe ways to start a Timer
  - These correspond to two functions in the Go time package
  - Workflow code must not use Go's functions for timers (non-deterministic)

# Pausing Workflow Execution for a Specified Duration

- **Use the `workflow.Sleep` function for this**
  - This is an alternative to Go's `time.Sleep` function
  - It blocks until the Timer is fired (or is canceled)

```
// This will pause Workflow Execution for 10 seconds
// The first parameter (ctx) is the context passed to the Workflow
err := workflow.Sleep(ctx, time.Second*10)
```

# Running Code a Specific Point in the Future

- **Use the `workflow.NewTimer` function for this**
  - This is an alternative to Go's `time.NewTimer` function
  - This returns a `Future`, which becomes ready when the Timer fires (or is canceled)

```
// workflow.Sleep is a Workflow-safe counterpart to time.Sleep
timerFuture := workflow.NewTimer(ctx, time.Second * 5)
logger.Info("The timer was set")

// Unlike workflow.Sleep, waiting for the timer here is a separate operation
logger.Info("Waiting until the timer has fired")
err := timerFuture.Get(ctx, nil)
```

# What Happens to a Timer if the Worker Crashes?

- **Timers are maintained by the Temporal Service**
  - Once set, they fire regardless of whether any Workers are running
- **Scenario: Timer set for 10 seconds and Worker crashes 3 seconds later**
  - If Worker is restarted within 7 seconds, it will be running when the Timer fires
    - It will be as if the Worker had never crashed at all
  - If Worker is restarted *5 minutes* later, the Timer will have already fired
    - In this case, the Worker will resume executing the Workflow code without delay

# Exercise #1: Observing Durable Execution

- **During this exercise, you will**
  - Create Workflow and Activity loggers
  - Add logging statements to the code
  - Add a Timer to the Workflow Definition
  - Launch two Workers, run the Workflow, and kill one of the Workers, observing that the remaining Worker completes the execution
- **Refer to this exercise's README.md file for details**
  - The code is below the `exercises/durable-execution` directory
  - Don't forget to make your changes in the `practice` subdirectory

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# Workflow Definition

```
package example

import (
    "time"

    "go.temporal.io/sdk/workflow"
)

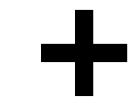
func MyWorkflow(ctx workflow.Context, input MyWorkflowInput) (MyWorkflowOutput, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    var activityResult MyActivityOutput
    err := workflow.ExecuteActivity(ctx, MyActivity).Get(ctx, &activityResult)
    if err != nil {
        return MyWorkflowOutput{}, err
    }

    return MyWorkflowOutput{ activityResult.Name }, nil
}
```

combined with

# Execution Request



```
client.ExecuteWorkflow(context.Background(), options, example.MyWorkflow, input)
```

results in

# Workflow Execution



Running Workflow

# 1 Workflow Definition

combined with

n Execution Requests

results in

# n Workflow Executions

```
package example

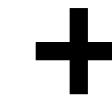
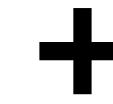
import (
    "time"

    "go.temporal.io/sdk/workflow"
)

func MyWorkflow(ctx workflow.Context, input MyWorkflowInput) (MyWorkflowOutput, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    var activityResult MyActivityOutput
    err := workflow.ExecuteActivity(ctx, MyActivity).Get(ctx, &activityResult)
    if err != nil {
        return MyWorkflowOutput{}, err
    }

    return MyWorkflowOutput{ activityResult.Name }, nil
}
```



client.ExecuteWorkflow(..., {"ID": 812} )

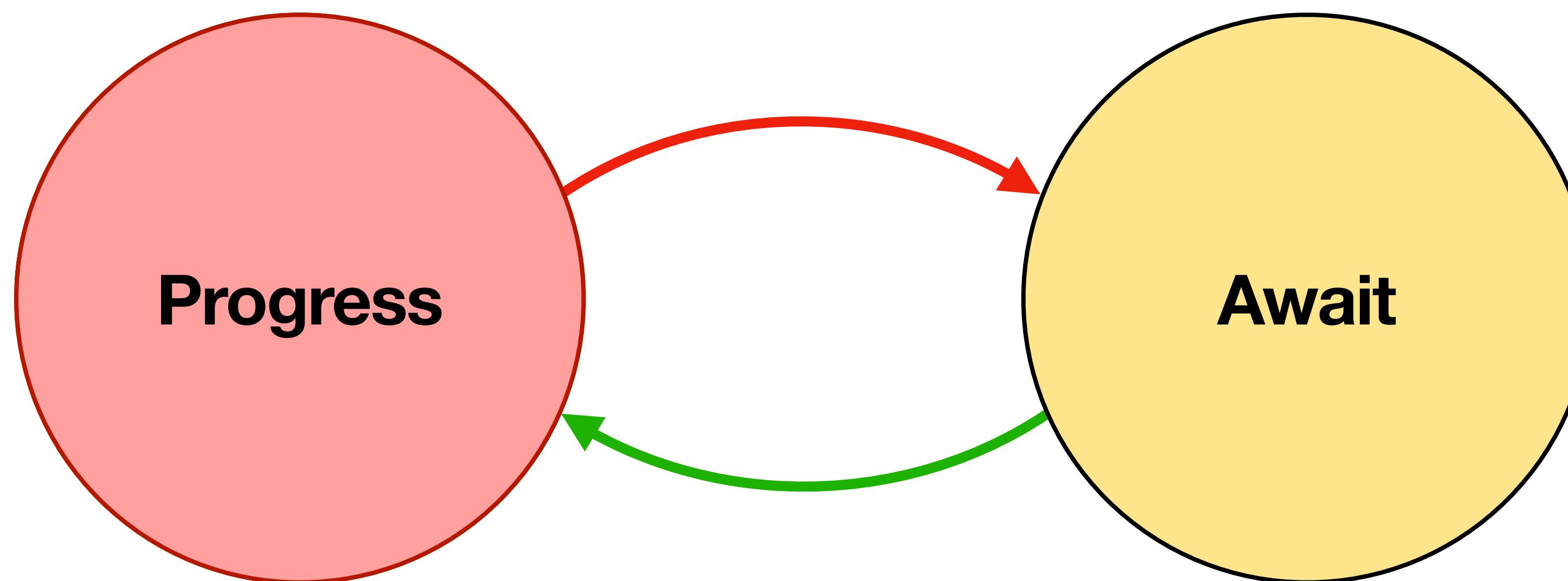
client.ExecuteWorkflow(..., {"ID": 947} )



Workflow Execution 1

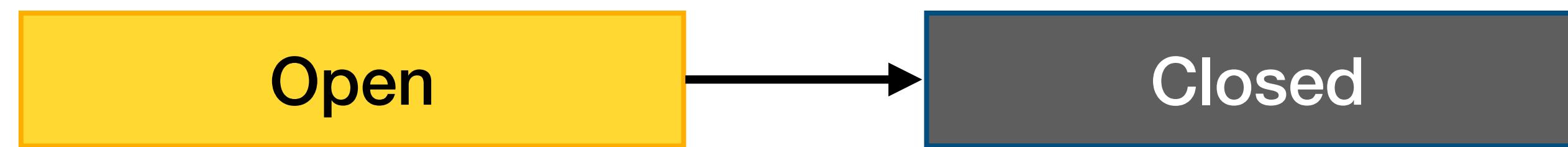
Workflow Execution 2

# What Happens During Workflow Execution



**This cycle continues throughout Workflow Execution**

# Workflow Execution States



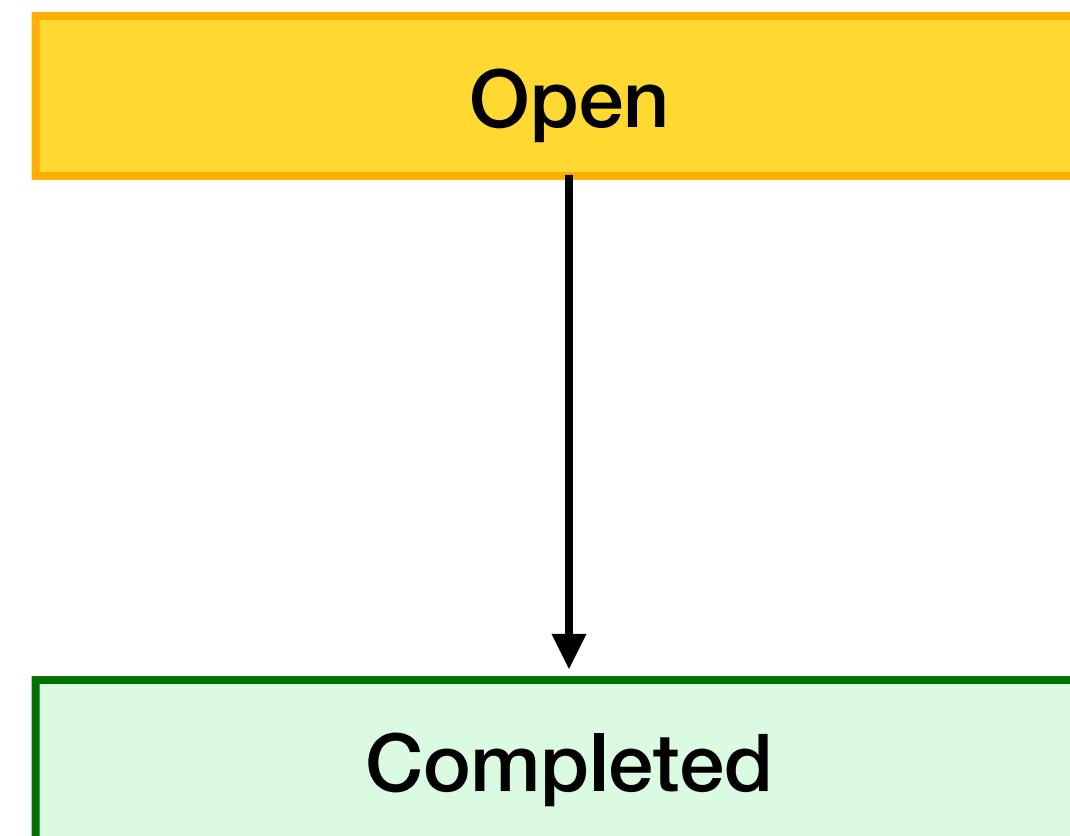
**This is a one-way transition**

# **Workflow Execution States**

---

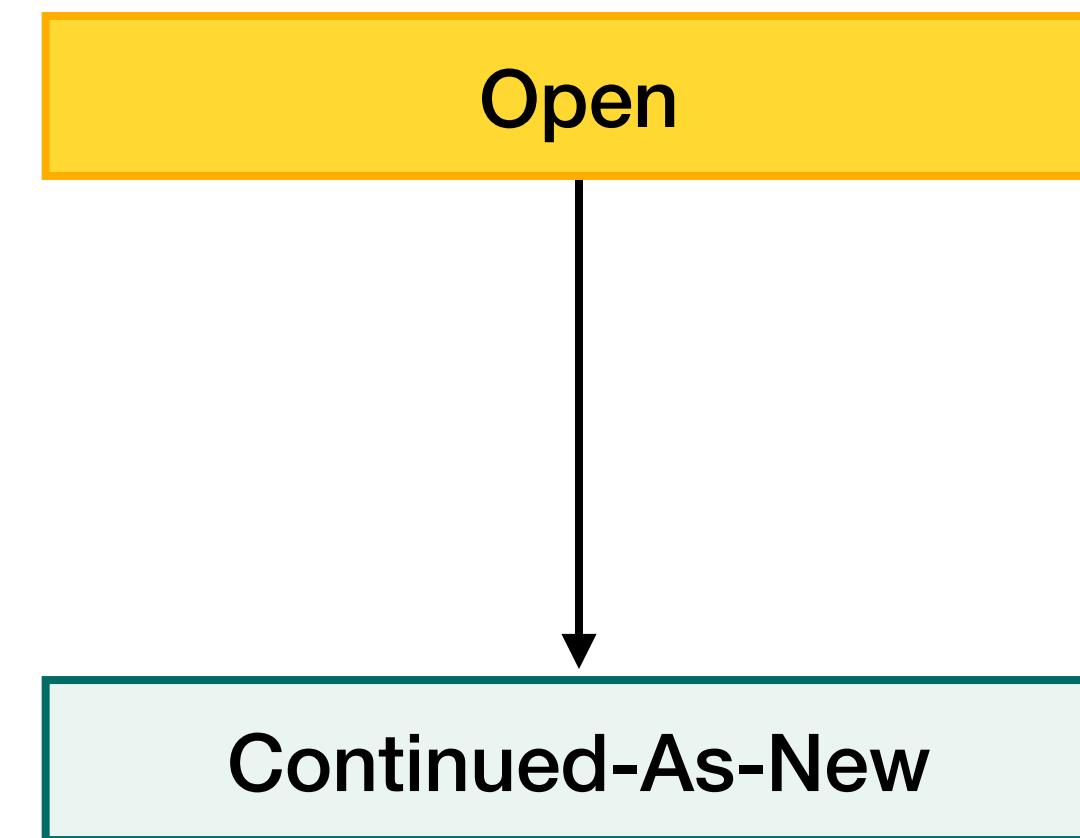
# Completed

**Meaning: The Workflow function returned a result**



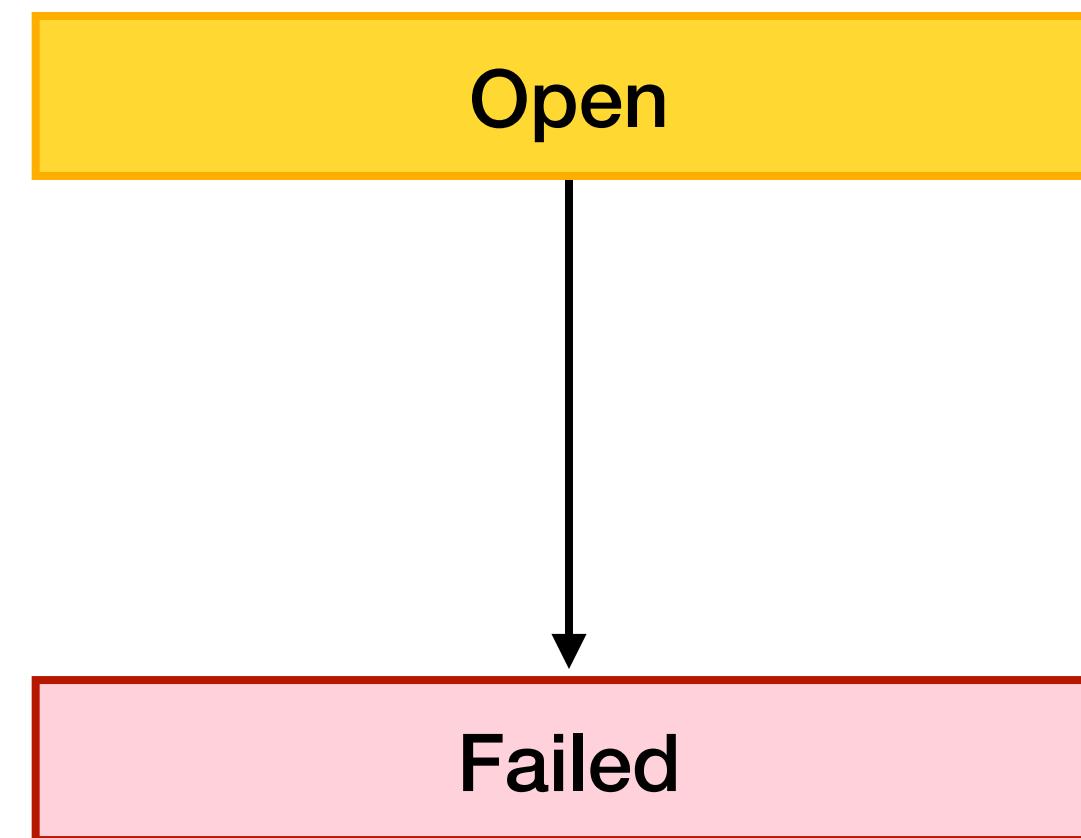
# Continued-As-New

**Meaning: Future progress will take place in a new Workflow Execution**



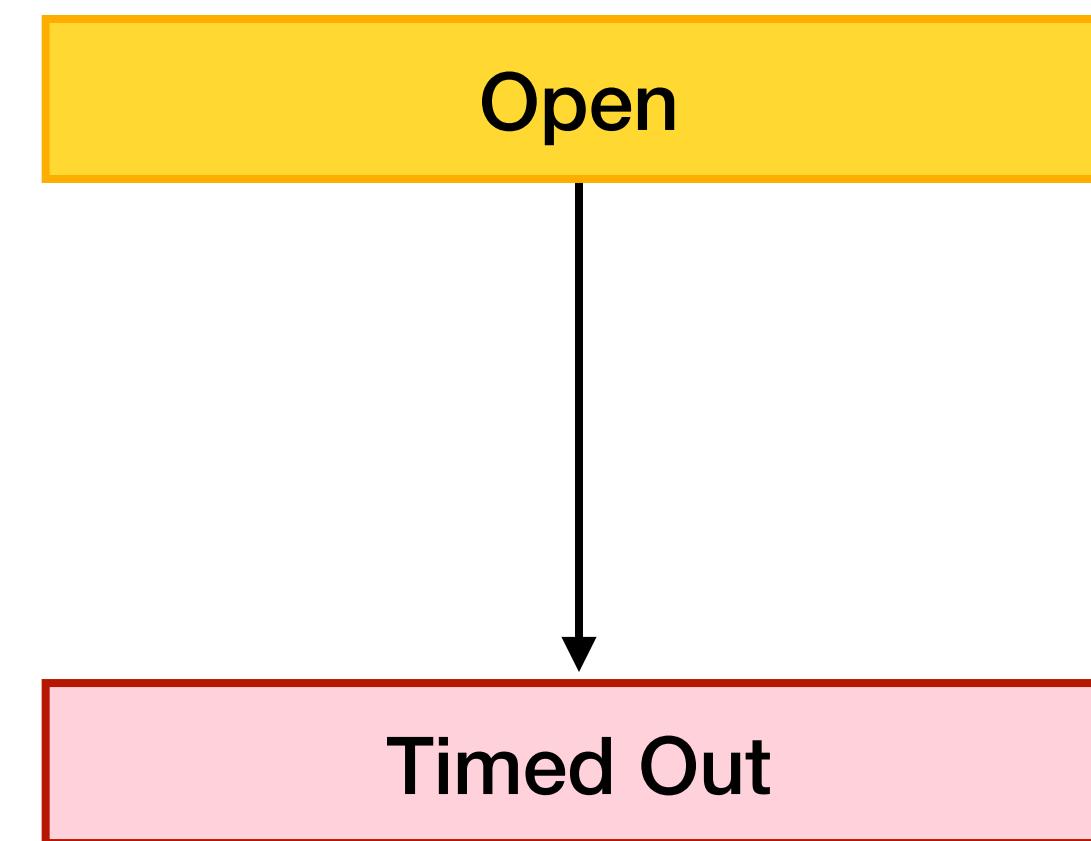
# Failed

**Meaning: The Workflow function returned an error**



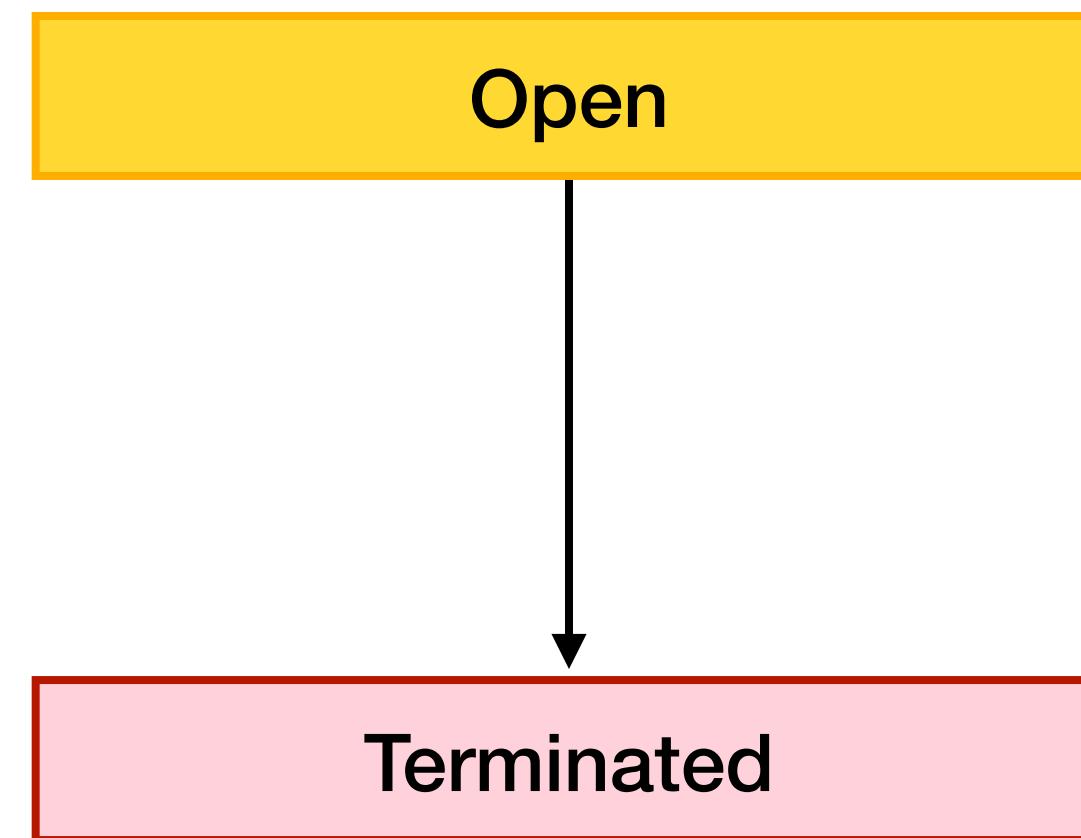
# Timed Out

**Meaning: Execution exceeded a specified time limit**



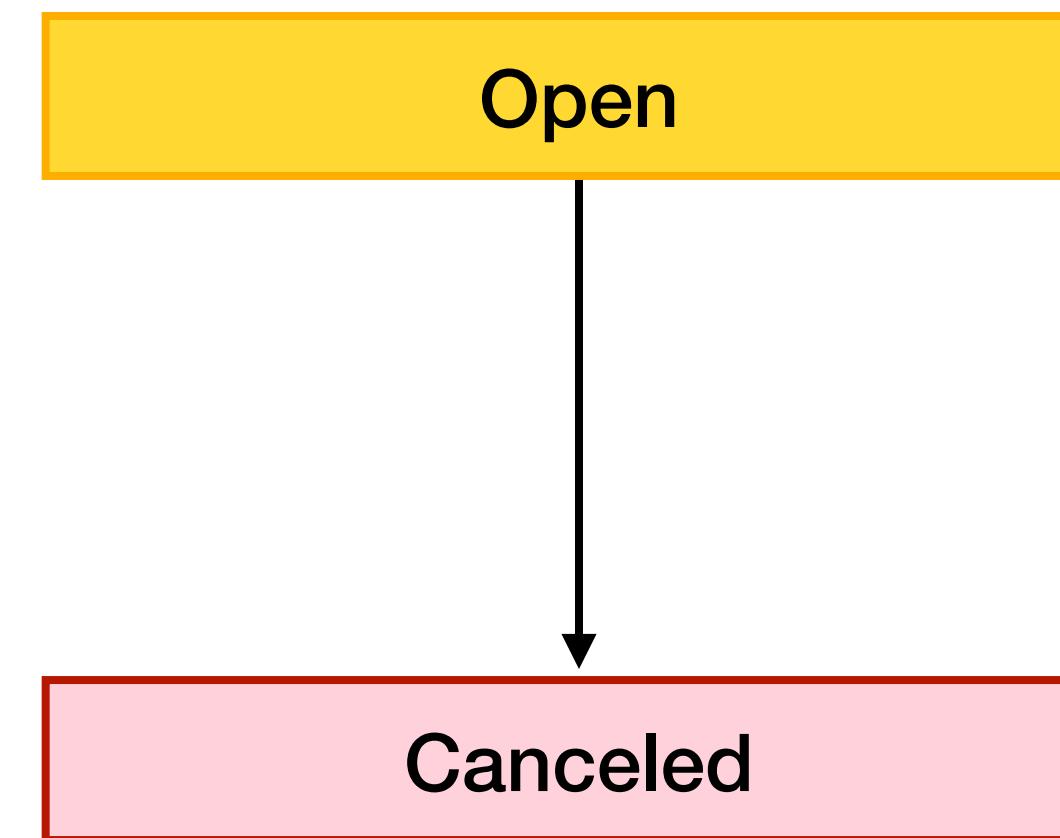
# Terminated

**Meaning:** Temporal Service acted upon a termination request

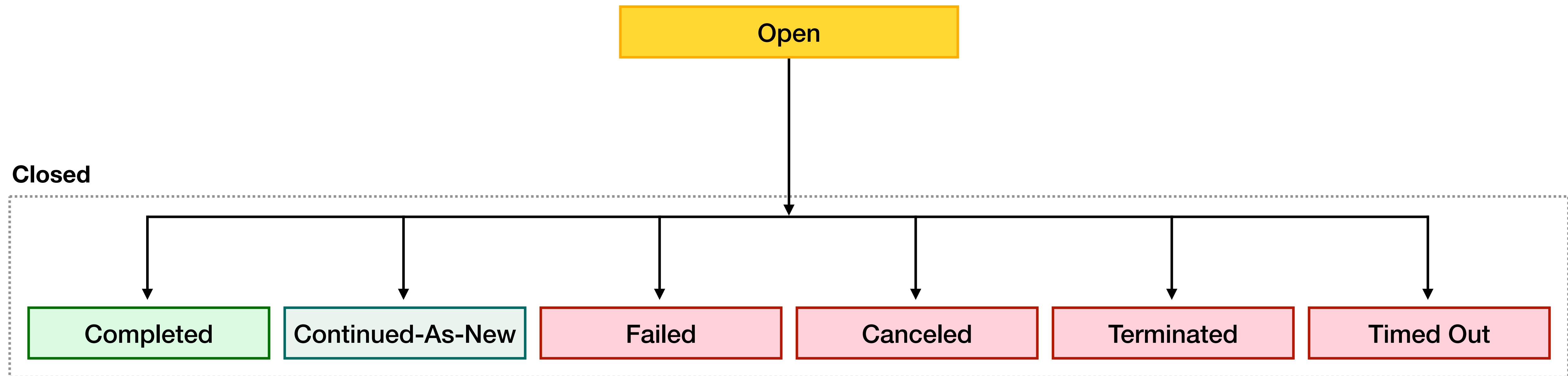


# Canceled

**Meaning:** Temporal Service acted upon a request to cancel execution



# Summary of Workflow Execution States



# How Workflow Code Maps to Commands

---

## pseudocode

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount:     totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```

## Basic Temporal Workflow Definition

- Defines a Start-to-Close Timeout
- Calculates total price of the pizzas
- Determines distance to customer
- Fails if customer is too far away for delivery
- Sleeps for 30 minutes
- Populates a struct with billing information
- Sends a bill to the customer

# Basic Temporal Workflow Definition

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount:     totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```

- A Workflow is a sequence of steps
- Some steps are *internal to the Workflow*
  - Involve no interaction with Temporal Service
- Examples include
  - Setting configuration parameters
  - Performing calculations
  - Evaluating variables or expressions
  - Populating data structures
- These internal steps are highlighted in white

# Basic Temporal Workflow Definition

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount: totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```

- Some steps do interact with the Temporal Service
- Examples include
  - Executing an Activity
  - Setting a Timer
  - Returning an error from the Workflow
  - Returning a value from the Workflow
- These external steps are highlighted in yellow

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {

    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}
```

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {

    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}
```

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount:     totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```

## Command

ScheduleActivityTask  
("pizza-tasks", GetDistance, { Line1: "123 Oak St.", Line2: "", ... })

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {

    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}
```

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount: totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```

## Command

StartTimer  
(30 minutes)

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {

    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}
```

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount: totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```

## Command

ScheduleActivityTask  
("pizza-tasks", SendBill, { Amount: 2750, Description: "Pizzas", ... })

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount: totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```

## Command

```
CompleteWorkflowExecution  
( {ConfirmationNumber: "TPD-26074139"} )
```

# Workflow Execution Event History

- **Each Workflow Execution is associated with an Event History**
- **Represents the source of truth for what transpired during execution**
  - As viewed from the perspective of the Temporal Service
  - Durably persisted by the Temporal Service
- **Event Histories serve two key purposes in Temporal**
  - Allow reconstruction of Workflow state following a crash
  - Enable developers to investigate both current and past executions
- **You can access them from code, command line, and Web UI**

# Event History Content

- **An Event History acts as an ordered append-only log of Events**
  - Begins with the WorkflowExecutionStarted Event
  - New Events are appended as Workflow Execution progresses
  - Ends when the Workflow Execution closes

# Event History Limits

- **Temporal places limits on a Workflow Execution's Event History**
- **Warnings begin after 10K (10,240) Events**
  - These say "history size exceeds warn limit" and will appear in Temporal Cluster's logs
  - They identify the Workflow ID, Run ID, and namespace for the Workflow Execution
- **Workflow Execution will be *terminated* after exceeding additional limits**
  - If its Event History exceeds 50K (51,200) Events
  - If its Event History exceeds 50 MB of storage

# Event Structure and Characteristics

- **Every Event always contains the following three attributes**
  - ID (uniquely identifies this Event within the History)
  - Time (timestamp representing when the Event occurred)
  - Type (the kind of Event it is)

# Attributes Vary by Event Type

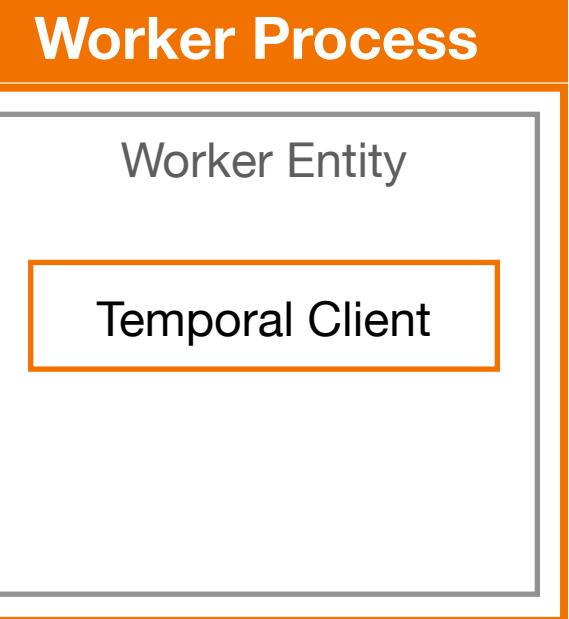
- Additionally, each Event contains attributes specific to its type
  - **WorkflowExecutionStarted** contains the Workflow Type and input parameters
  - **WorkflowExecutionCompleted** contains the result returned by the Workflow function
  - **WorkflowExecutionFailed** contains the error returned by the Workflow function
  - **ActivityTaskScheduled** contains the Activity Type and input parameters
  - **ActivityTaskCompleted** contains the result returned by the Activity function

# How Commands Map to Events

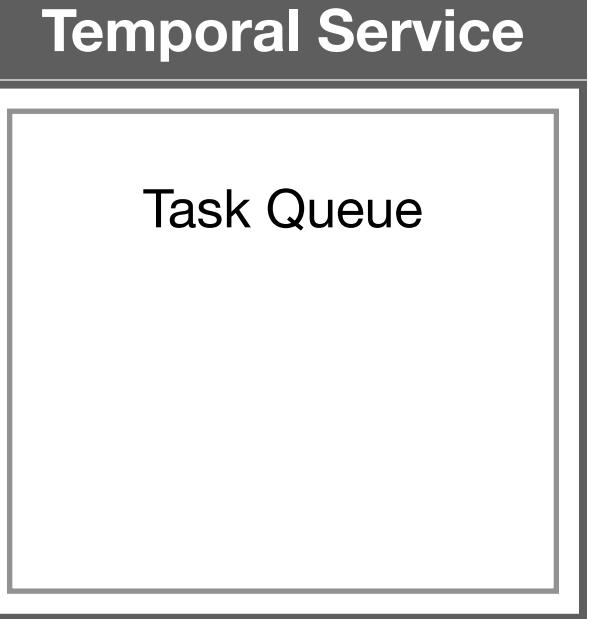
---

## pseudocode

```
func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {  
  
    options := workflow.ActivityOptions{  
        StartToCloseTimeout: time.Second * 5,  
    }  
    ctx = workflow.WithActivityOptions(ctx, options)  
  
    // Iterate over the items and calculate the cost of the order  
    var totalPrice int  
    for pizza : order.Items {  
        totalPrice += pizza.Price  
    }  
  
    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)  
  
    if order.IsDelivery && distance > 25 {  
        return "", errors.New("customer too far away for delivery")  
    }  
  
    // Wait 30 minutes before billing the customer  
    workflow.Sleep(ctx, time.Minute * 30)  
  
    bill := Bill{  
        CustomerId: order.Customer.CustomerId,  
        Amount:     totalPrice,  
        Description: order.OrderNumber,  
    }  
  
    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)  
  
    return confirmation, nil  
}
```



## Commands



## Events

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

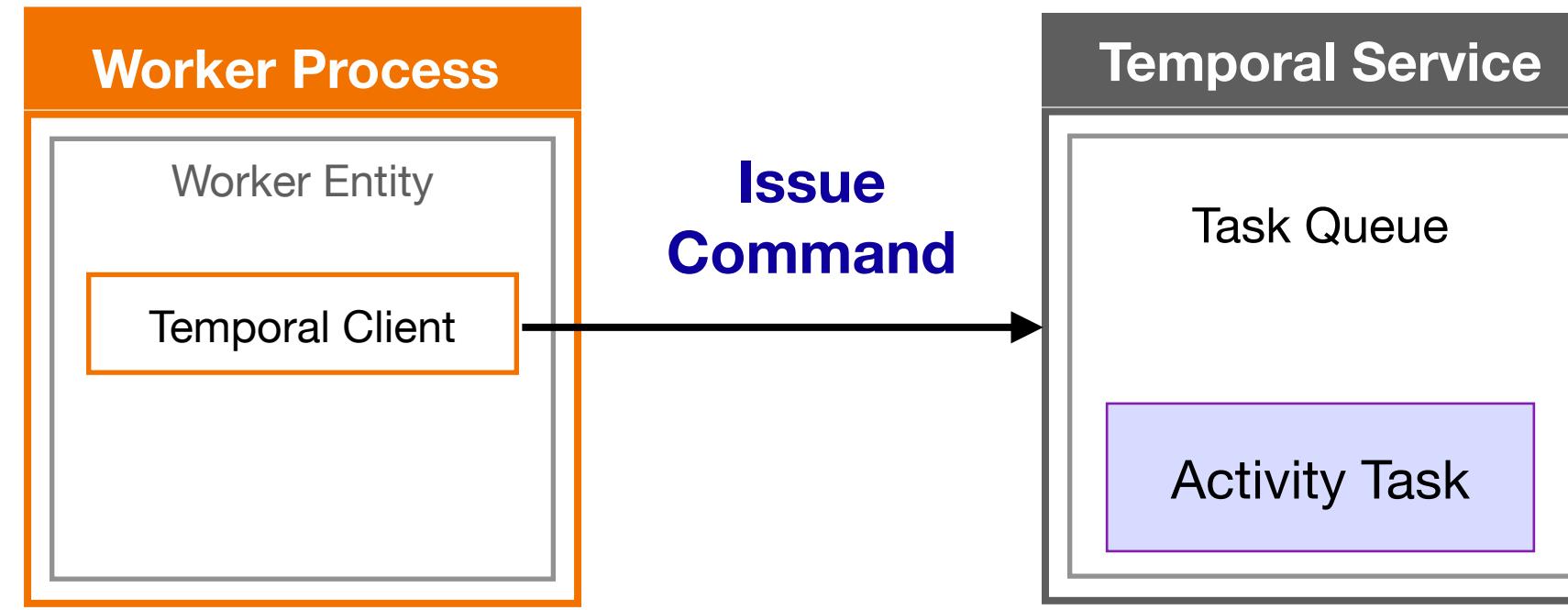
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

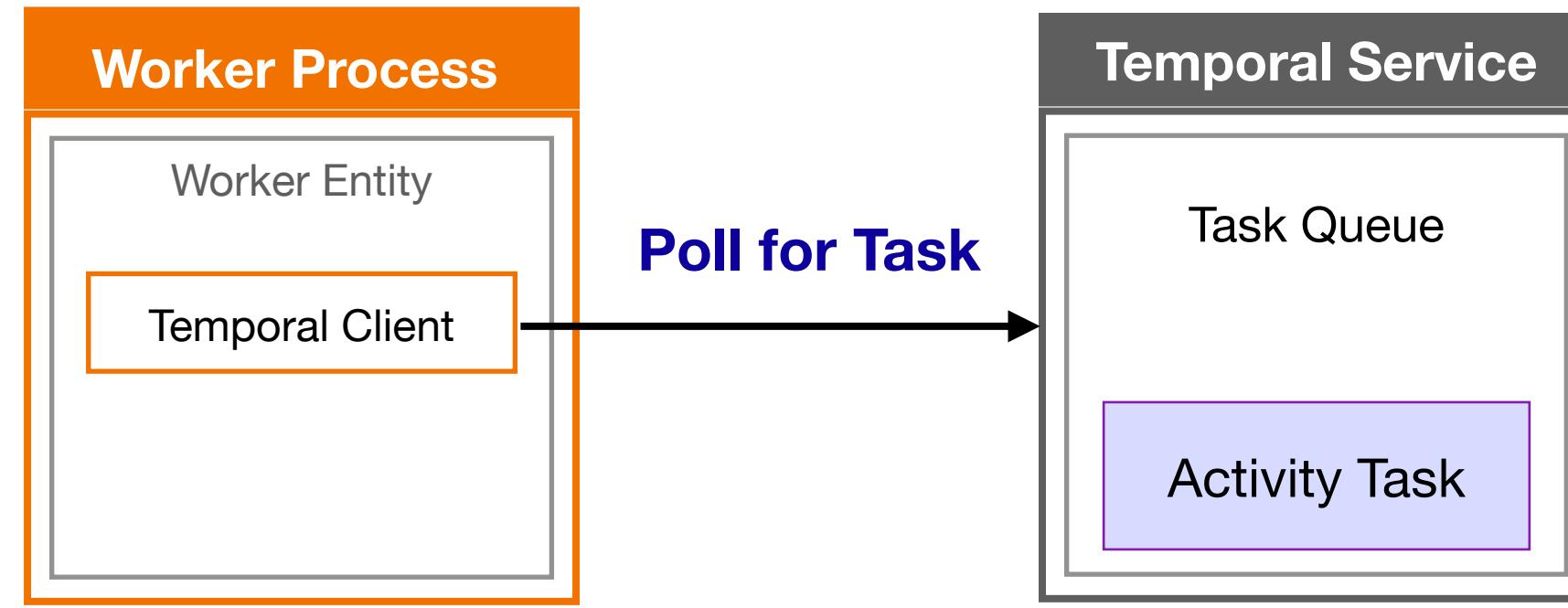
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

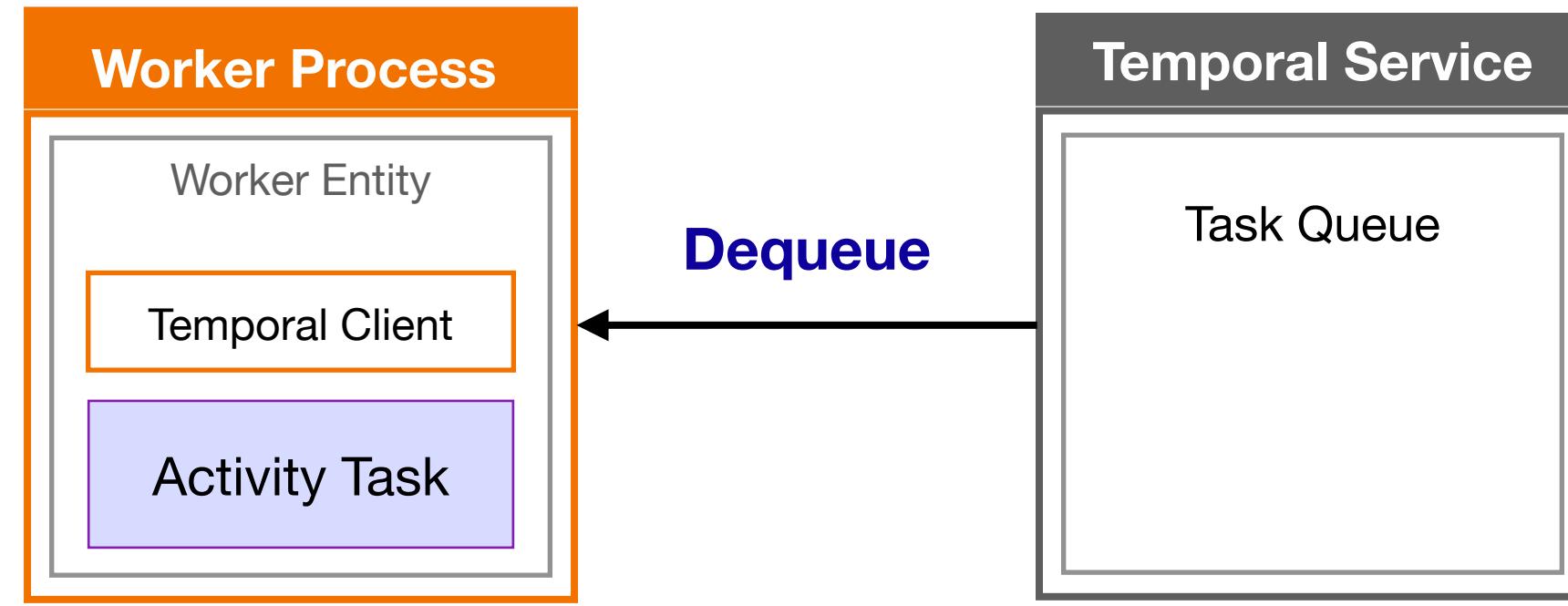
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

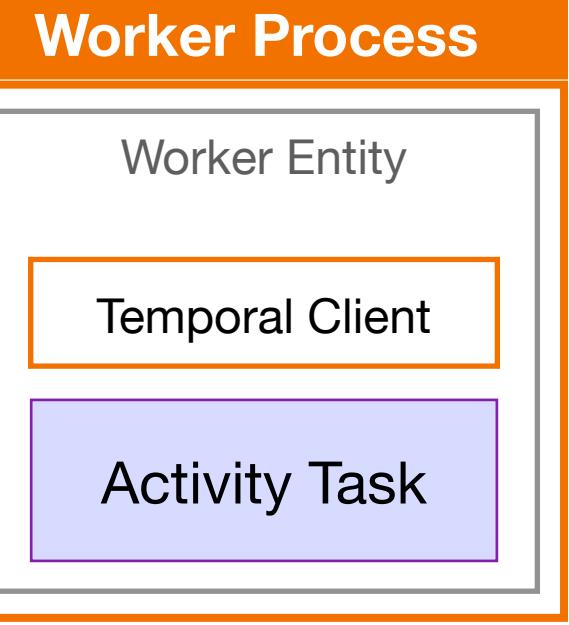
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

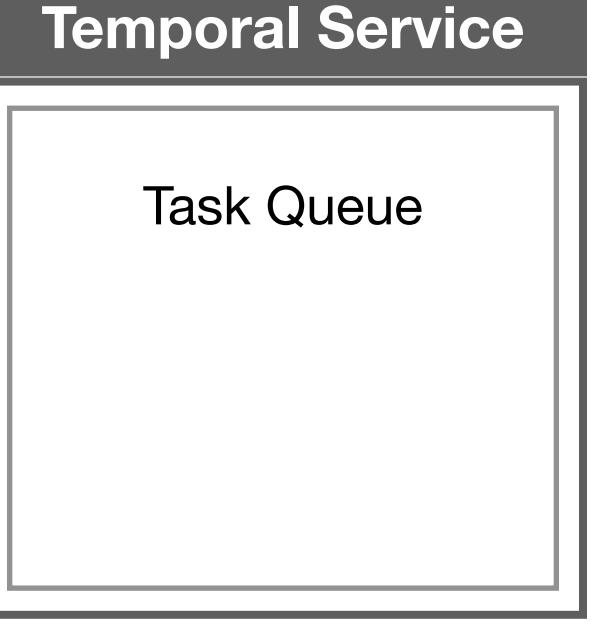
    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)



## Events

ActivityTaskScheduled  
ActivityTaskStarted

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

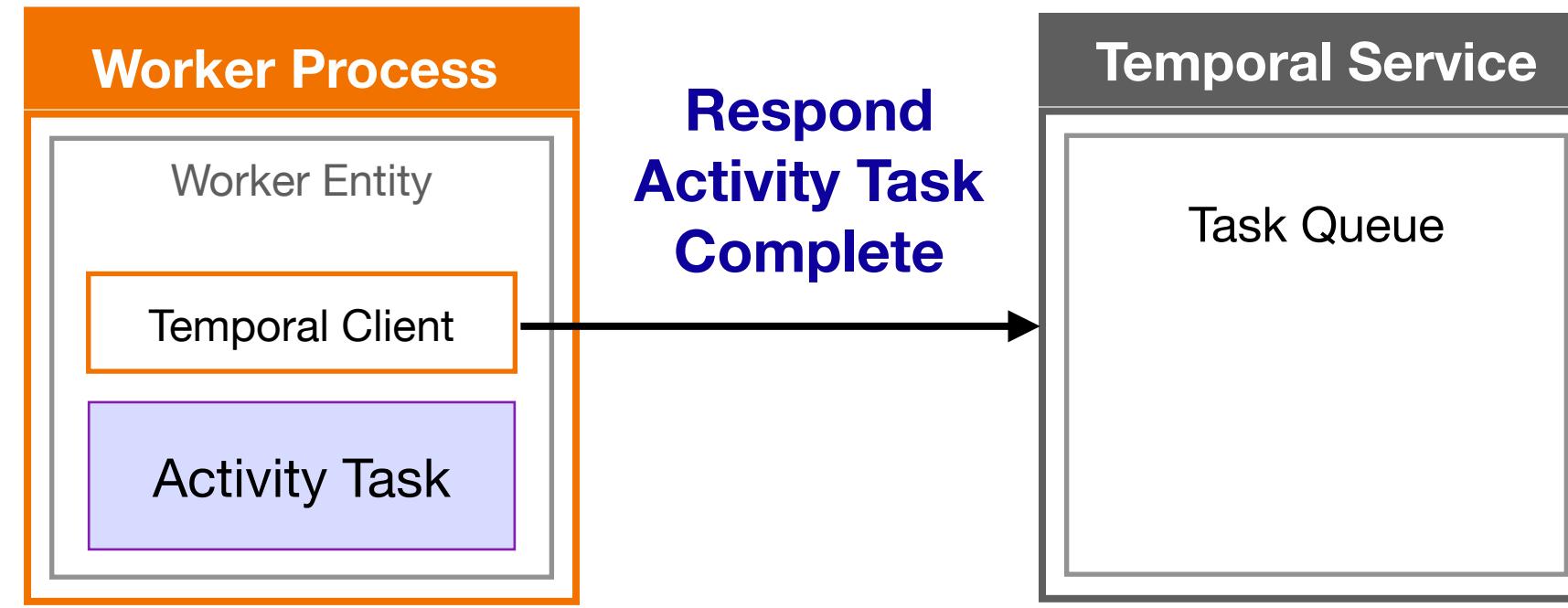
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled  
ActivityTaskStarted  
ActivityTaskCompleted

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

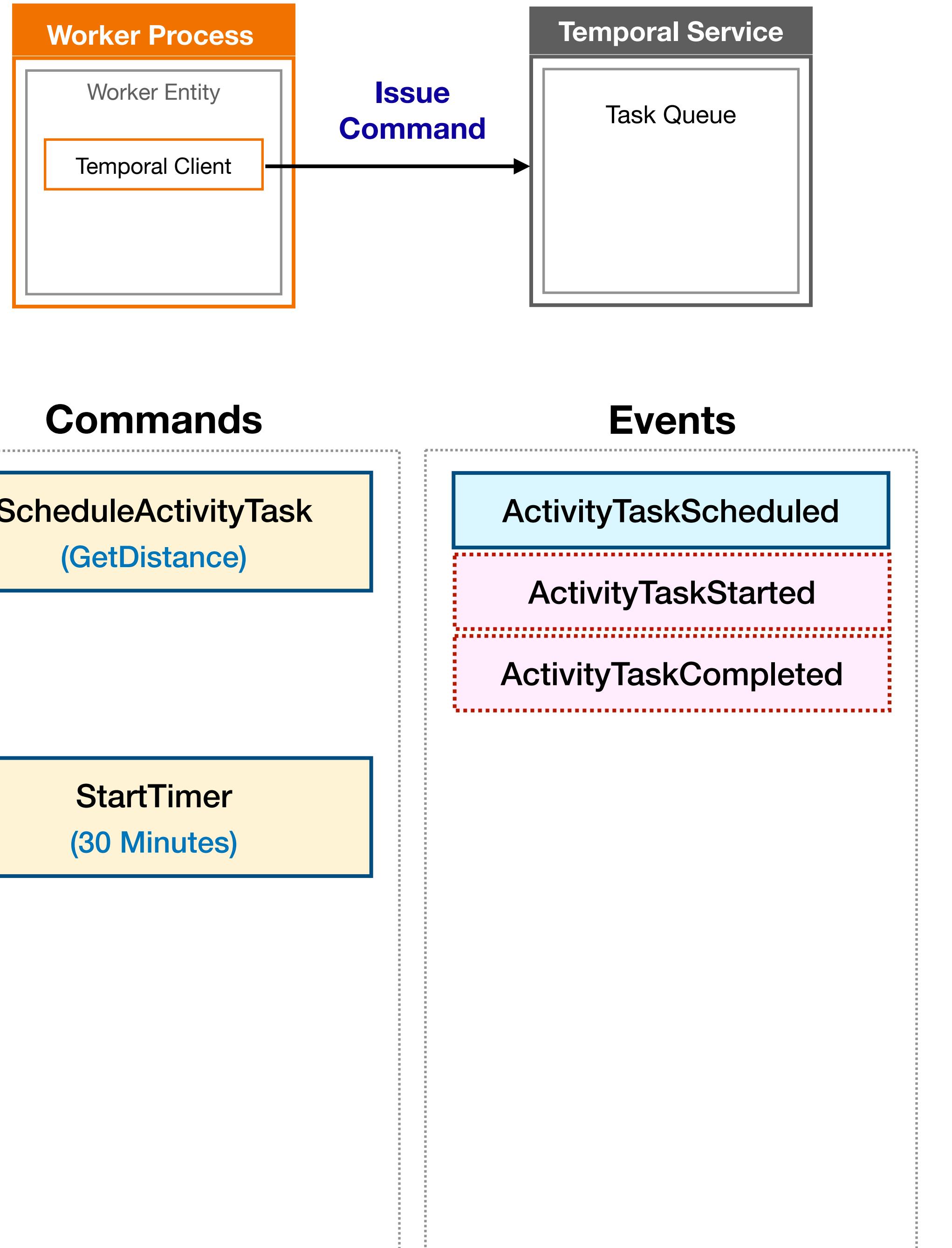
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

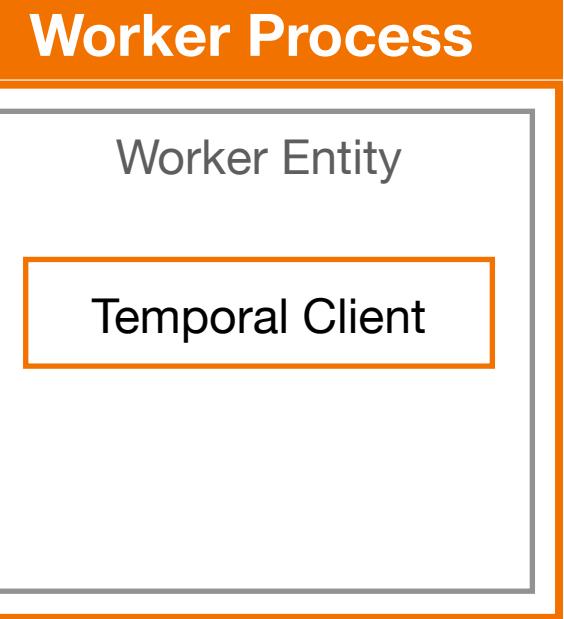
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

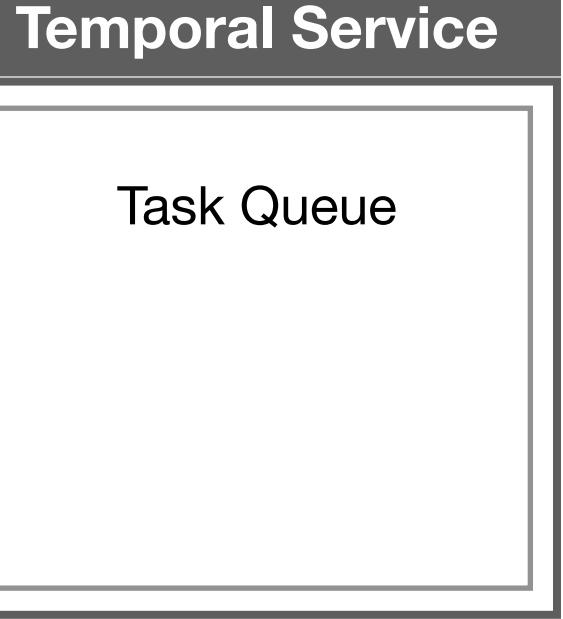
```



## Worker Process

Worker Entity

Temporal Client



## Temporal Service

Task Queue

## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

StartTimer  
(30 Minutes)

TimerStarted

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

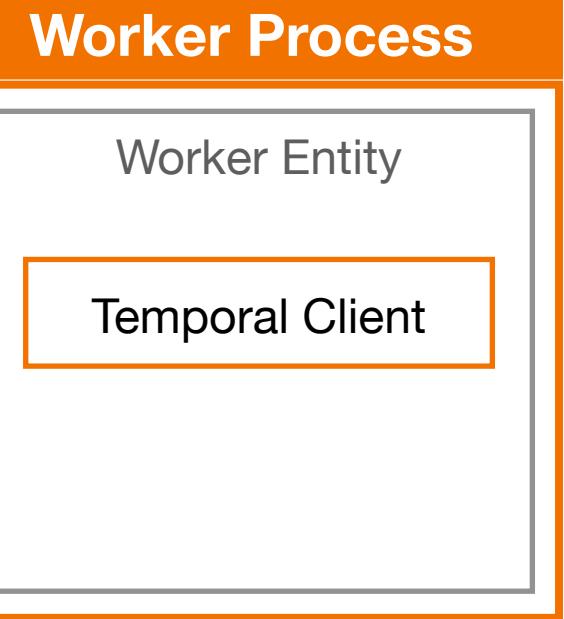
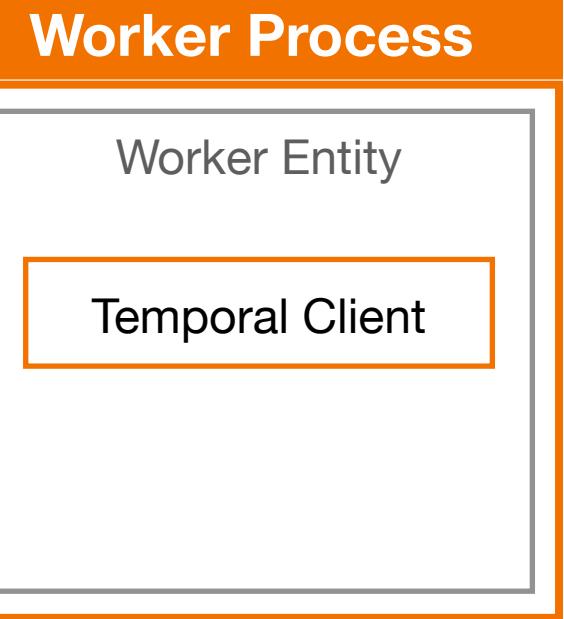
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

StartTimer  
(30 Minutes)

TimerStarted

TimerFired

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

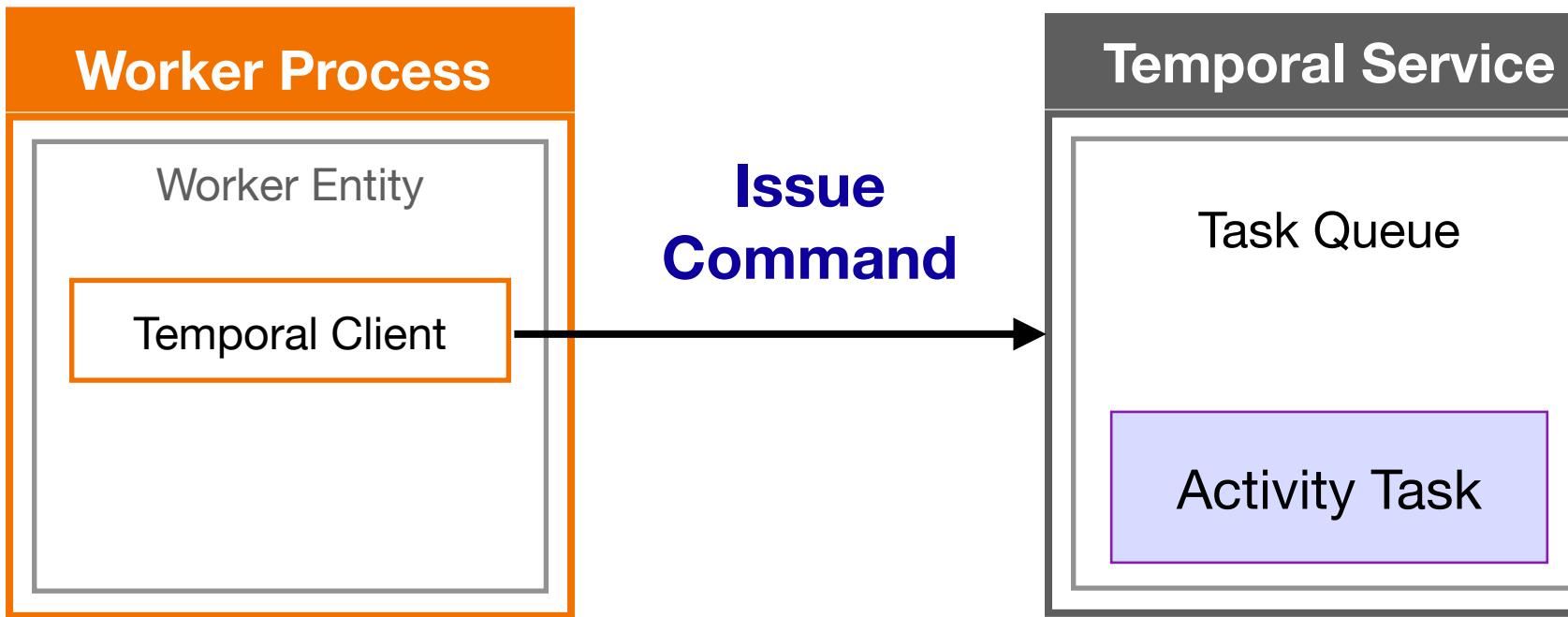
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

StartTimer  
(30 Minutes)

TimerStarted

TimerFired

ScheduleActivityTask  
(SendBill)

ActivityTaskScheduled

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

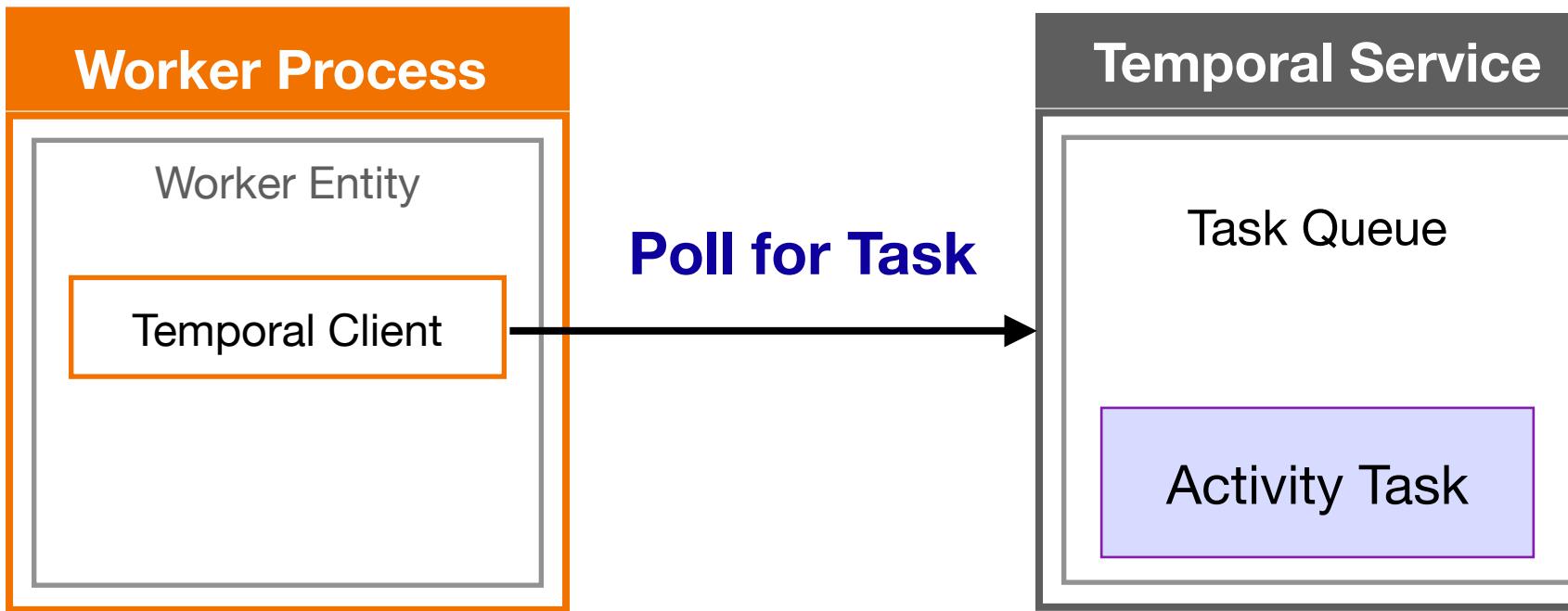
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

StartTimer  
(30 Minutes)

TimerStarted

TimerFired

ScheduleActivityTask  
(SendBill)

ActivityTaskScheduled

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

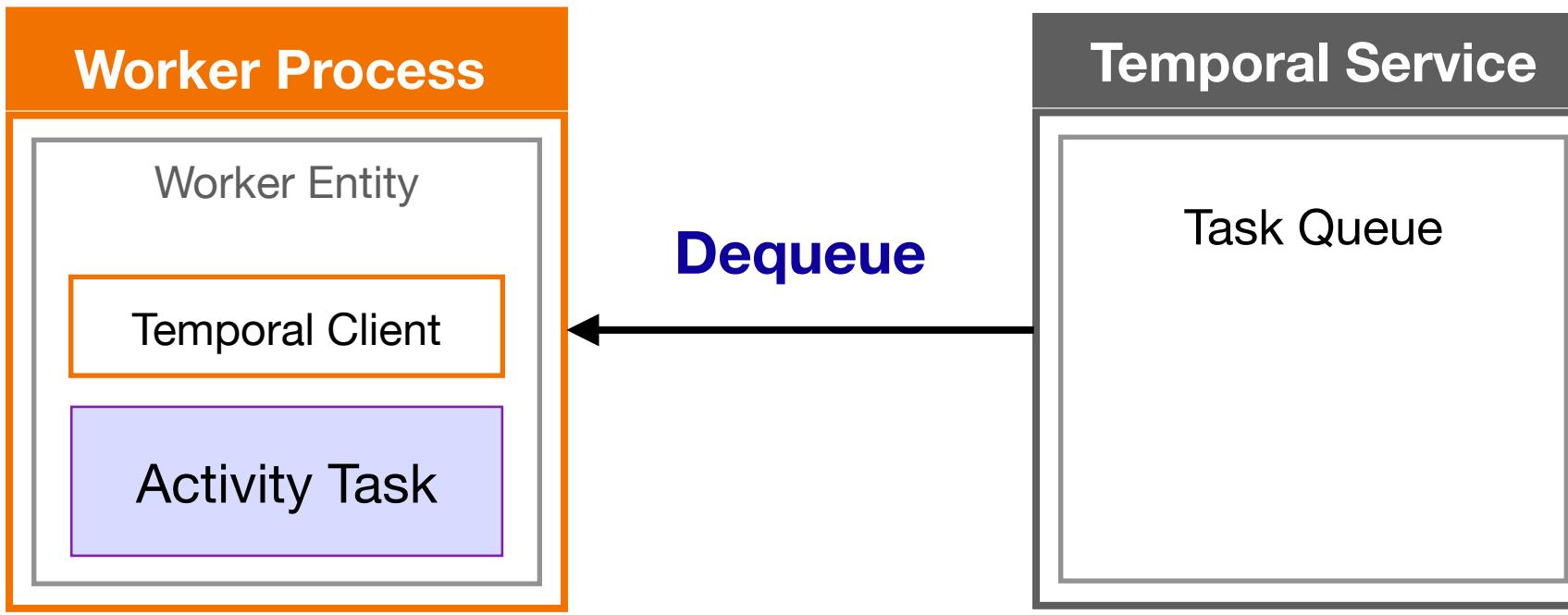
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

StartTimer  
(30 Minutes)

TimerStarted

TimerFired

ScheduleActivityTask  
(SendBill)

ActivityTaskScheduled

ActivityTaskStarted

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

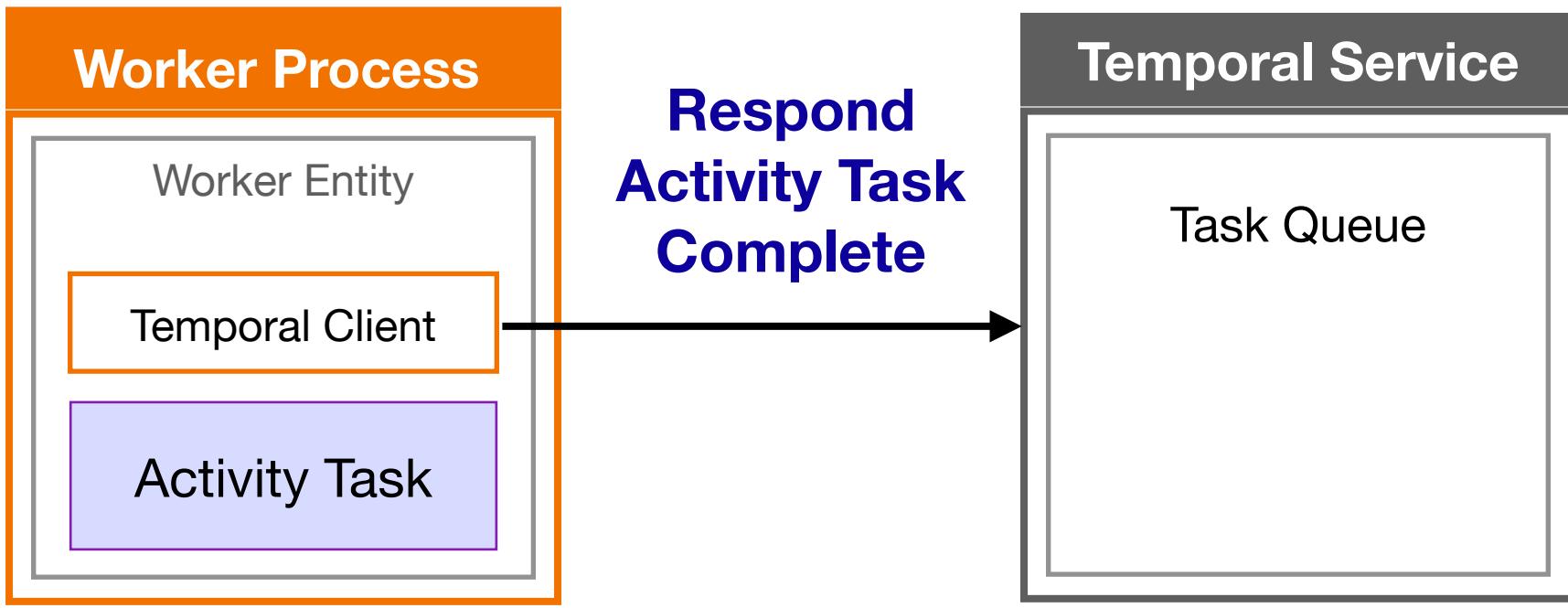
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```



## Commands

ScheduleActivityTask  
(GetDistance)

## Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

StartTimer  
(30 Minutes)

TimerStarted

TimerFired

ScheduleActivityTask  
(SendBill)

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

```

func PizzaWorkflow(ctx workflow.Context, order Order) (string, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    // Iterate over the items and calculate the cost of the order
    var totalPrice int
    for pizza : order.Items {
        totalPrice += pizza.Price
    }

    distance := workflow.ExecuteActivity(ctx, GetDistance, order.Address)

    if order.IsDelivery && distance > 25 {
        return "", errors.New("customer too far away for delivery")
    }

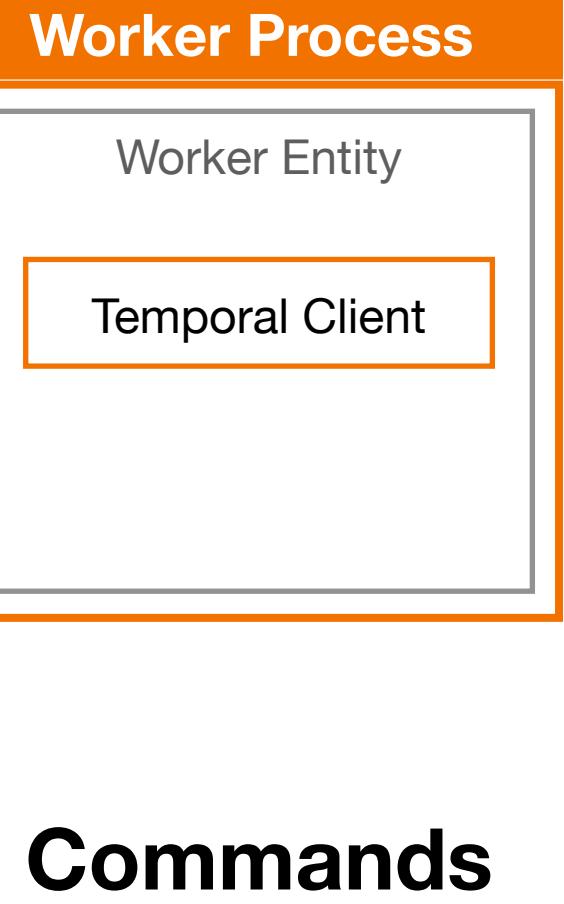
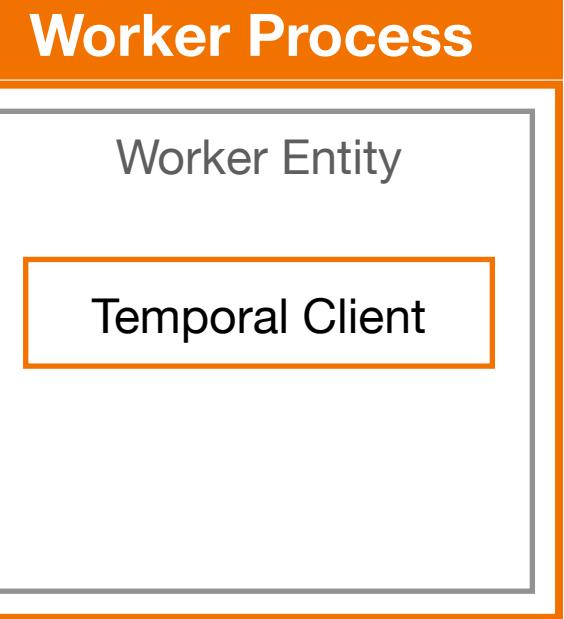
    // Wait 30 minutes before billing the customer
    workflow.Sleep(ctx, time.Minute * 30)

    bill := Bill{
        CustomerId: order.Customer.CustomerId,
        Amount:     totalPrice,
        Description: order.OrderNumber,
    }

    confirmation := workflow.ExecuteActivity(ctx, SendBill, bill)

    return confirmation, nil
}

```

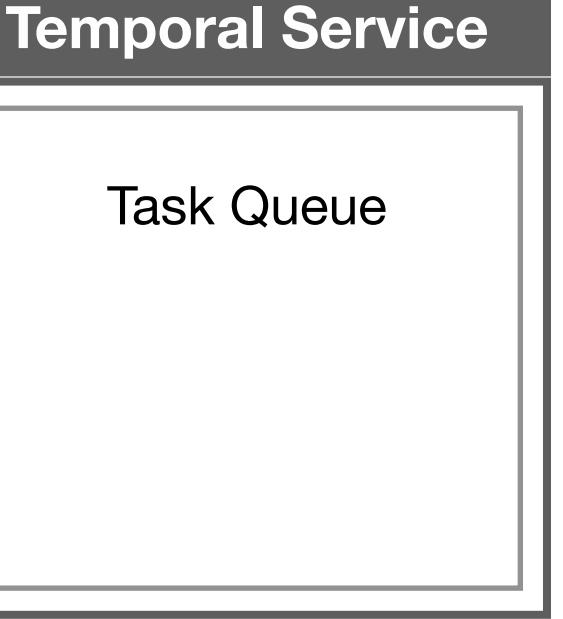


## Commands

ScheduleActivityTask  
(GetDistance)

StartTimer  
(30 Minutes)

ScheduleActivityTask  
(SendBill)



## Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted

TimerFired

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

# **Workflow and Activity Task States**

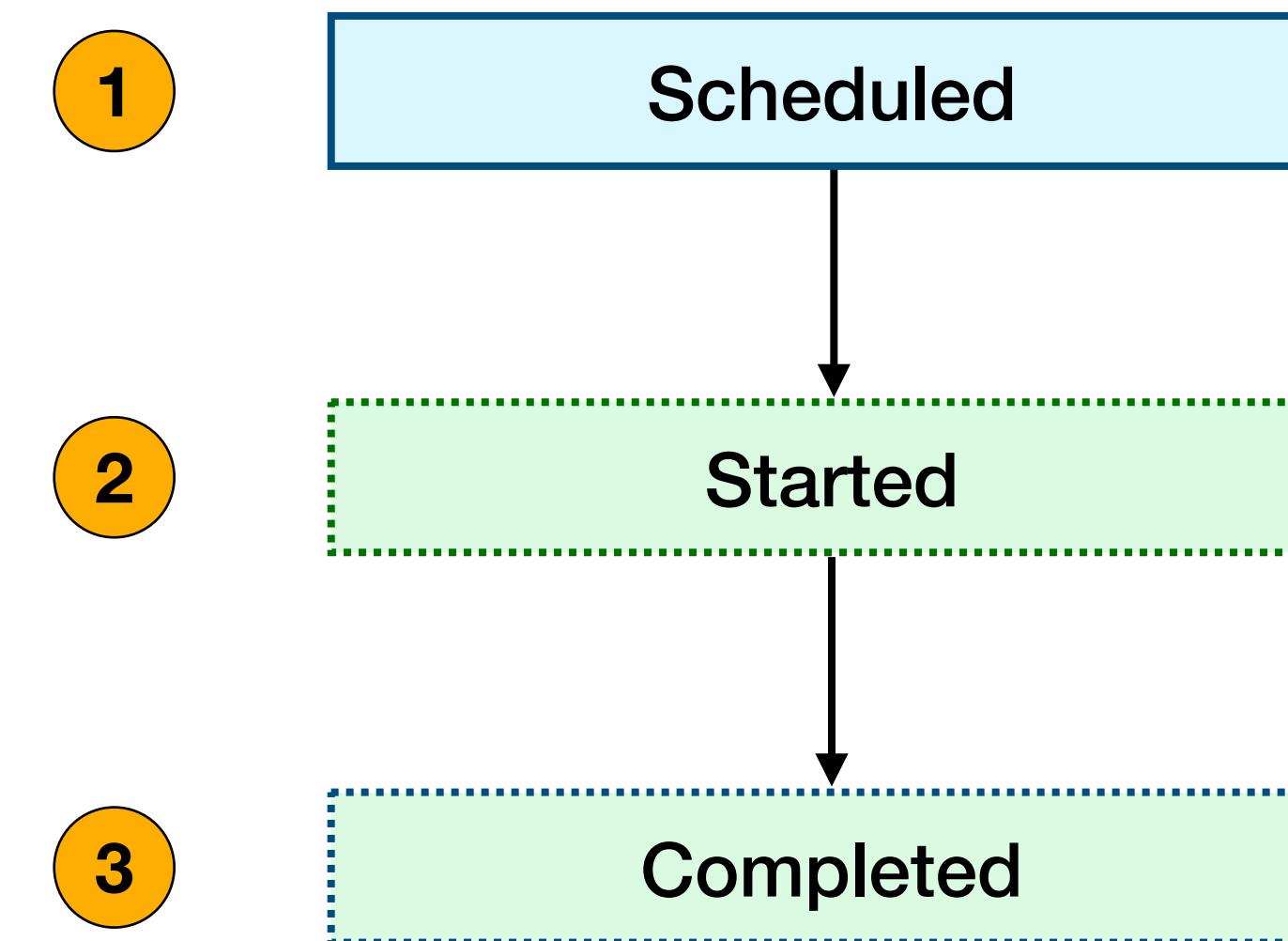
# Activity Task Event Sequence

ActivityTaskScheduled

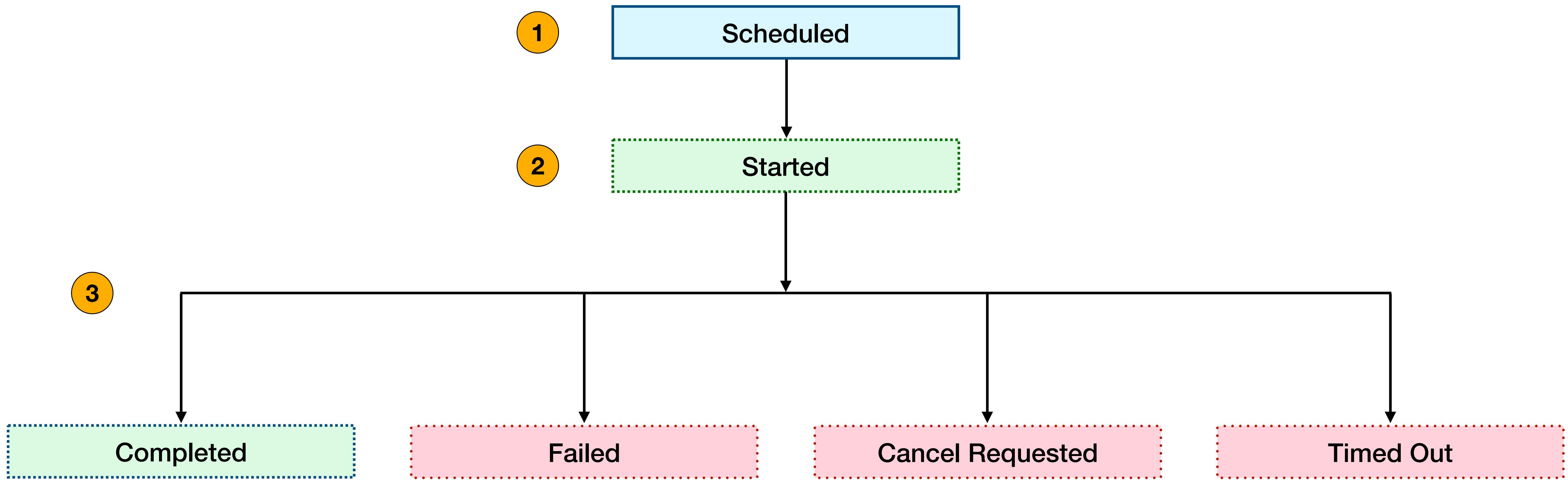
ActivityTaskStarted

ActivityTaskCompleted

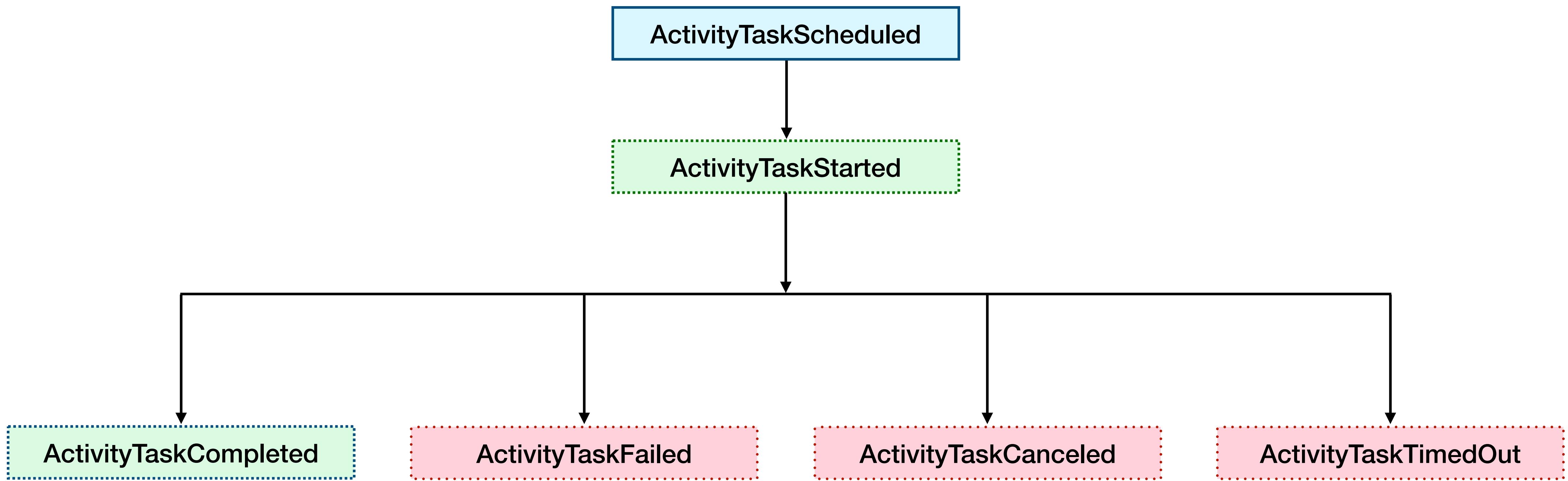
# Activity States in that Sequence



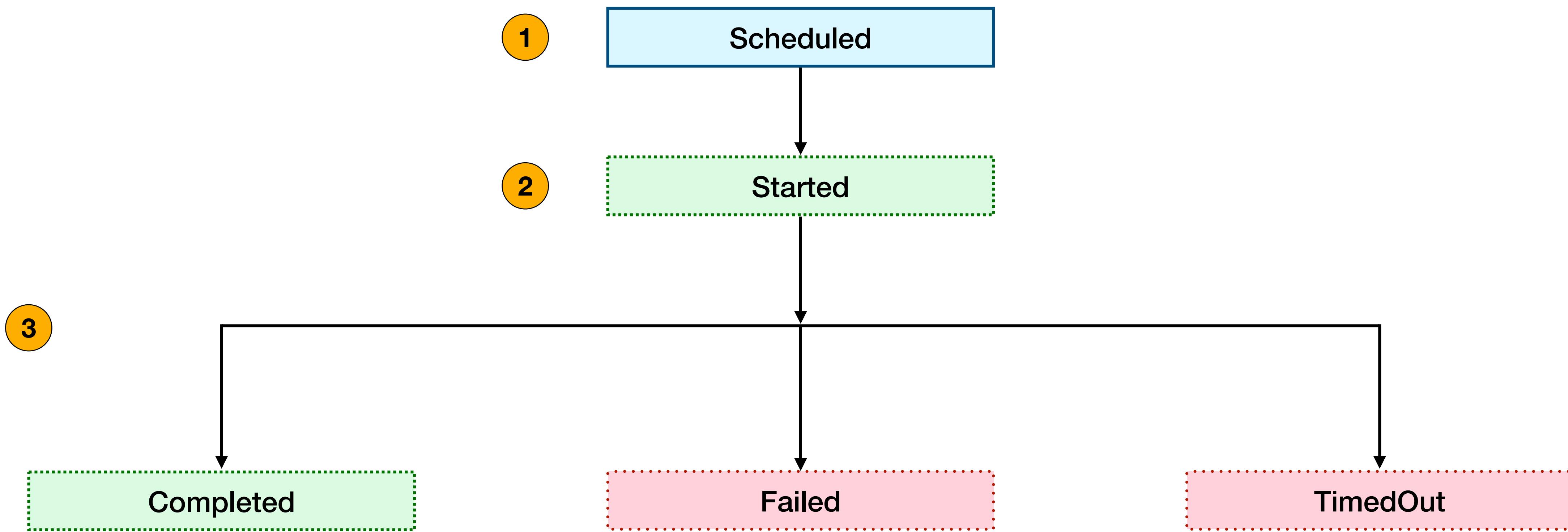
# Activity Task States



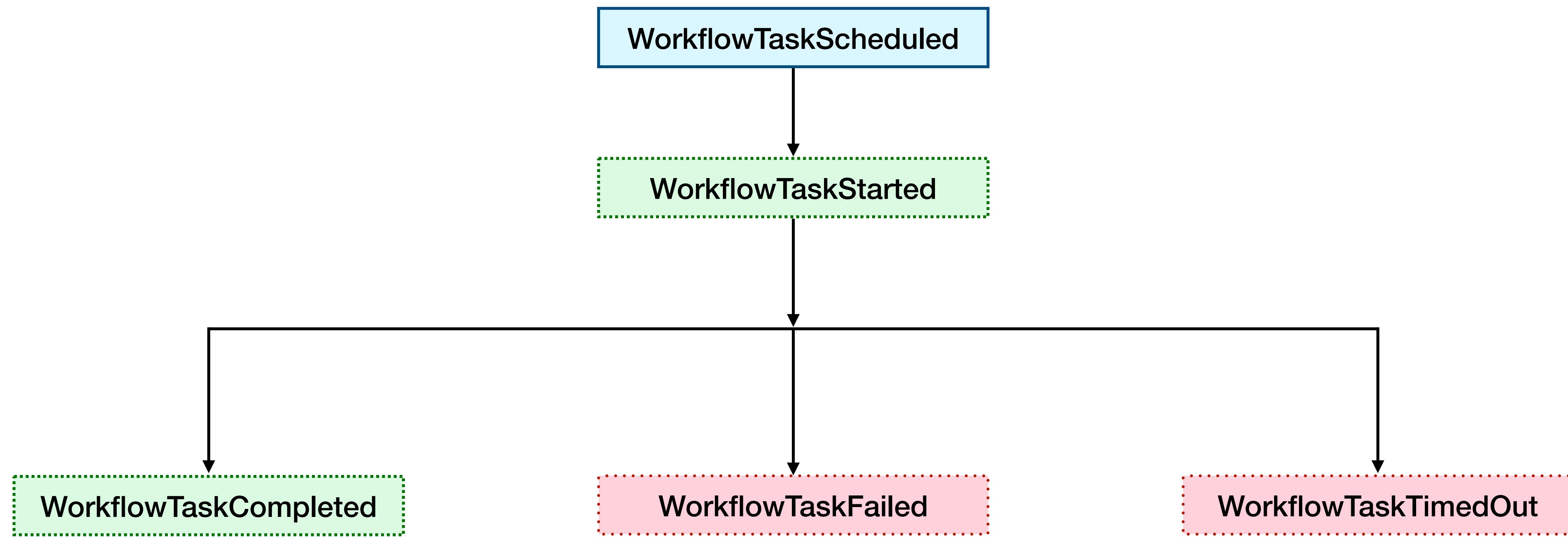
# Activity Task Events



# Workflow Task States



# Workflow Task Events



# Sticky Execution

- **To improve effectiveness of Worker's caching, Temporal use "sticky" execution for Workflow Tasks**
  - A Worker which completed the first Workflow Task is given preference for subsequent Workflow Tasks in the same execution via a Worker-specific Task Queue
- **Sticky execution is visible in the Web UI**
  - See the Task Queue Name / Kind fields
- **This does not apply to Activity Tasks**

## First Workflow Task

2	2023-07-19 UTC 17:02:31.35	WorkflowTaskScheduled
Summary	Task Queue	
Task Queue Name durable-exec-tasks	Task Queue Kind Normal	

## Later Workflow Task

8	2023-07-19 UTC 17:02:31.36	WorkflowTaskScheduled
Summary	Task Queue	
Task Queue Name twwmbp:b7b2434d-4fb5-4ca6-b05f-bb98d6565a96	Task Queue Kind Sticky	
Task Queue Normal Name durable-exec-tasks		

# Temporal 102

- 00. About this Workshop
- 01. Understanding Key Concepts in Temporal
- 02. Improving Your Temporal Application Code
- 03. Using Timers in a Workflow Definition
- 04. Understanding Event History

## ► **05. Understanding Workflow Determinism**

- 06. Testing Your Temporal Application Code
- 07. Debugging Workflow Execution
- 08. Deploying Your Application to Production
- 09. Conclusion

# History Replay:

## How Temporal Provides Durable Execution

# Start Workflow Execution

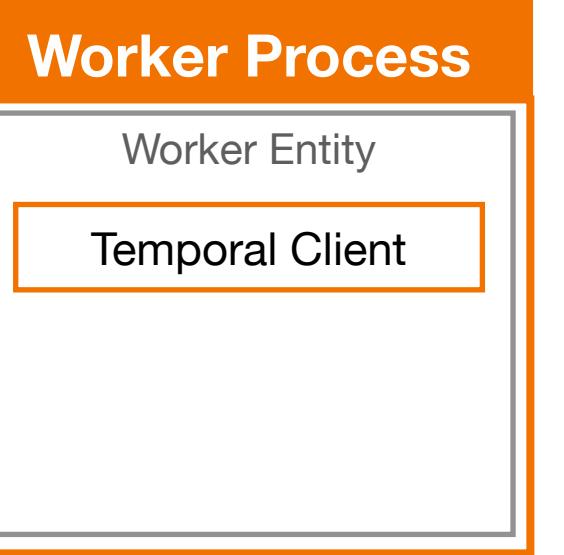
```
01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```

```
client.ExecuteWorkflow(ctx, options, PizzaWorkflow, input)
```

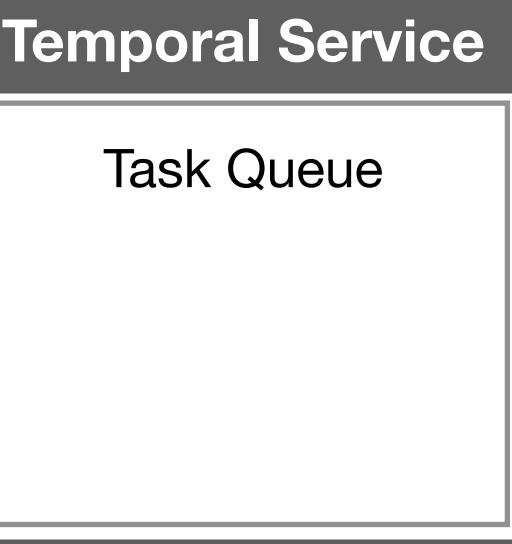
```
[{"OrderNumber": "Z1238", "Customer": {"CustomerID": 12983, "Name": "María García", "Email": "maria1985@example.com", "Phone": "415-555-7418"}, "Items": [{"Description": "Large, with pepperoni", "Price": 1500}, {"Description": "Small, with mushrooms and onions", "Price": 1000}], "IsDelivery": true, "Address": {"Line1": "701 Mission Street", "Line2": "Apartment 9C", "City": "San Francisco", "State": "CA", "PostalCode": "94103"}}]
```

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
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11        totalPrice += pizza.Price
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14    logger.Info("Calculated cost of order", "Total", totalPrice)
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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands

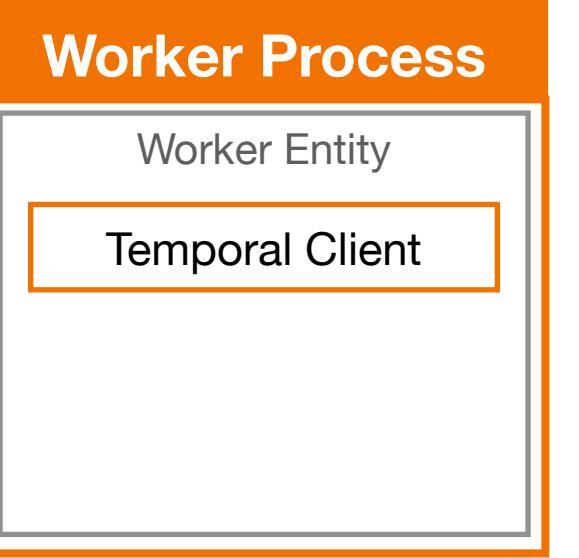


## Events

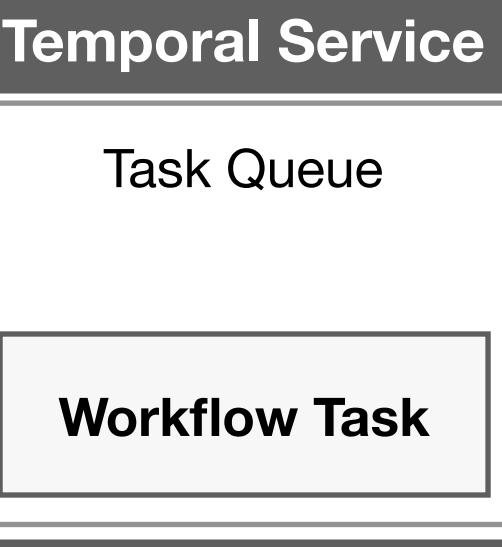
**WorkflowExecutionStarted**

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands

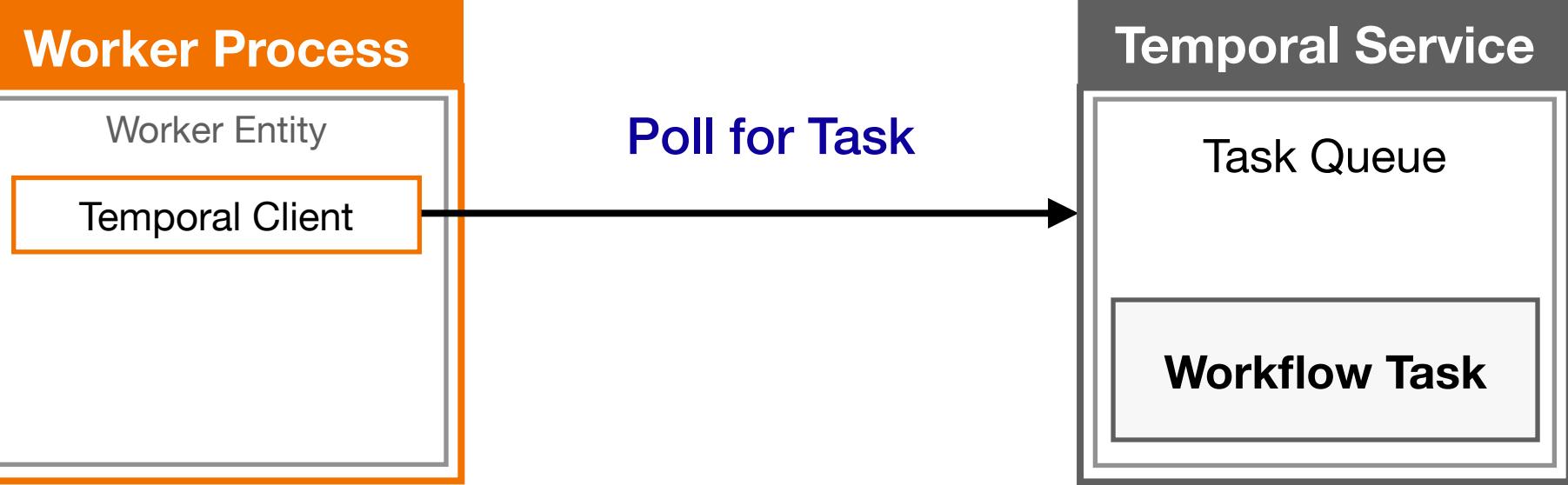


## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
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18    _ = future.Get(ctx, &distance)
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20    if order.IsDelivery && distance.Kilometers > 25 {
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22    }
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24    _ = workflow.Sleep(ctx, time.Minute * 30)
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27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands

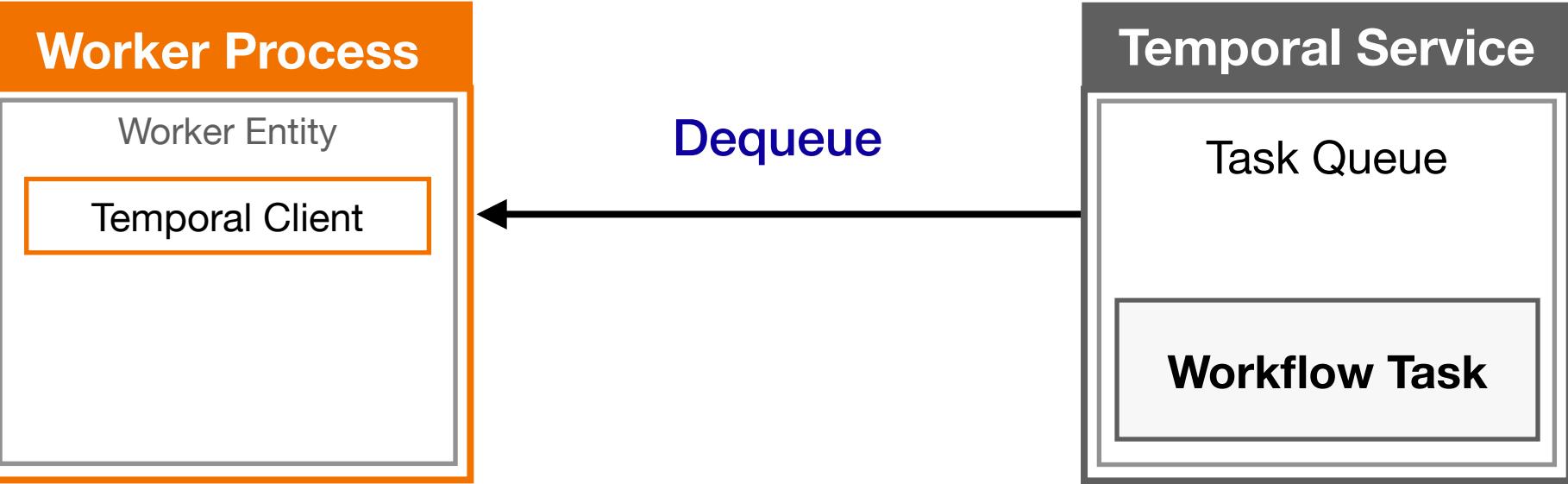
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
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18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
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26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



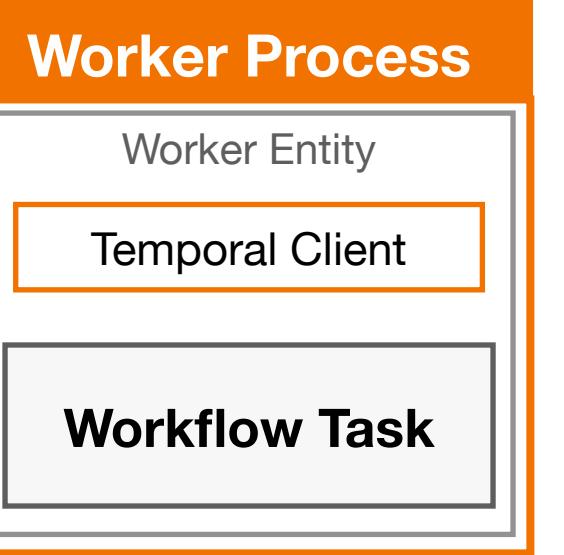
## Commands

## Events

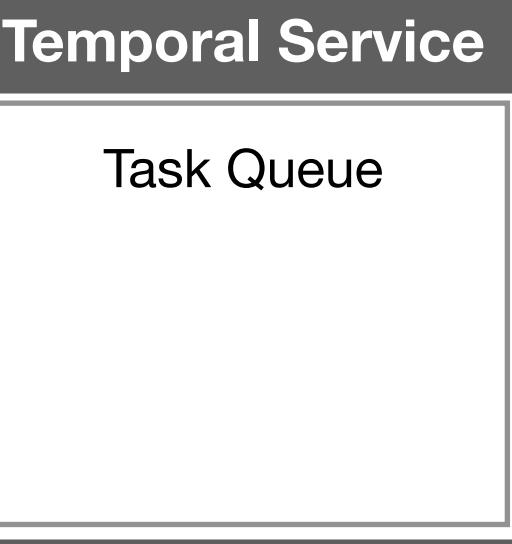
WorkflowExecutionStarted  
WorkflowTaskScheduled

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
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29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands



## Temporal Service

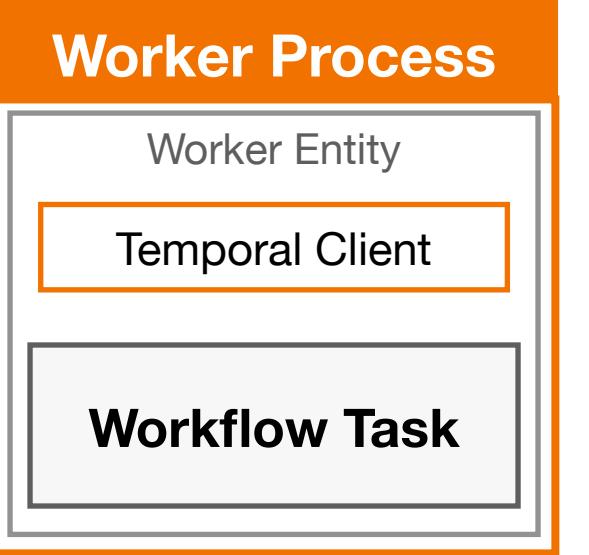
Task Queue

## Events

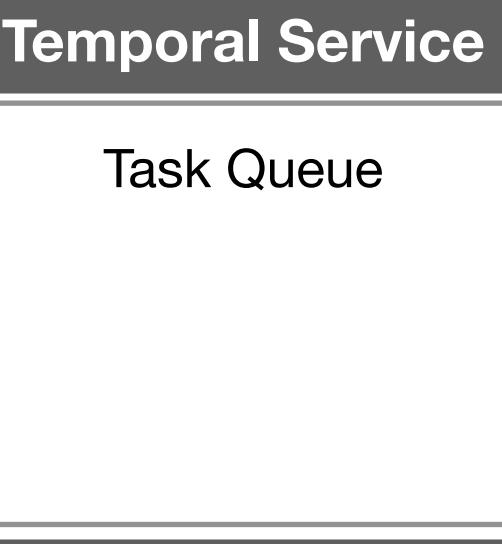
WorkflowExecutionStarted  
WorkflowTaskScheduled  
**WorkflowTaskStarted**

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
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09     var totalPrice int
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22    }
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24    _ = workflow.Sleep(ctx, time.Minute * 30)
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27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands

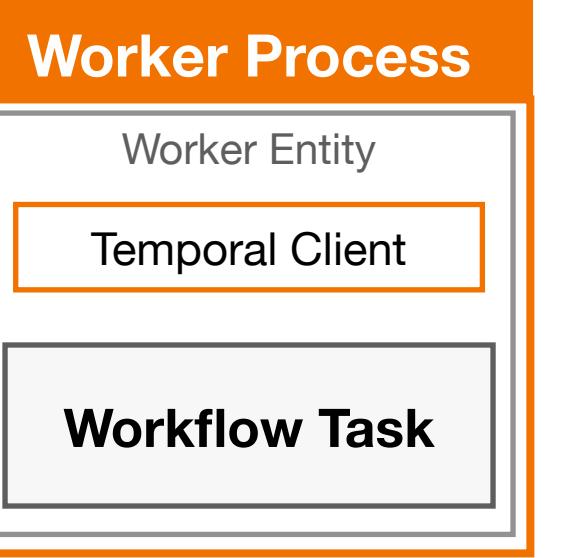


## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
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28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands



## Temporal Service

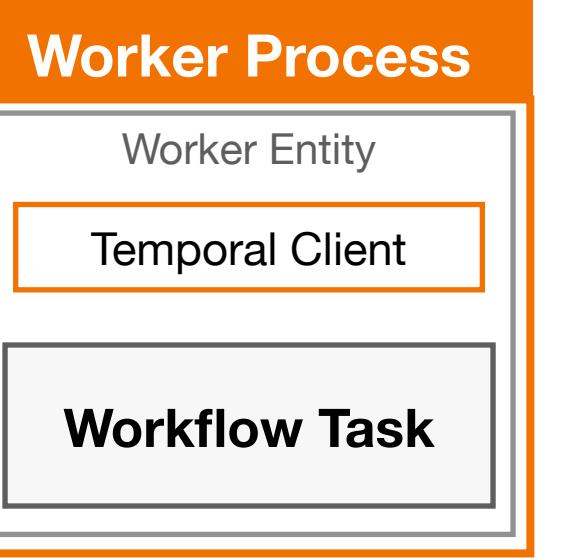
Task Queue

## Events

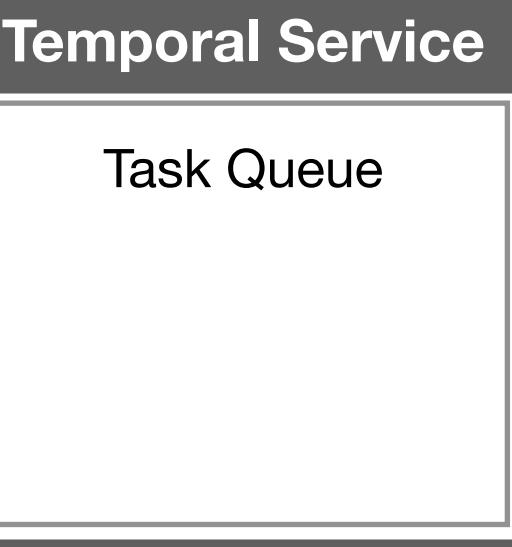
WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands

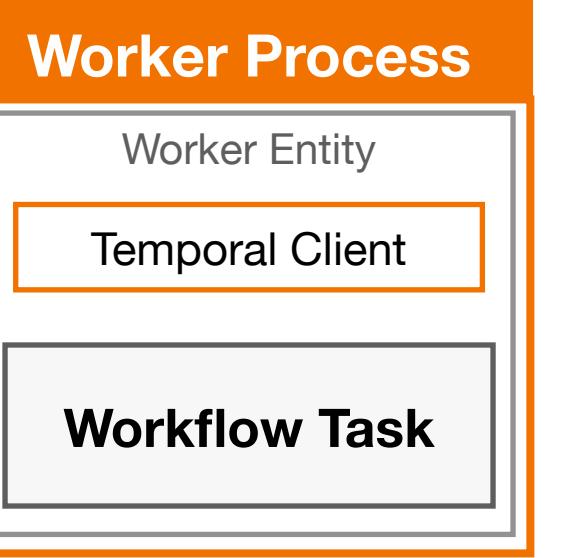


## Events

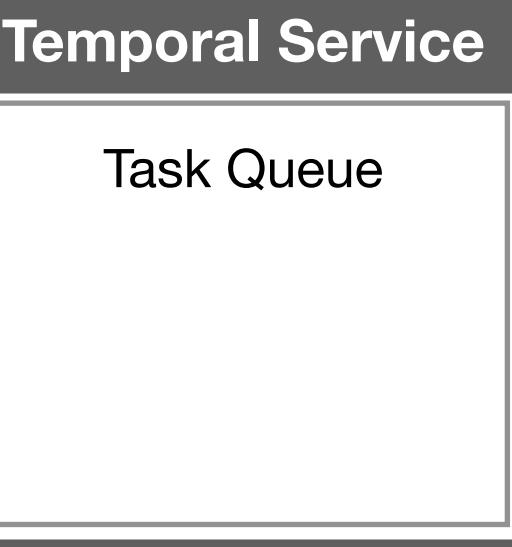
WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
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31    _ = future.Get(ctx, &confirmation)
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33    return confirmation, nil
34 }
```



## Commands

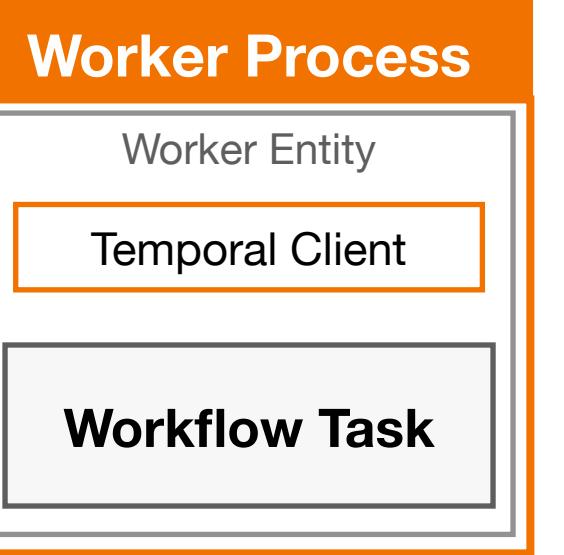


## Events

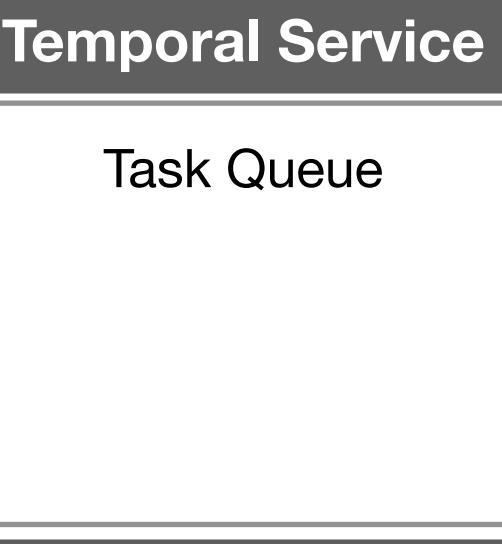
WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
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32
33    return confirmation, nil
34 }
```



## Commands

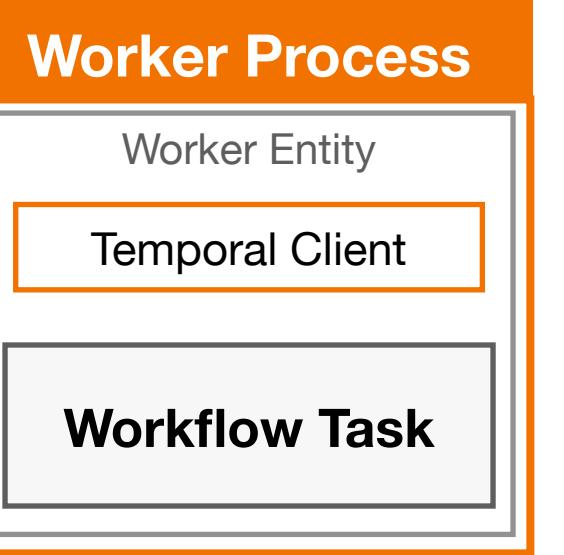


## Events

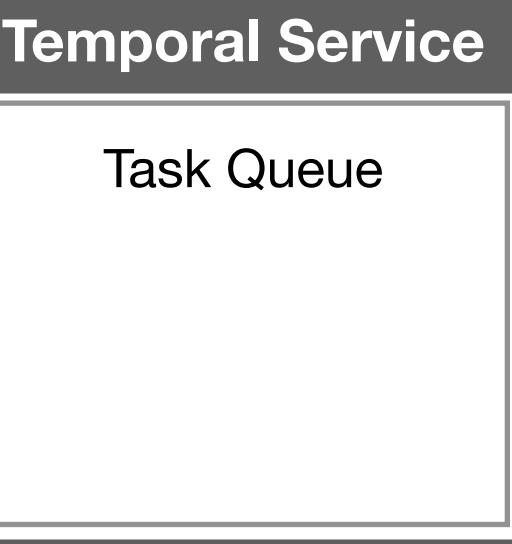
WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands

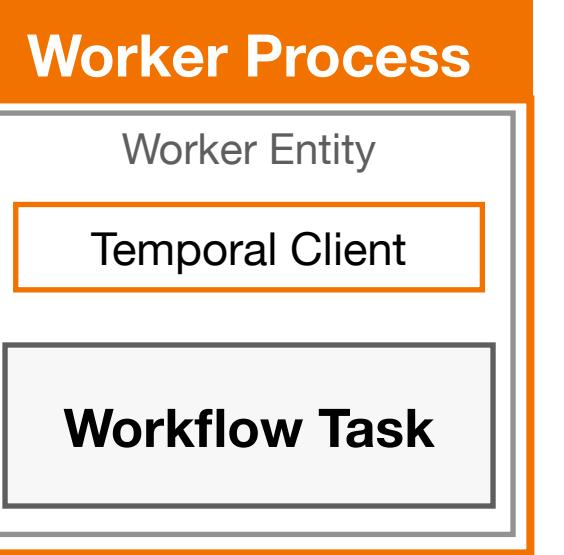


## Events

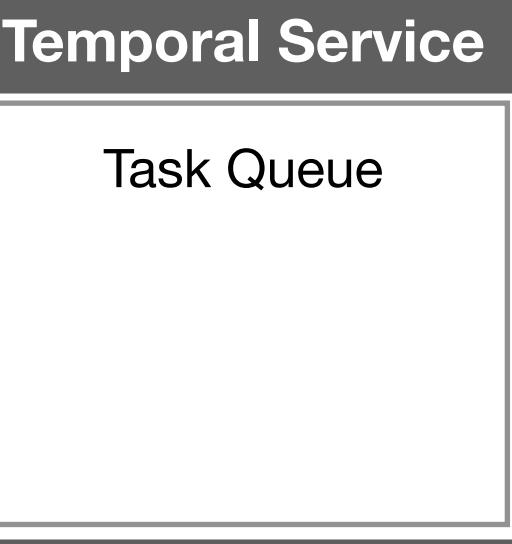
WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands



## Temporal Service

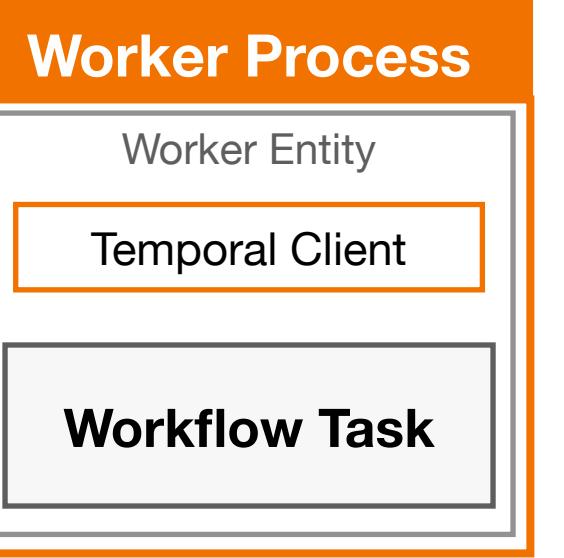
Task Queue

## Events

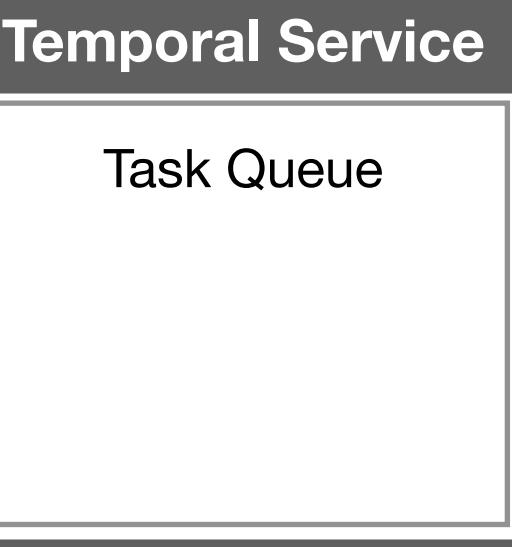
WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands



## Temporal Service

Task Queue

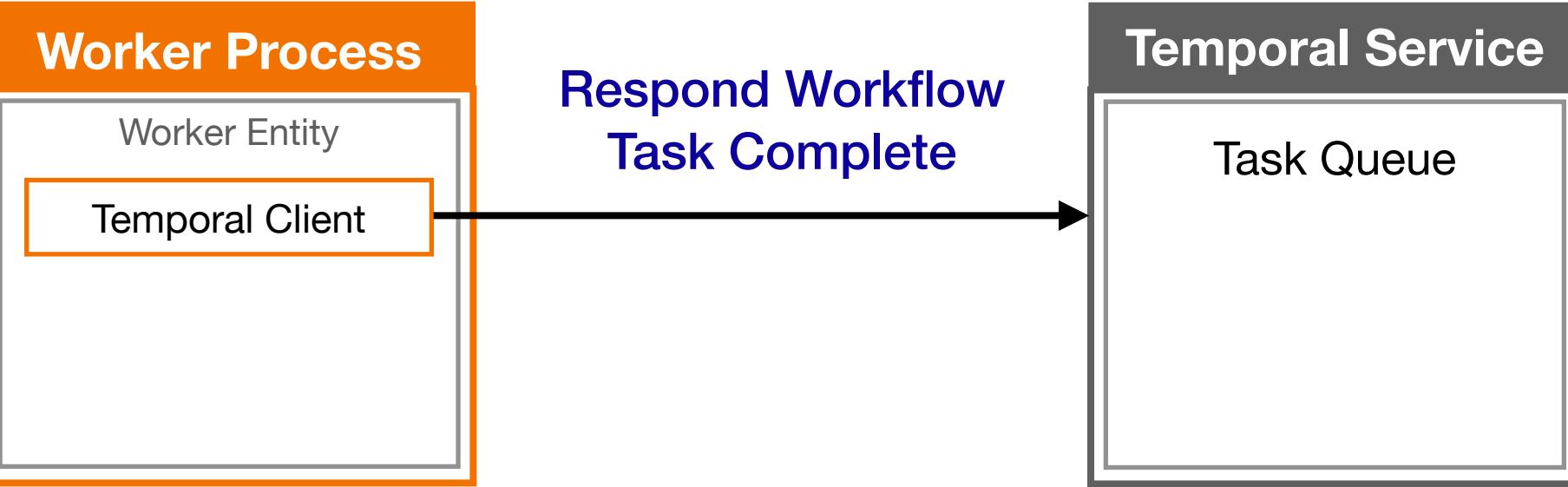
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



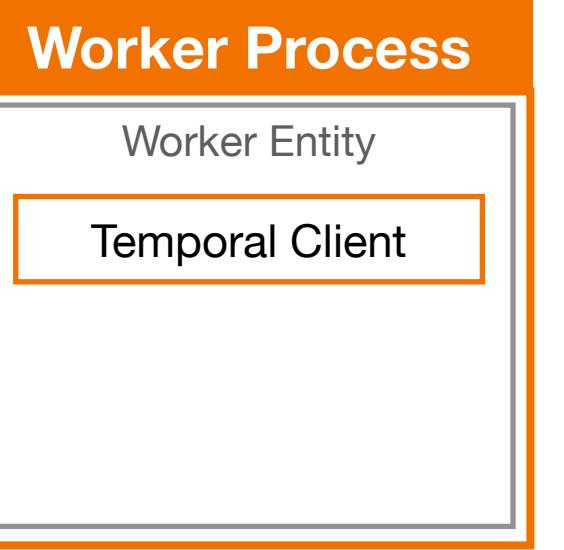
## Commands

## Events

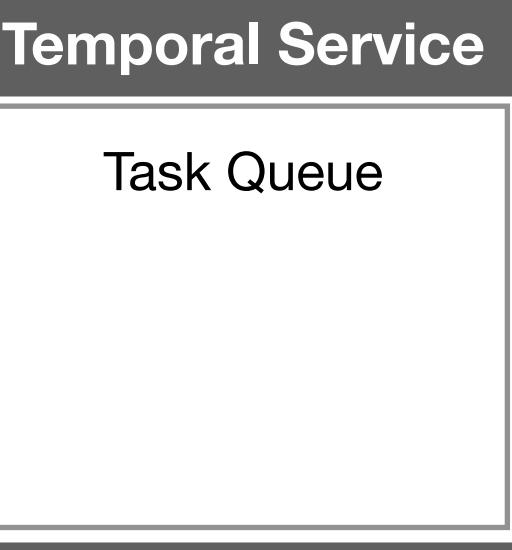
WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Worker Process



## Temporal Service

## Commands

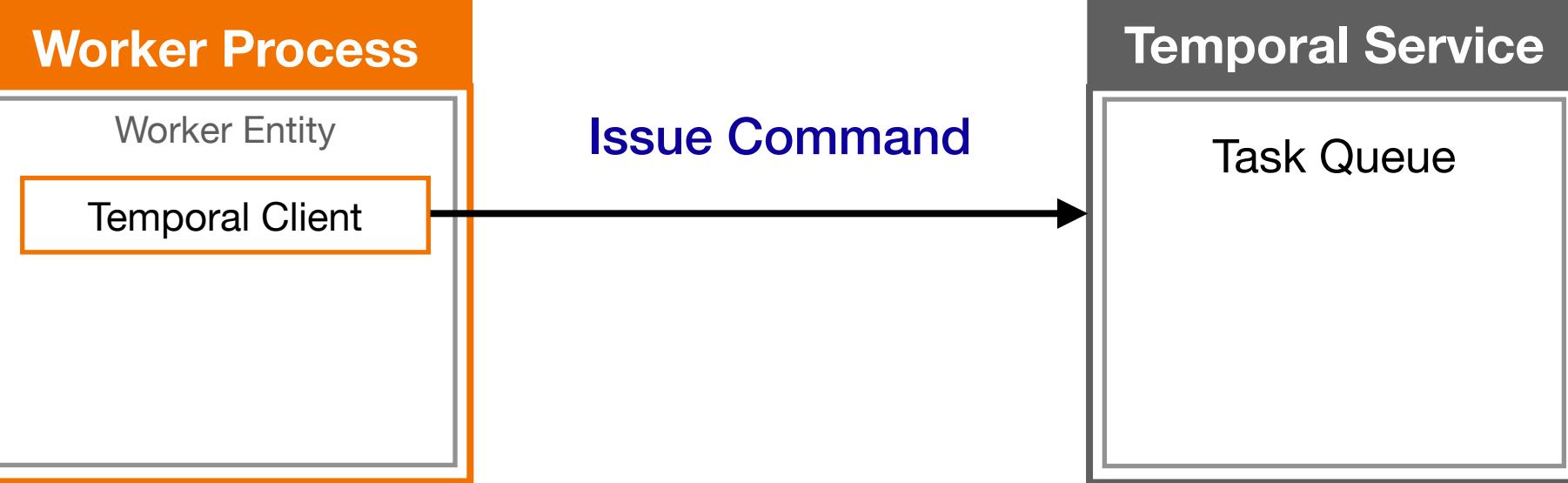
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
**WorkflowTaskCompleted**

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

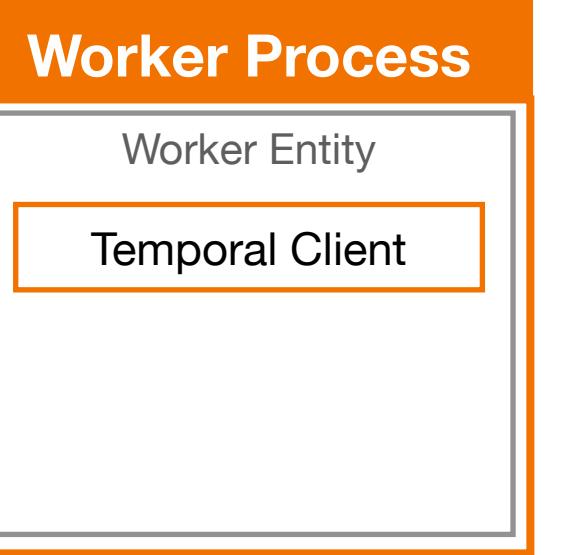
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
WorkflowTaskCompleted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

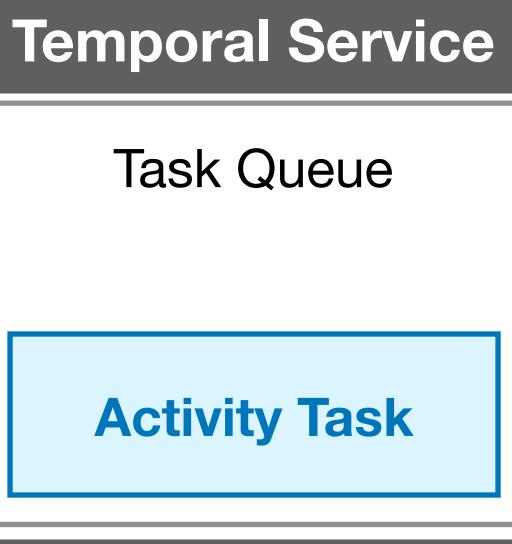
```



## Commands

### ScheduleActivityTask

Queue: **pizza-tasks**  
Type: **GetDistance**  
Input: **"OrderNumber": "Z1238", ...**



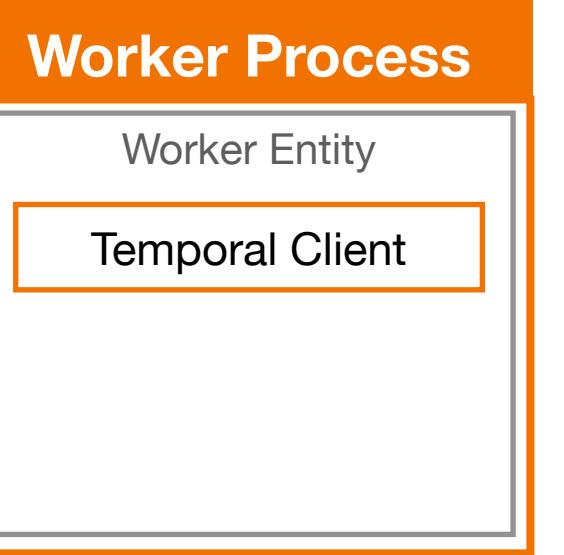
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
WorkflowTaskCompleted  
**ActivityTaskScheduled (GetDistance)**

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

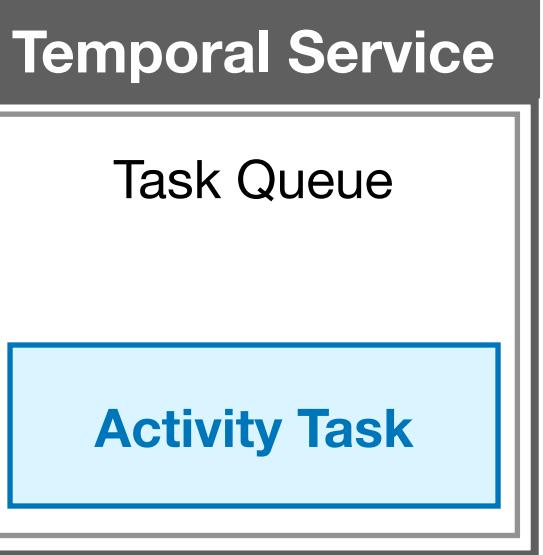
```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



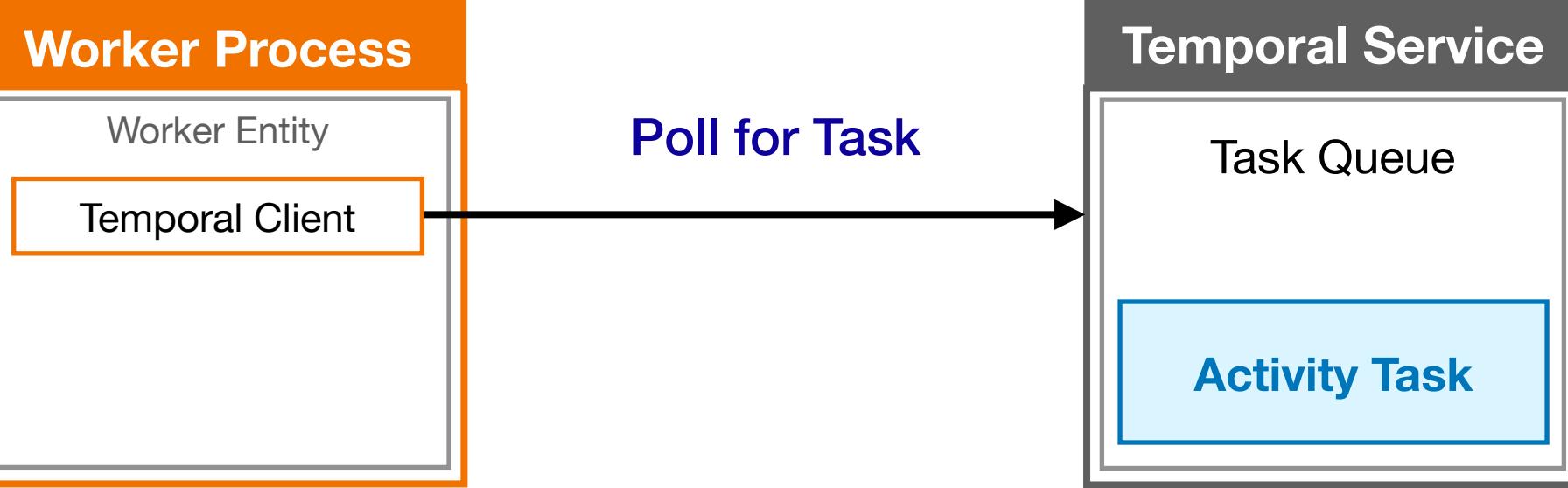
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
WorkflowTaskCompleted  
ActivityTaskScheduled (GetDistance)

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

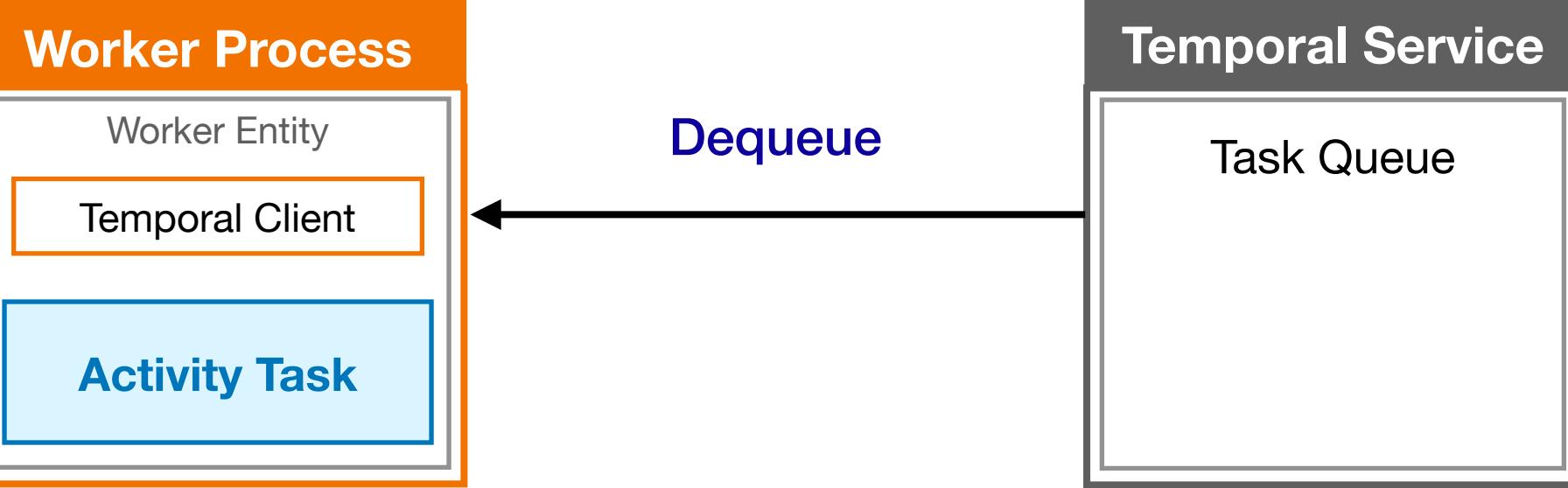
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
WorkflowTaskCompleted  
ActivityTaskScheduled (GetDistance)

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

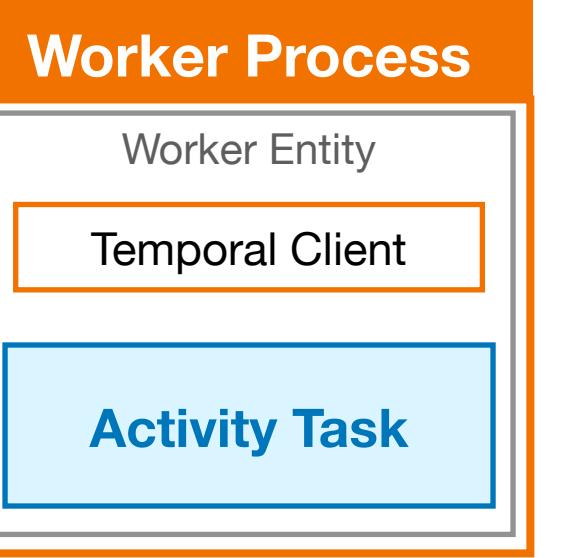
## Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled
(GetDistance)
<b>ActivityTaskStarted</b>

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

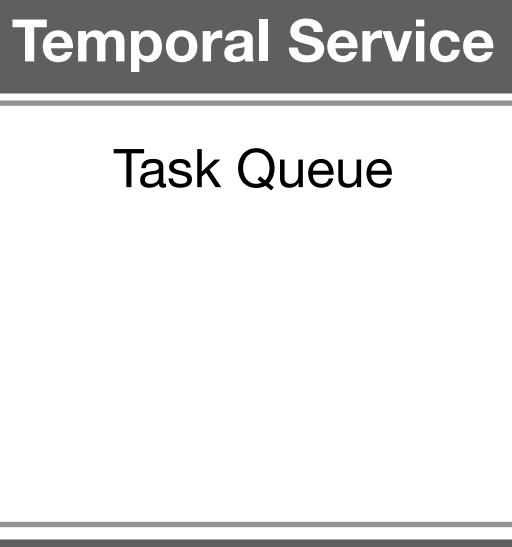
```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



## Temporal Service

Task Queue

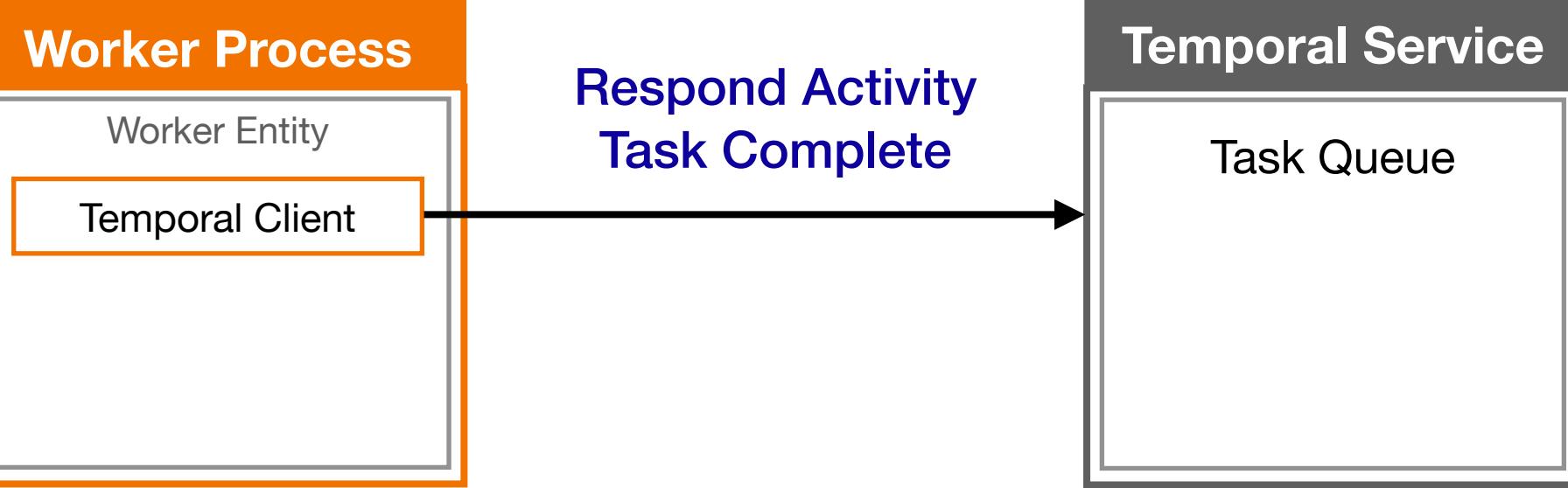
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
WorkflowTaskCompleted  
ActivityTaskScheduled (GetDistance)  
ActivityTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

## Events

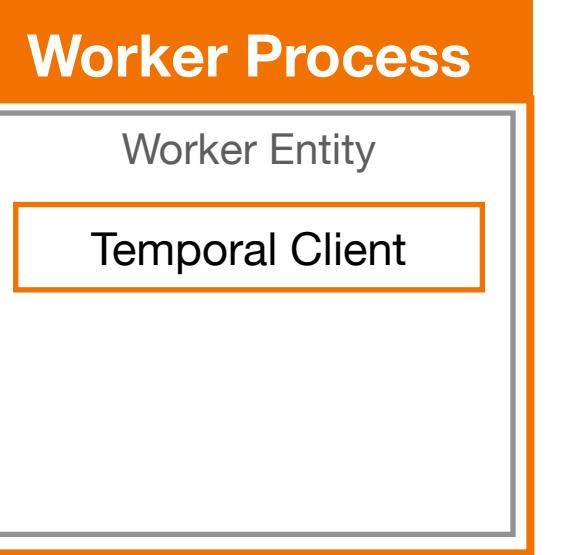
WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled
ActivityTaskStarted

`(GetDistance)`

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

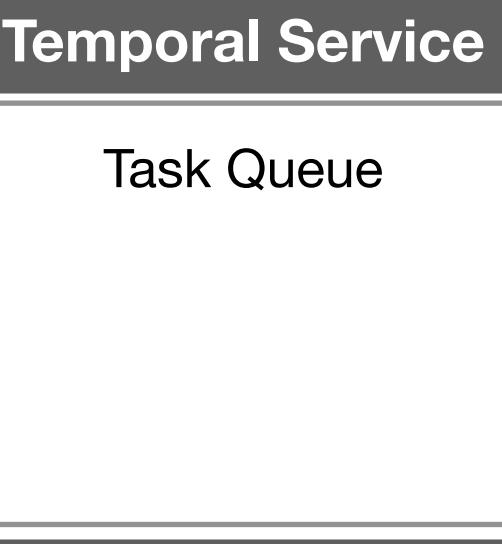
```



## Commands

### ScheduleActivityTask

Queue: **pizza-tasks**  
Type: **GetDistance**  
Input: **"OrderNumber": "Z1238", ...**



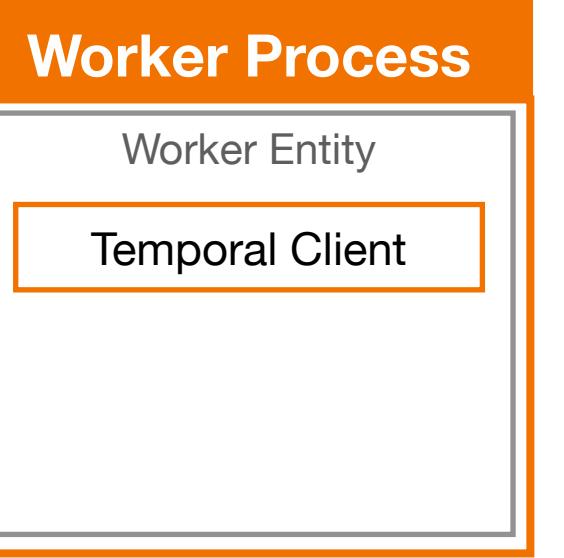
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
WorkflowTaskCompleted  
ActivityTaskScheduled **(GetDistance)**  
ActivityTaskStarted  
**ActivityTaskCompleted** **(distance=15)**

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

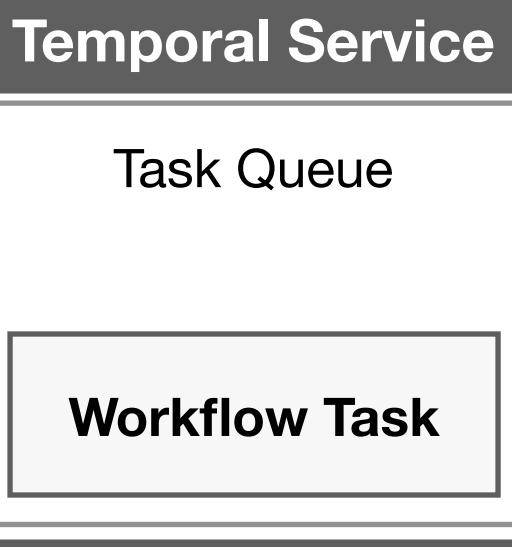
```



## Commands

### ScheduleActivityTask

Queue: **pizza-tasks**  
Type: **GetDistance**  
Input: **"OrderNumber": "Z1238", ...**



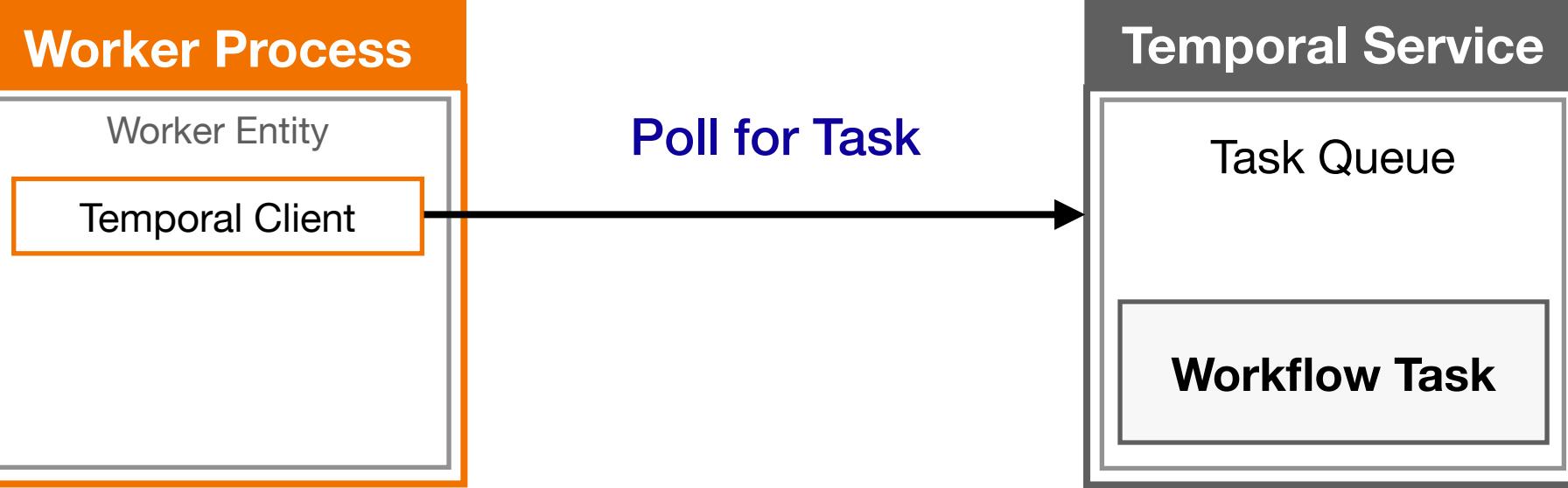
## Events

WorkflowExecutionStarted  
WorkflowTaskScheduled  
WorkflowTaskStarted  
WorkflowTaskCompleted  
ActivityTaskScheduled **(GetDistance)**  
ActivityTaskStarted  
ActivityTaskCompleted **(distance=15)**  
**WorkflowTaskScheduled**

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

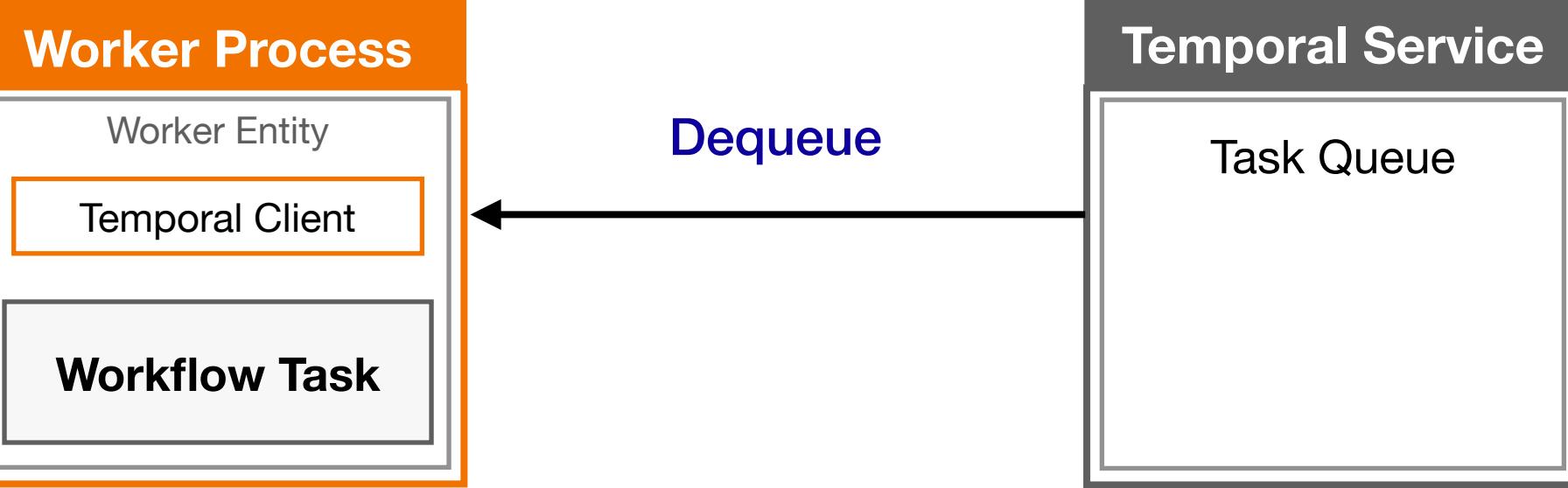
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
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26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

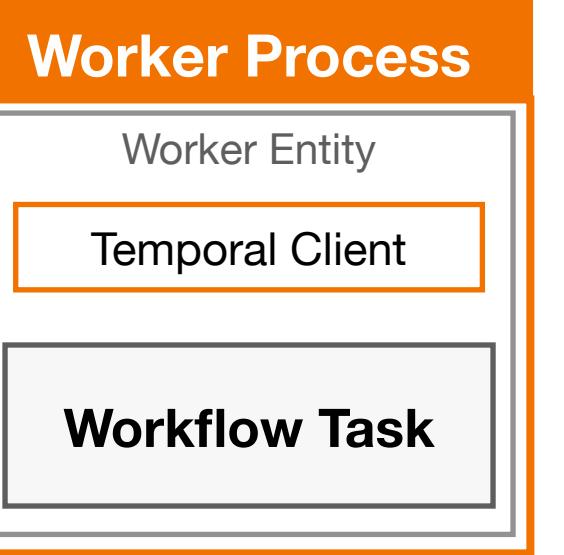
## Events

<code>WorkflowExecutionStarted</code>	
<code>WorkflowTaskScheduled</code>	
<code>WorkflowTaskStarted</code>	
<code>WorkflowTaskCompleted</code>	
<code>ActivityTaskScheduled</code>	<code>(GetDistance)</code>
<code>ActivityTaskStarted</code>	
<code>ActivityTaskCompleted</code>	<code>(distance=15)</code>
<code>WorkflowTaskScheduled</code>	
<b>WorkflowTaskStarted</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

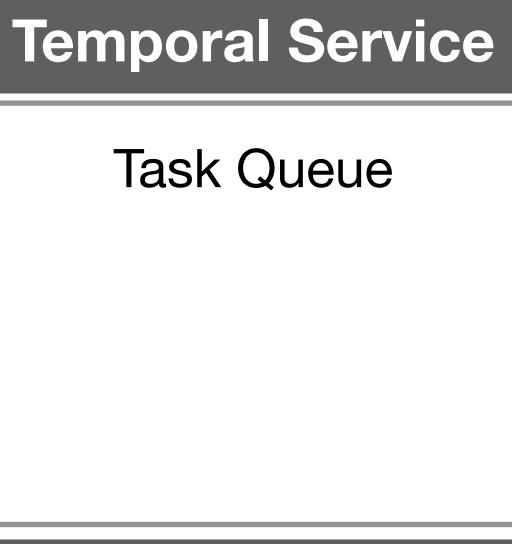
```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



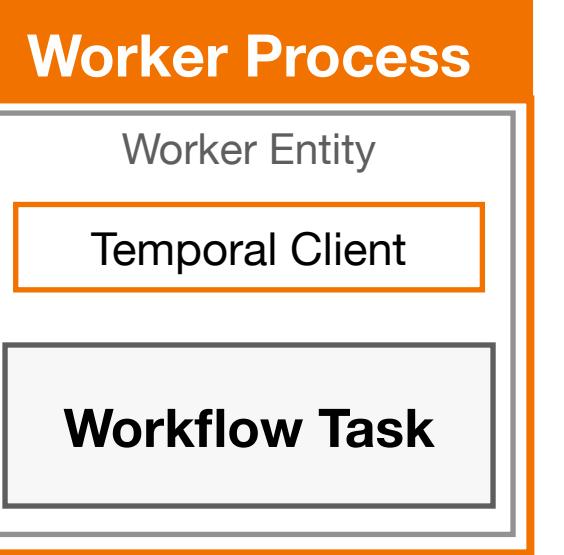
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

**ScheduleActivityTask**

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



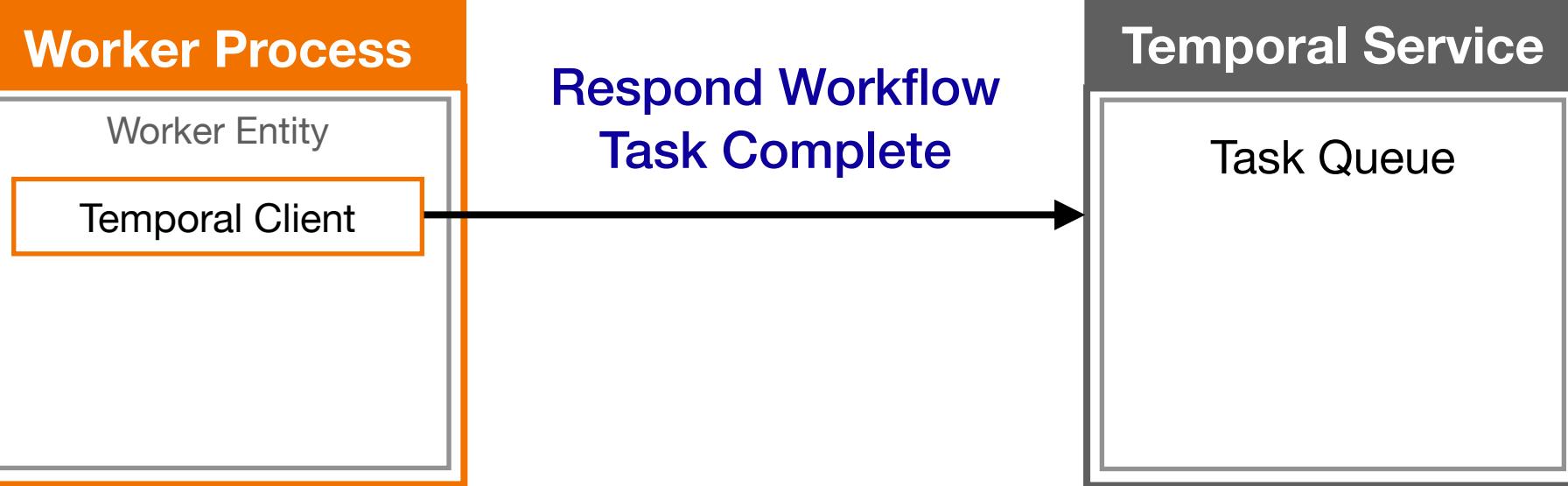
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
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13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

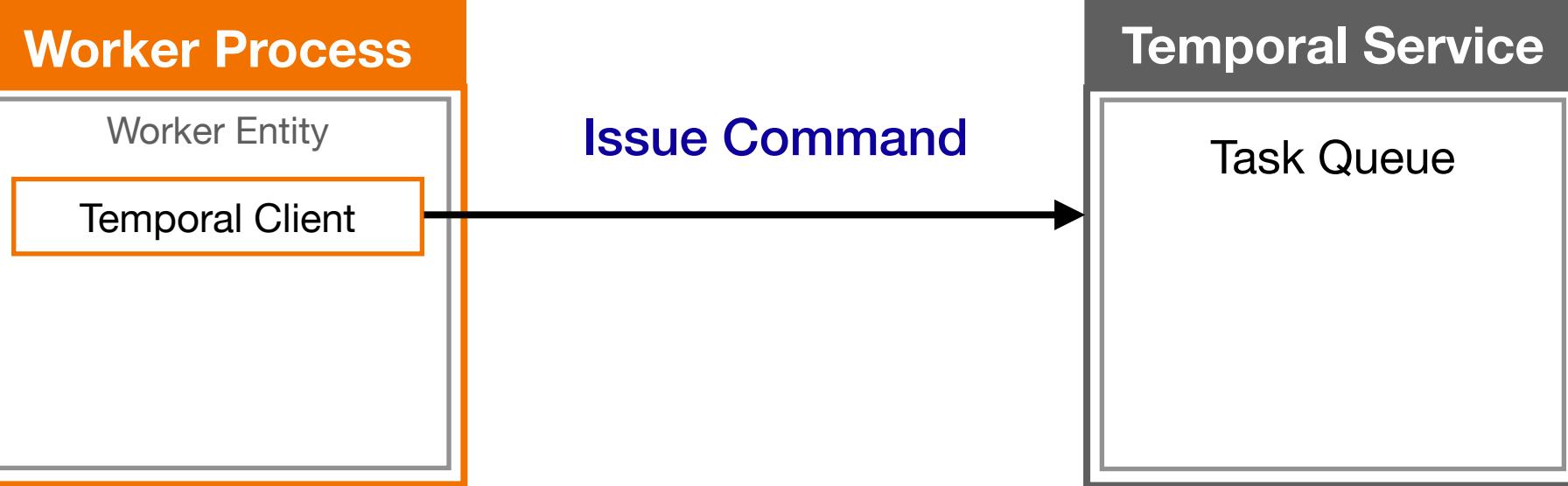
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	
WorkflowTaskStarted	
<b>WorkflowTaskCompleted</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
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11        totalPrice += pizza.Price
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13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

**ScheduleActivityTask**

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

**StartTimer**  
Duration: `30 minutes`

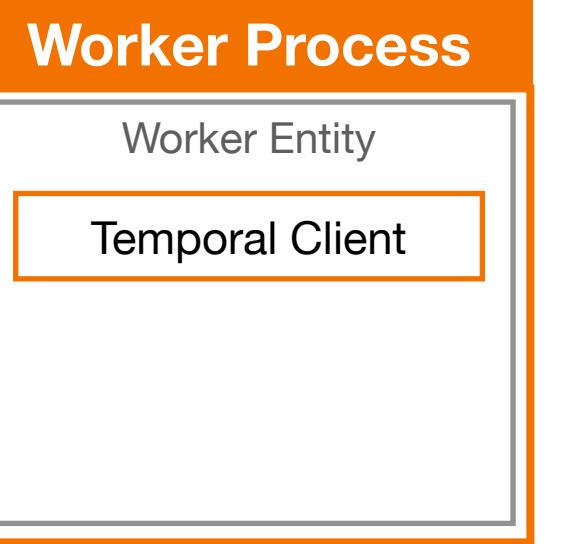
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
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09     var totalPrice int
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13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
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20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



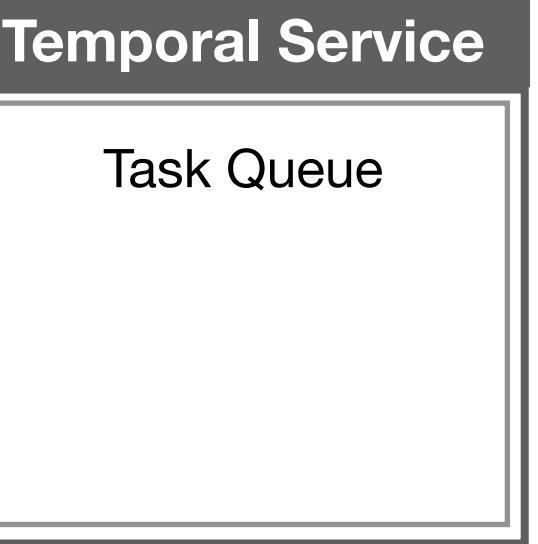
## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

### StartTimer

Duration: `30 minutes`



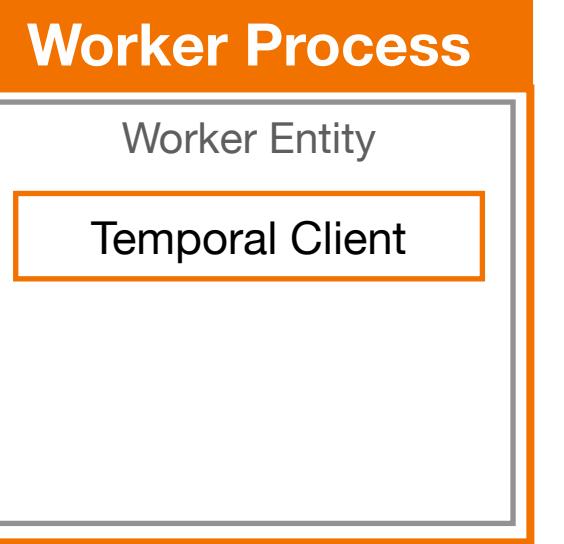
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	<code>(GetDistance)</code>
ActivityTaskStarted	
ActivityTaskCompleted	<code>(distance=15)</code>
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	<code>(30 Minutes)</code>

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
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10    for _, pizza := range order.Items {
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28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```

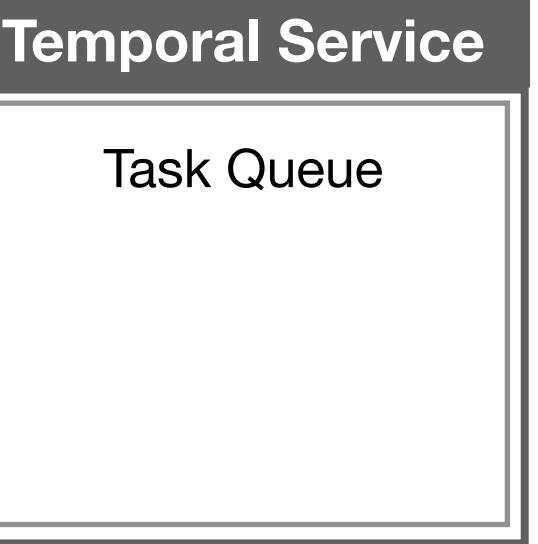


## Commands

**ScheduleActivityTask**

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

**StartTimer**  
Duration: `30 minutes`



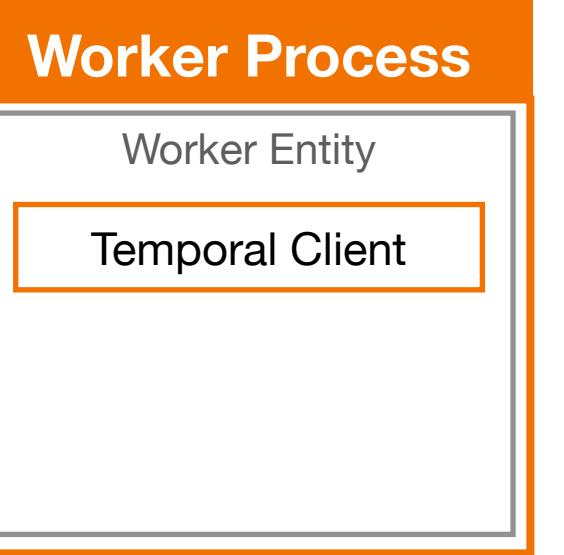
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
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11        totalPrice += pizza.Price
12    }
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19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
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27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```

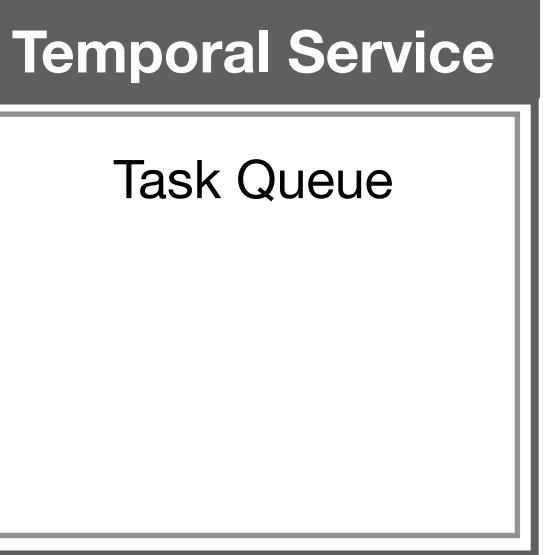


## Commands

**ScheduleActivityTask**

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

**StartTimer**  
Duration: `30 minutes`



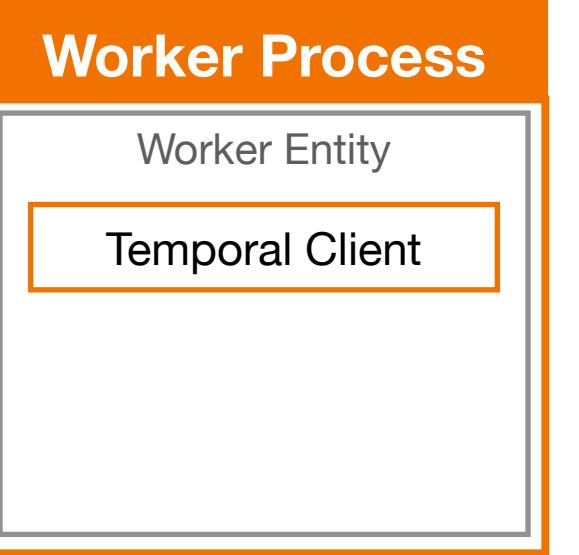
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
<b>TimerFired</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
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14    logger.Info("Calculated cost of order", "Total", totalPrice)
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17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
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24    _ = workflow.Sleep(ctx, time.Minute * 30)
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26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```

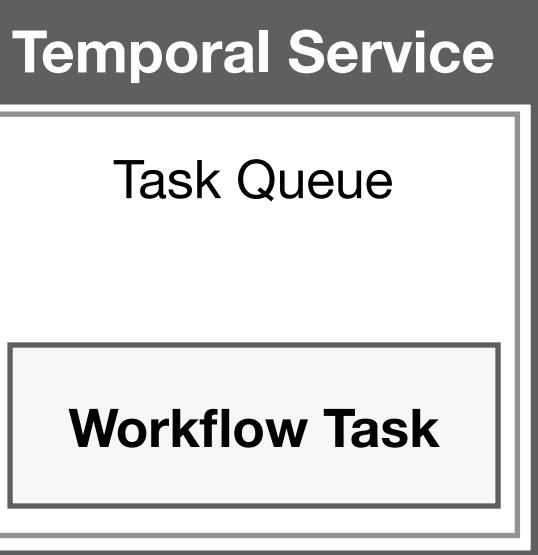


## Commands

**ScheduleActivityTask**

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

**StartTimer**  
Duration: `30 minutes`



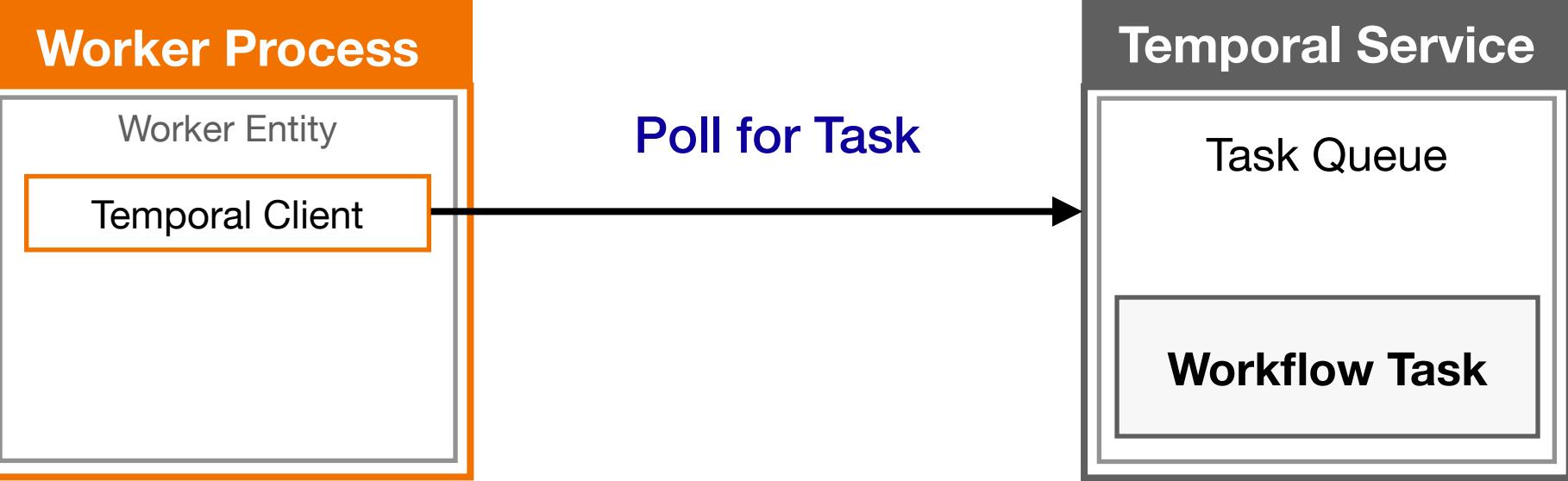
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	( <code>GetDistance</code> )
ActivityTaskStarted	
ActivityTaskCompleted	( <code>distance=15</code> )
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
<b>WorkflowTaskScheduled</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
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13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
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18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

### StartTimer

Duration: `30 minutes`

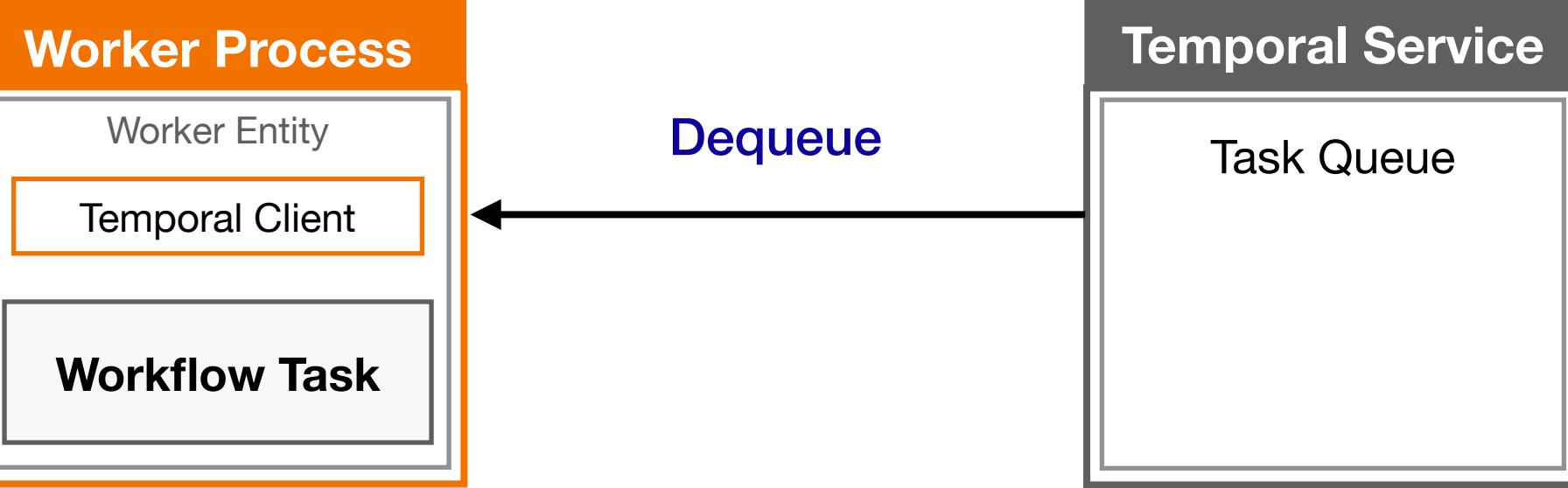
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	<code>(GetDistance)</code>
ActivityTaskStarted	
ActivityTaskCompleted	<code>(distance=15)</code>
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	<code>(30 Minutes)</code>
TimerFired	
WorkflowTaskScheduled	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
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18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
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22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
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28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`

### StartTimer

Duration: `30 minutes`

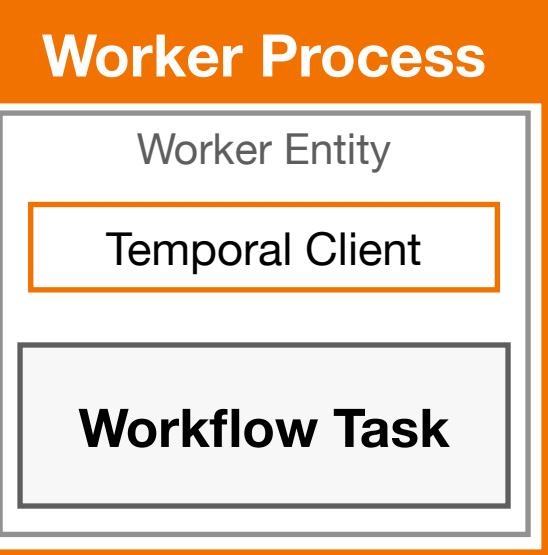
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	<code>(GetDistance)</code>
ActivityTaskStarted	
ActivityTaskCompleted	<code>(distance=15)</code>
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	<code>(30 Minutes)</code>
TimerFired	
WorkflowTaskScheduled	
<b>WorkflowTaskStarted</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
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09     var totalPrice int
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15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Worker Process

Worker Entity  
Temporal Client

Workflow Task

## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

Duration: 30 minutes

## Temporal Service

Task Queue

## Events

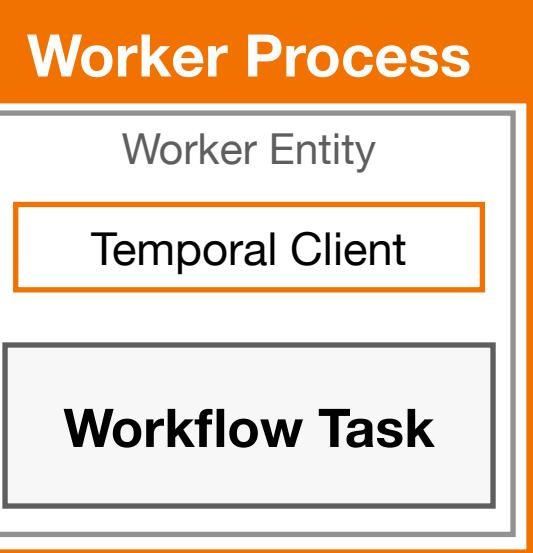
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```

**Worker crashes here**

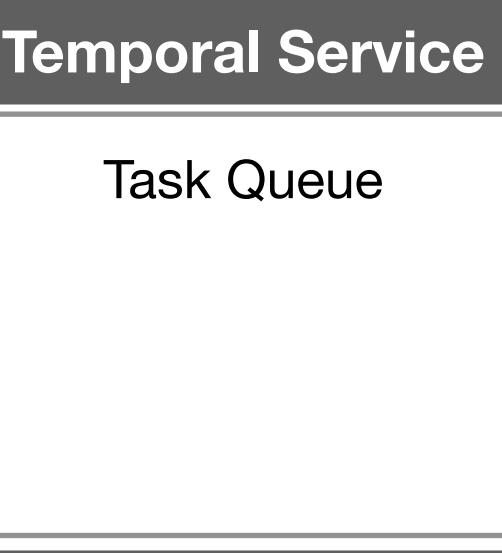
## Commands

### ScheduleActivityTask

Queue: **pizza-tasks**  
Type: **GetDistance**  
Input: **"OrderNumber": "Z1238", ...**

### StartTimer

Duration: **30 minutes**



## Events

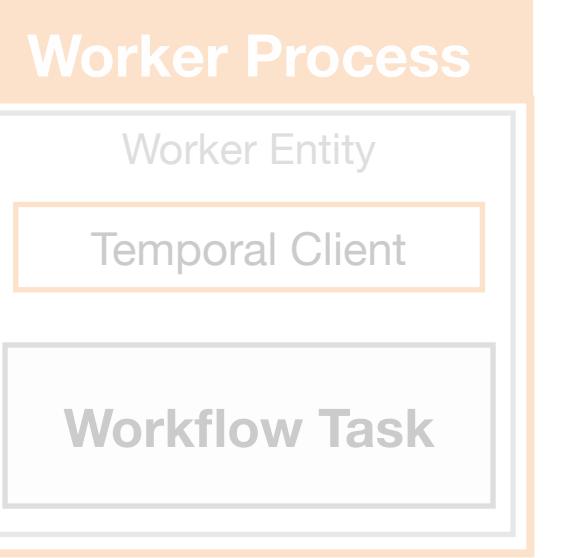
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	<b>(GetDistance)</b>
ActivityTaskStarted	
ActivityTaskCompleted	<b>(distance=15)</b>
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	<b>(30 Minutes)</b>
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

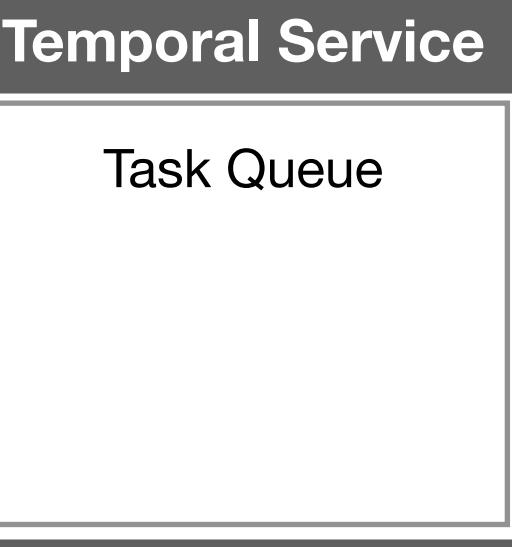
01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
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07     ctx = workflow.WithActivityOptions(ctx, options)
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32
33    return confirmation, nil
34 }

```

**Worker crashes here**

## Commands

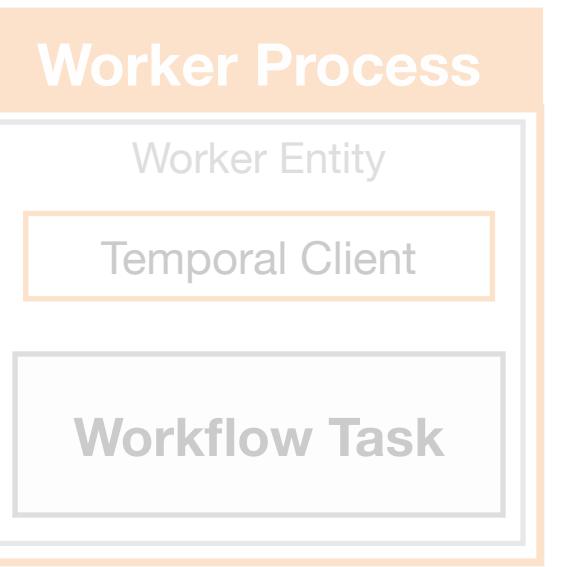


## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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34 }
```



## Commands

## Temporal Service

Task Queue

## Events

WorkflowExecutionStarted

WorkflowTaskScheduled

WorkflowTaskStarted

WorkflowTaskCompleted

ActivityTaskScheduled **(GetDistance)**

ActivityTaskStarted

ActivityTaskCompleted **(distance=15)**

WorkflowTaskScheduled

WorkflowTaskStarted

WorkflowTaskCompleted

TimerStarted **(30 Minutes)**

TimerFired

WorkflowTaskScheduled

WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
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```

## Worker Process

Workflow Task Timeout Exceeded

## Temporal Service

Task Queue

## Commands

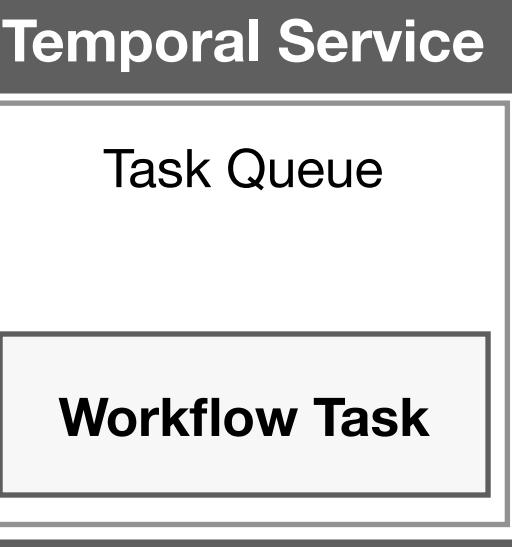
## Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled
ActivityTaskStarted
ActivityTaskCompleted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
TimerStarted
TimerFired
WorkflowTaskScheduled
WorkflowTaskStarted
<b>WorkflowTaskTimedOut</b>

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
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34 }
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## Commands

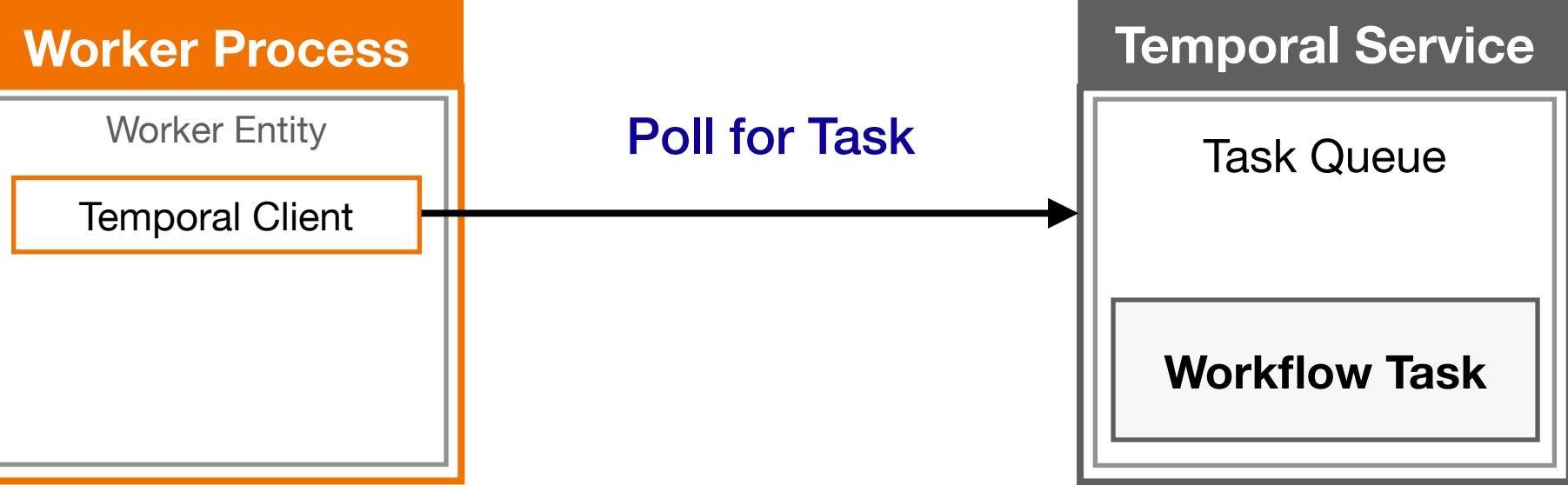


## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
<b>WorkflowTaskScheduled</b>	

```

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## Commands

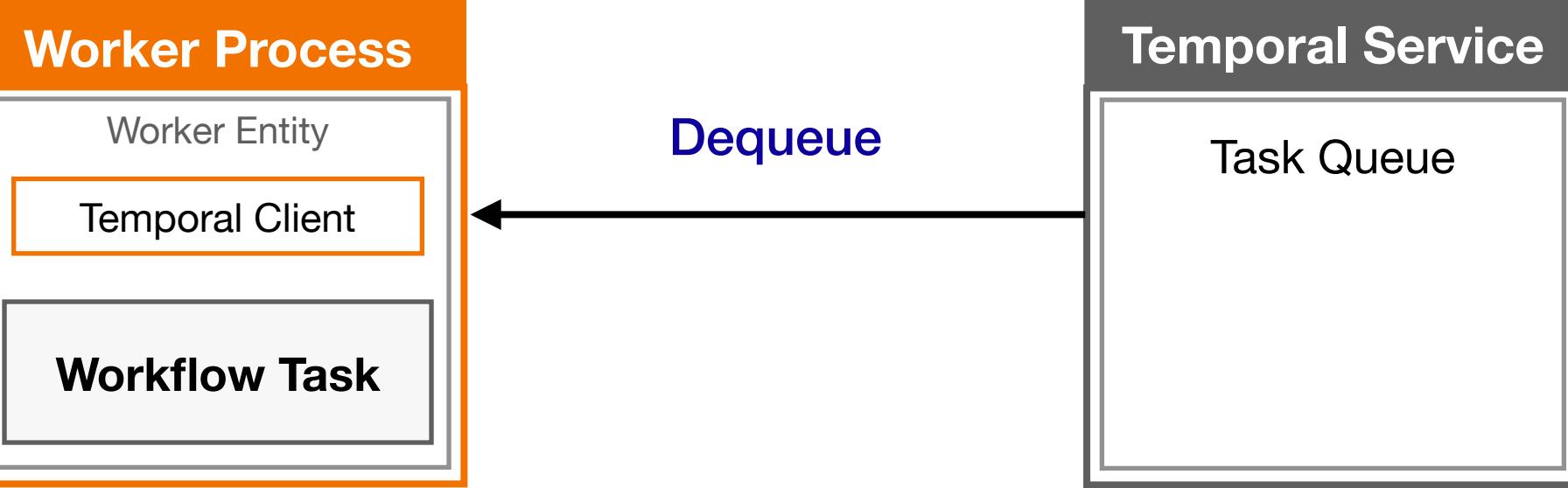
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	

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```



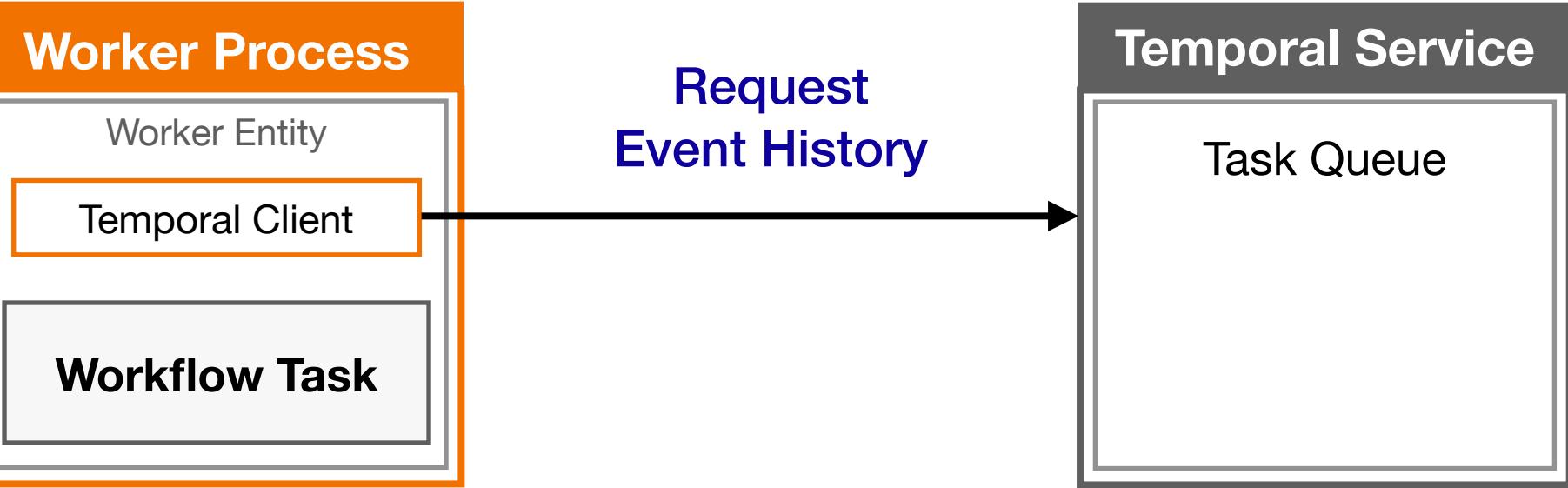
## Commands

Events	
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
<b>WorkflowTaskStarted</b>	

```

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```



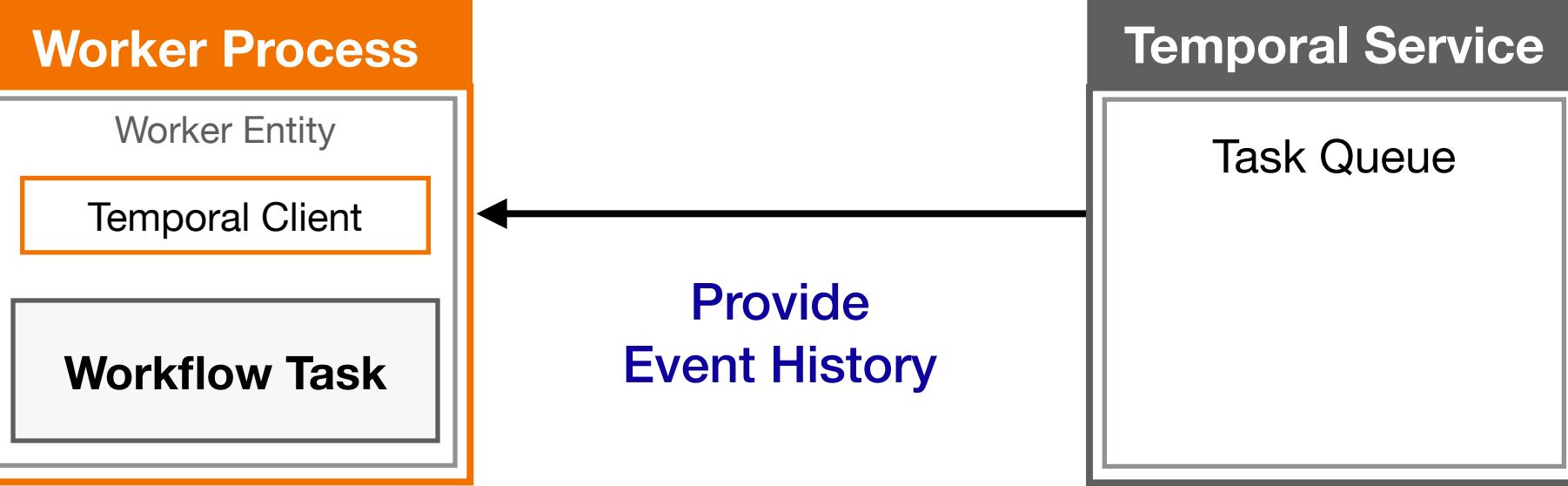
## Commands

Events	
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

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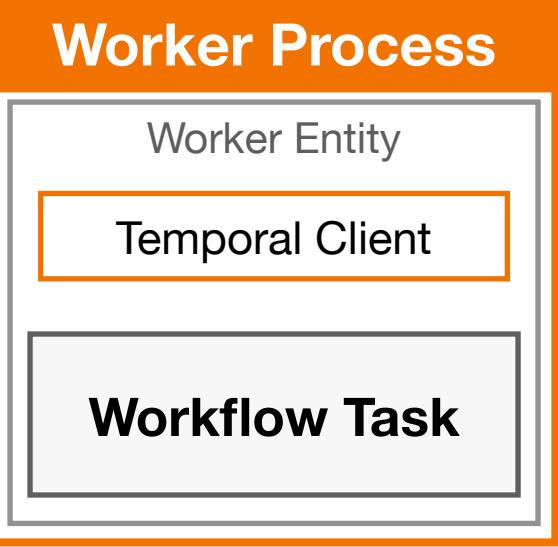


## Commands

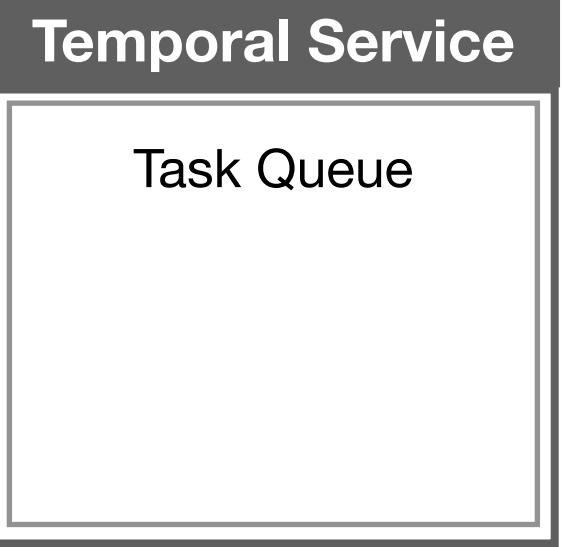
Events	
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
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WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

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## Worker Process



## Temporal Service

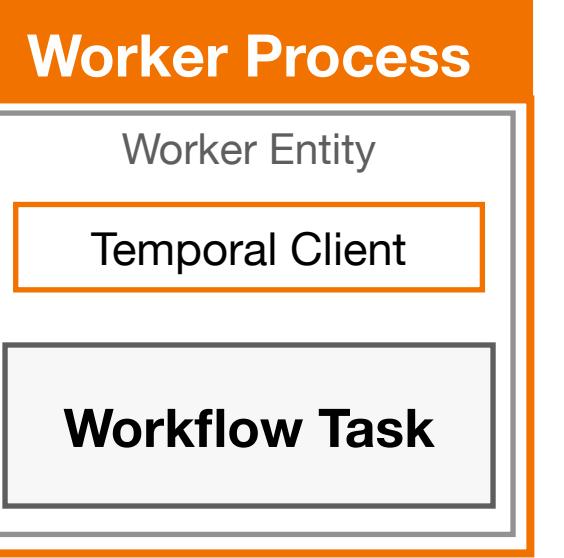
## Commands

## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
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WorkflowTaskStarted	
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TimerFired	
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WorkflowTaskStarted	
WorkflowTaskTimedOut	
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WorkflowTaskStarted	

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```



## Commands

## Temporal Service

Task Queue

## Events

WorkflowExecutionStarted

WorkflowTaskScheduled

WorkflowTaskStarted

WorkflowTaskCompleted

ActivityTaskScheduled **(GetDistance)**

ActivityTaskStarted

ActivityTaskCompleted **(distance=15)**

WorkflowTaskScheduled

WorkflowTaskStarted

WorkflowTaskCompleted

TimerStarted **(30 Minutes)**

TimerFired

WorkflowTaskScheduled

WorkflowTaskStarted

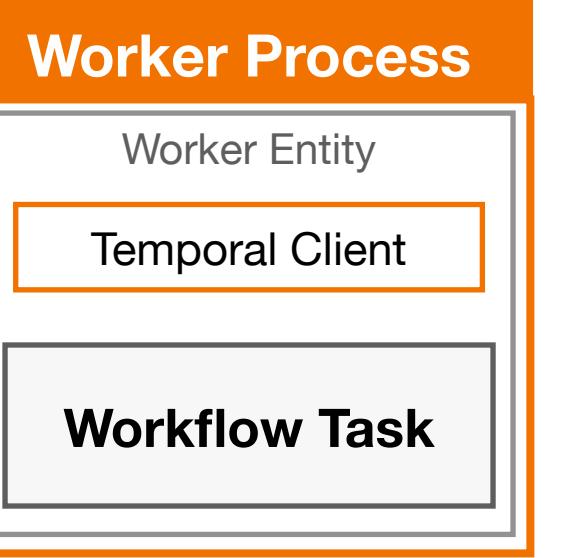
WorkflowTaskTimedOut

WorkflowTaskScheduled

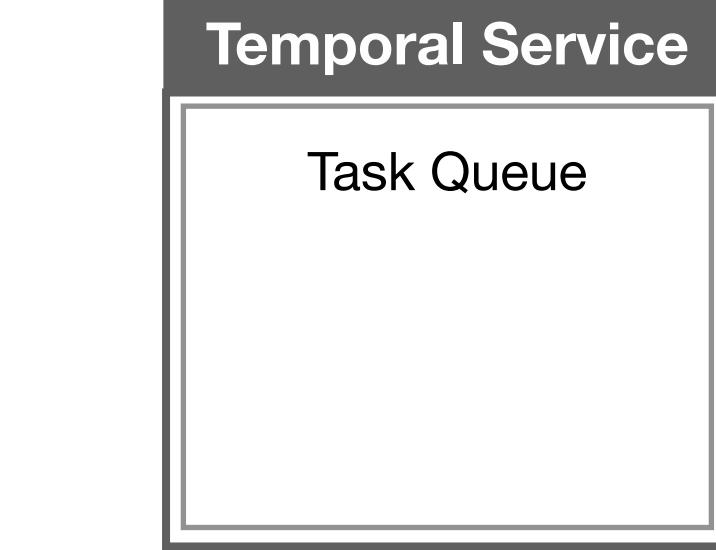
WorkflowTaskStarted

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
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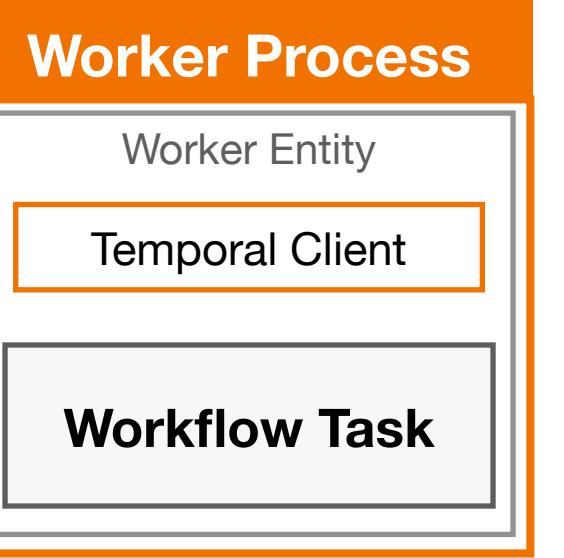


## Events

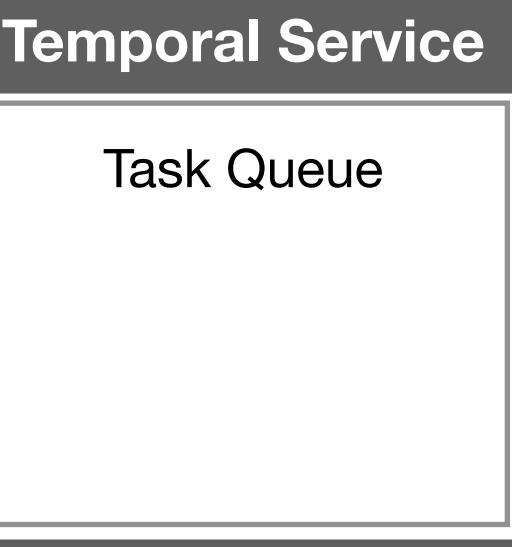
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
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```



## Commands

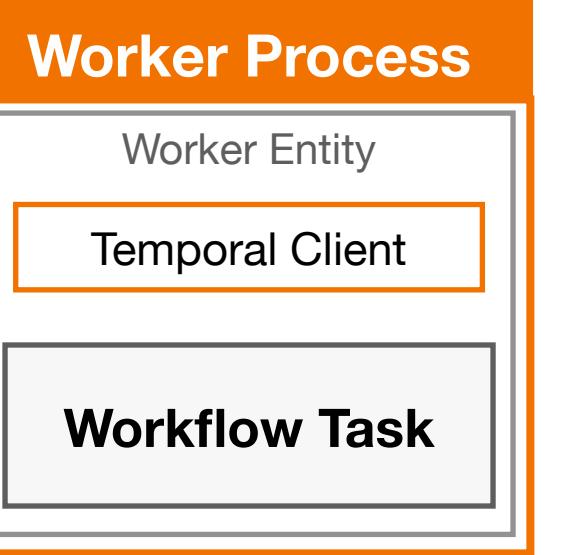


## Events

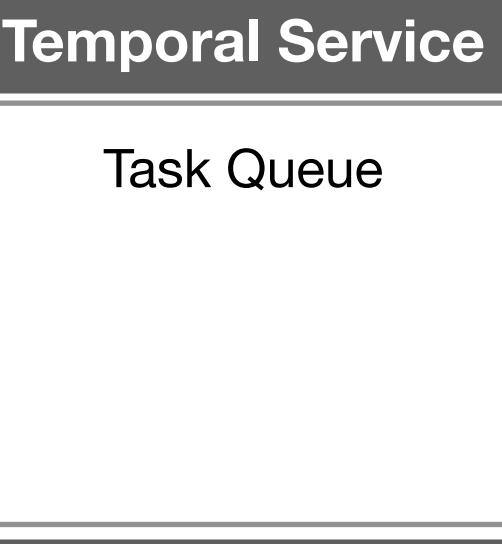
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands



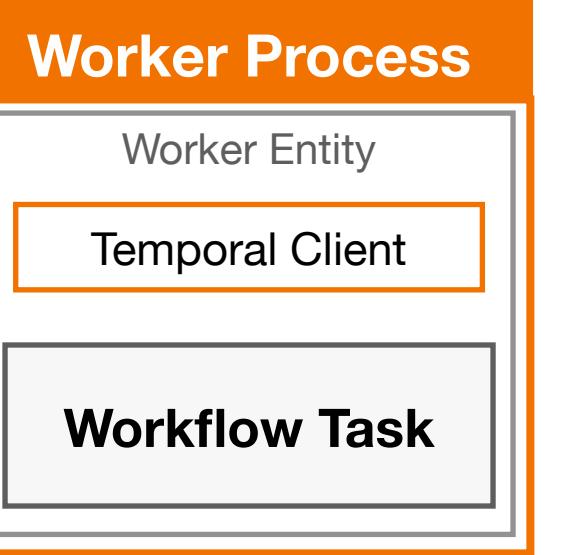
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

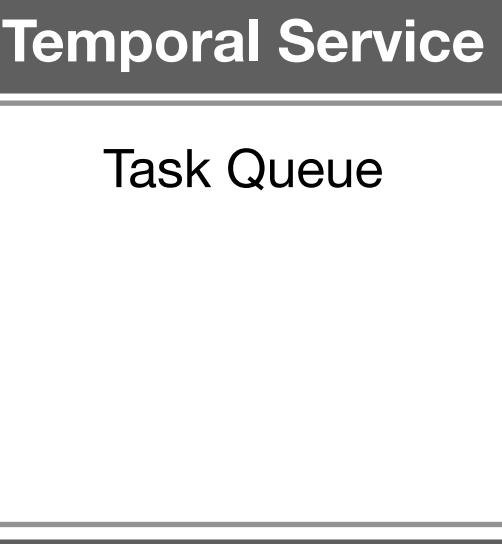
```

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28
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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands



## Temporal Service

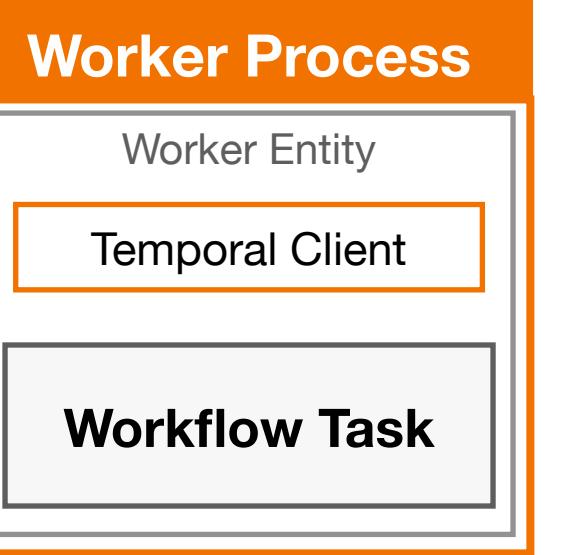
Task Queue

## Events

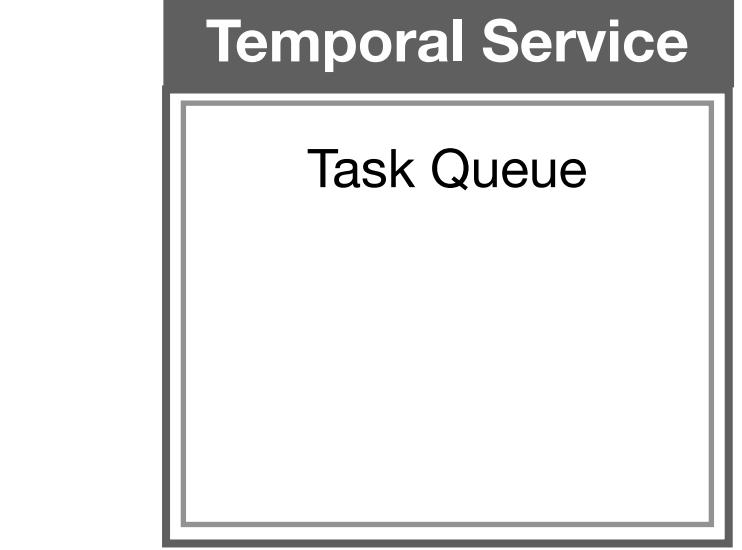
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands



## Temporal Service

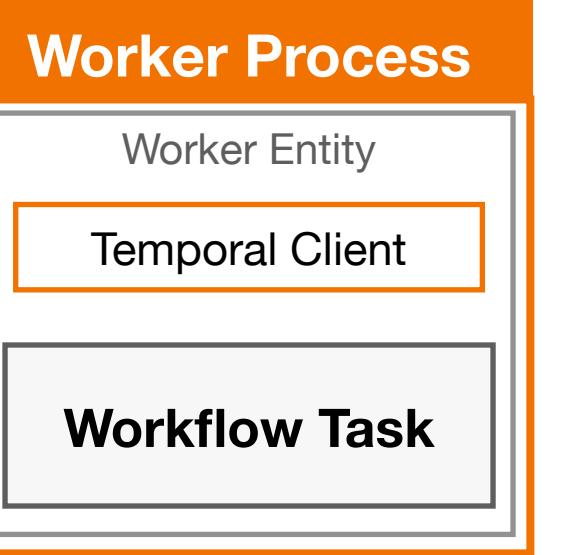
Task Queue

## Events

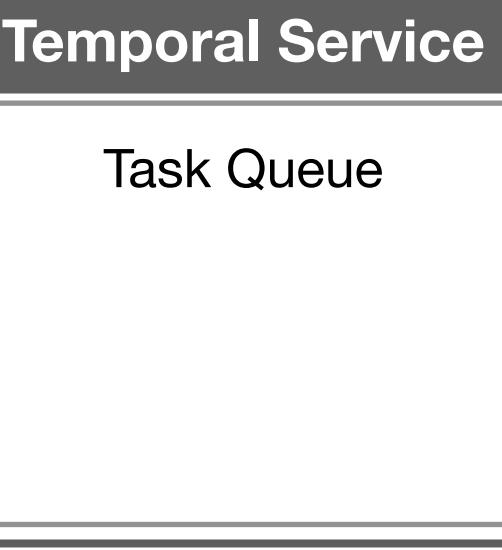
WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
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23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
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28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }
```



## Commands



## Temporal Service

Task Queue

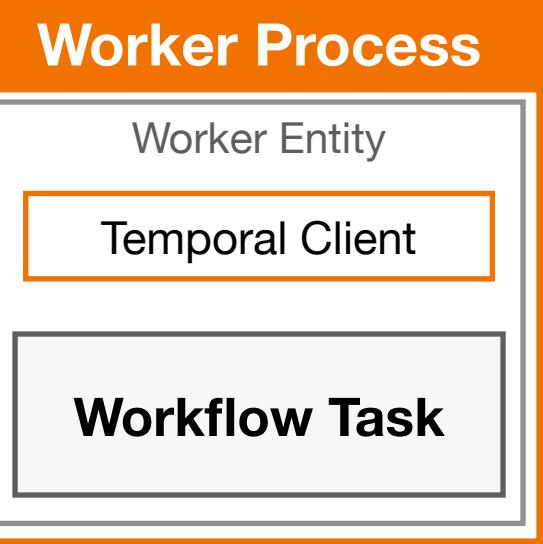
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

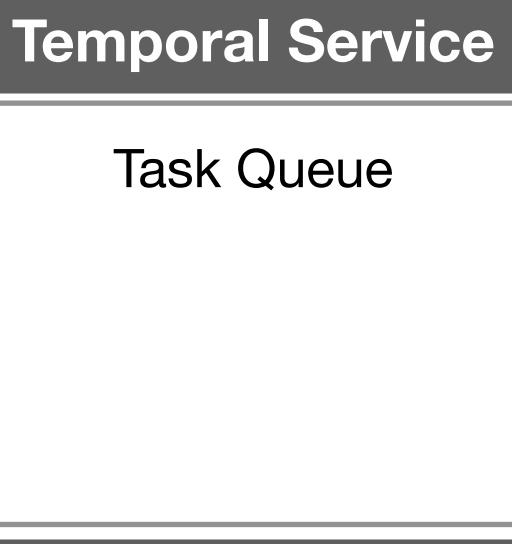
```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



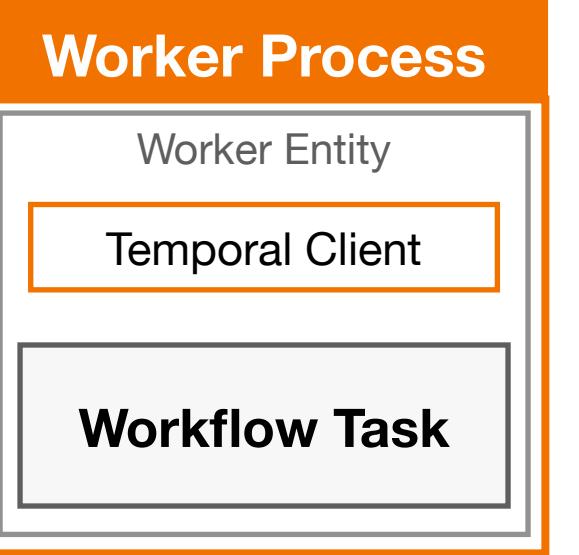
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	<code>(GetDistance)</code>
ActivityTaskStarted	
ActivityTaskCompleted	<code>(distance=15)</code>
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	<code>(30 Minutes)</code>
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
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28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

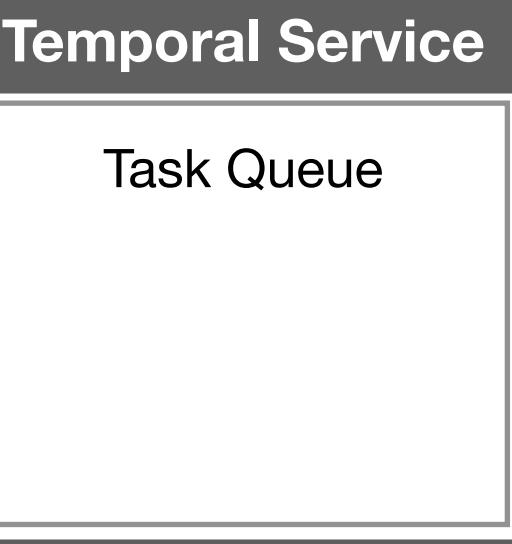
```



## Commands

**ScheduleActivityTask**

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



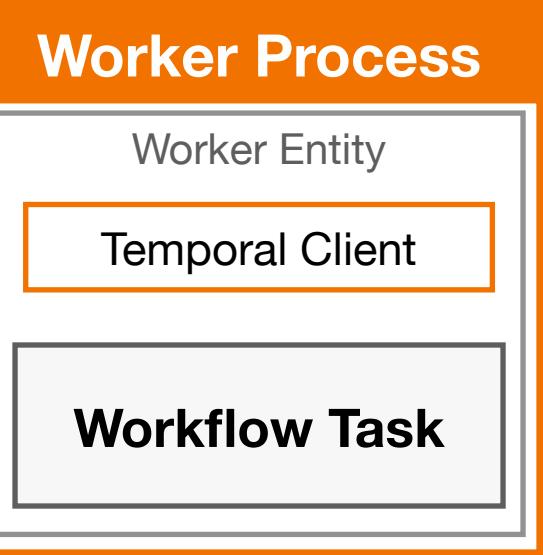
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
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19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
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32
33    return confirmation, nil
34}

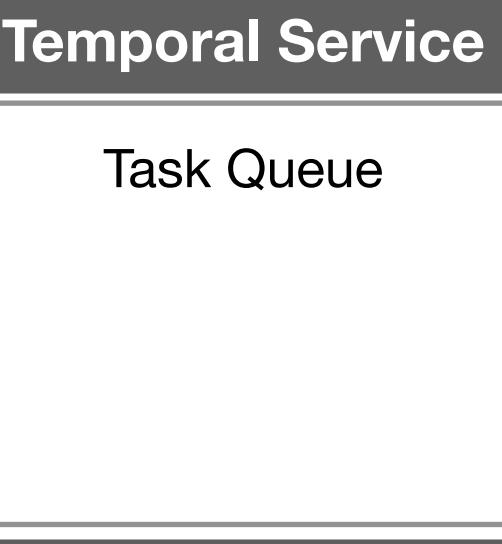
```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



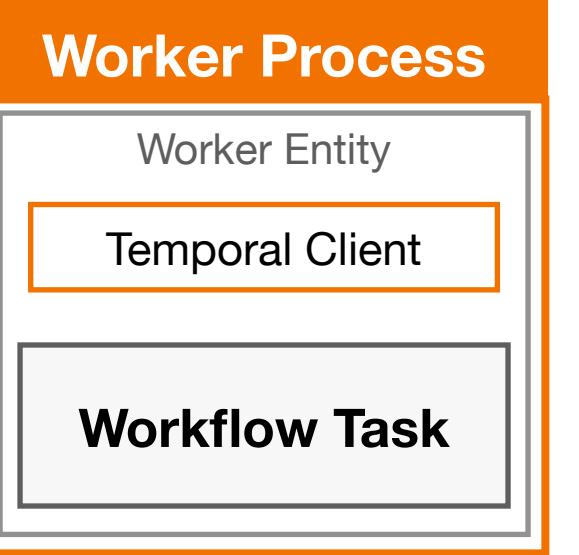
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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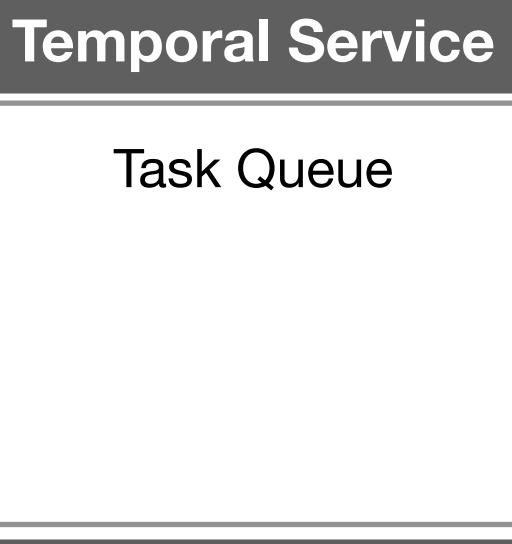
```



## Commands

**ScheduleActivityTask**

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



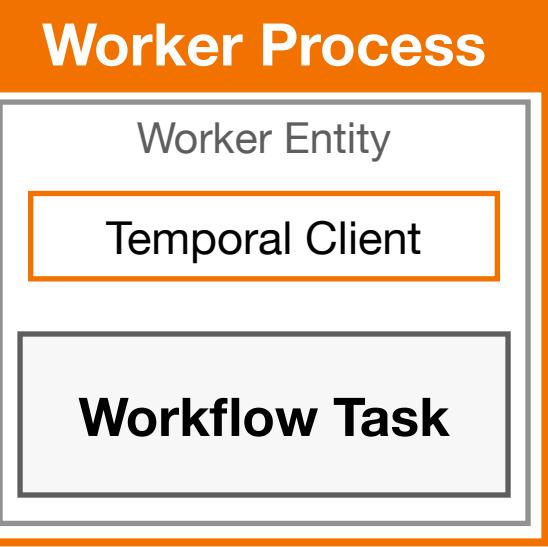
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	distance=15
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
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14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance) ← Worker assigns 15 to this variable
19
20    if order.IsDelivery && distance.Kilometers > 25 {
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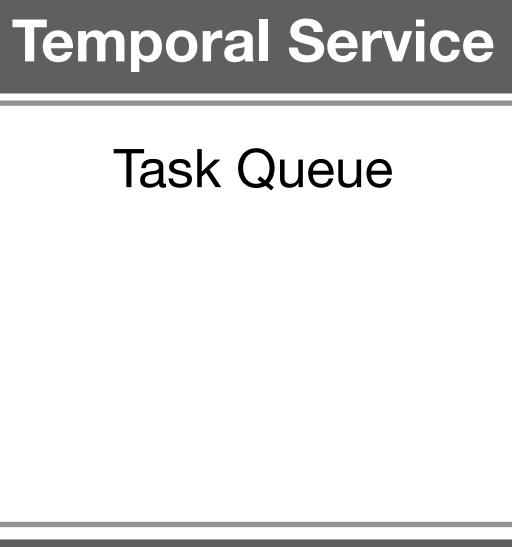
```



## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
Type: `GetDistance`  
Input: `"OrderNumber": "Z1238", ...`



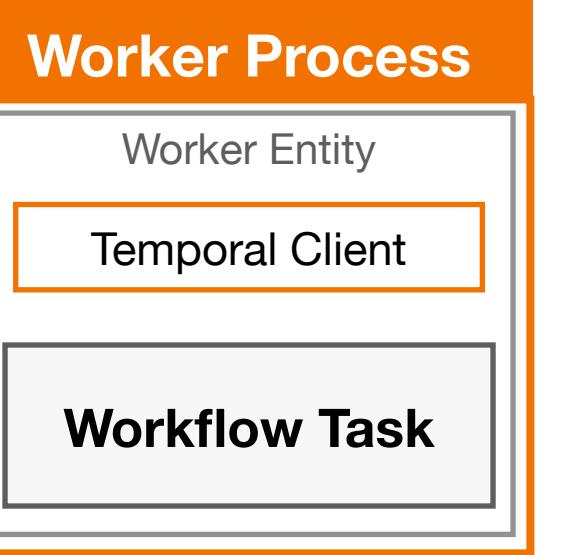
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

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33    return confirmation, nil
34}

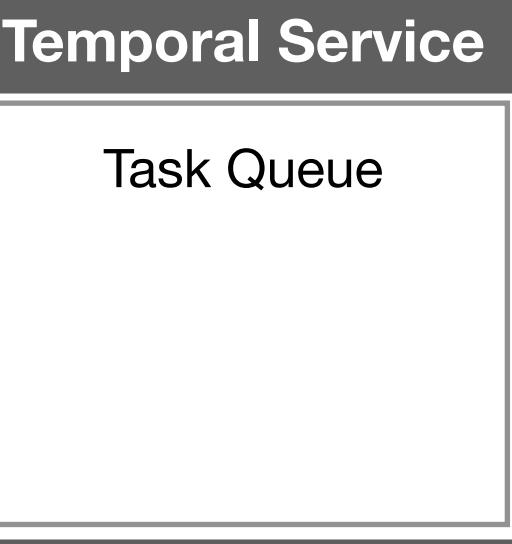
```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...



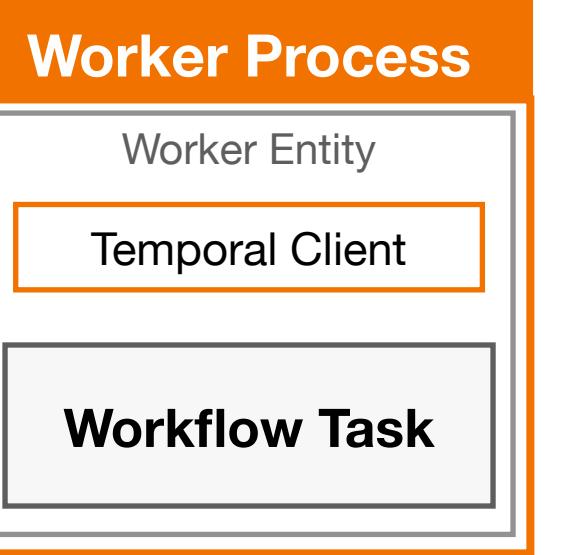
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

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31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

## Temporal Service

Task Queue

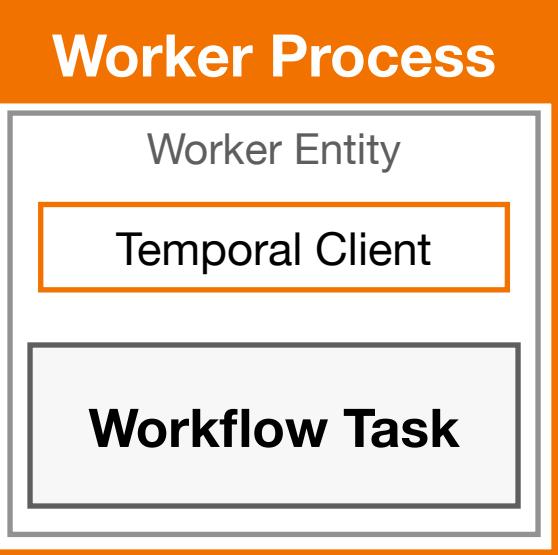
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

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18    _ = future.Get(ctx, &distance)
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20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

## Temporal Service

Task Queue

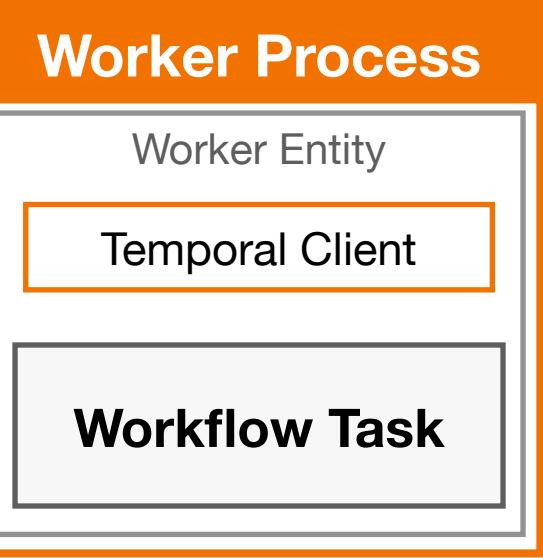
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



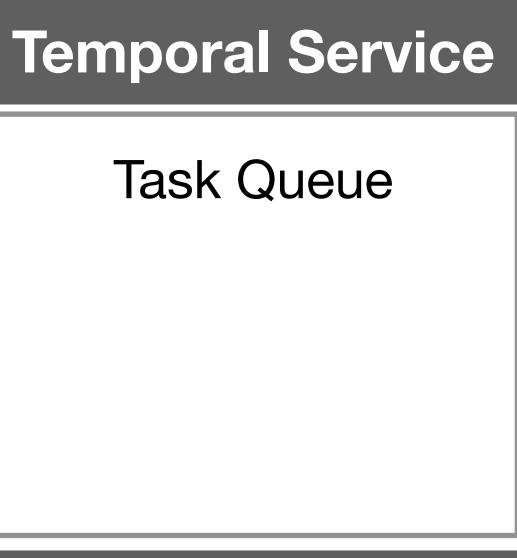
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

Duration: 30 minutes



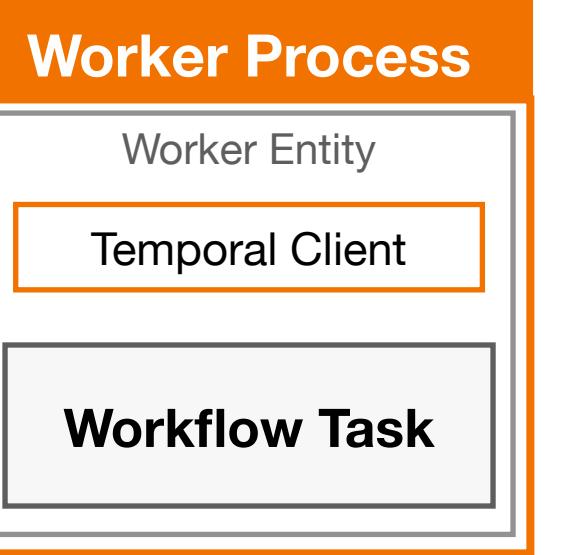
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
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33    return confirmation, nil
34 }

```



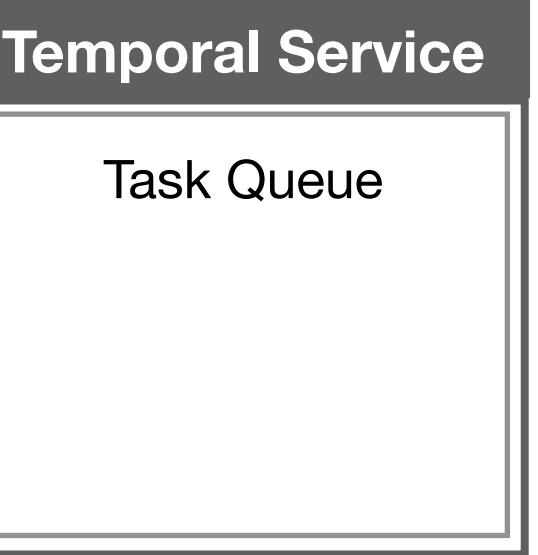
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

Duration: 30 minutes



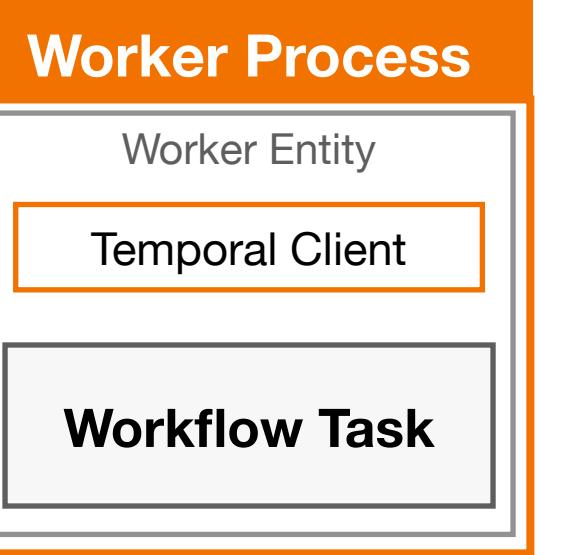
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

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31    _ = future.Get(ctx, &confirmation)
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33    return confirmation, nil
34 }

```



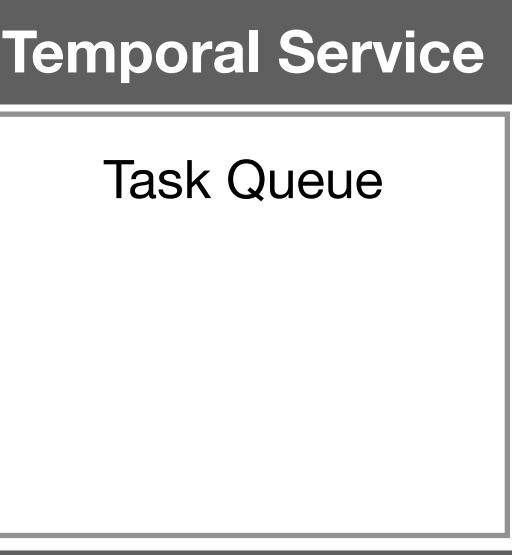
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

Duration: 30 minutes



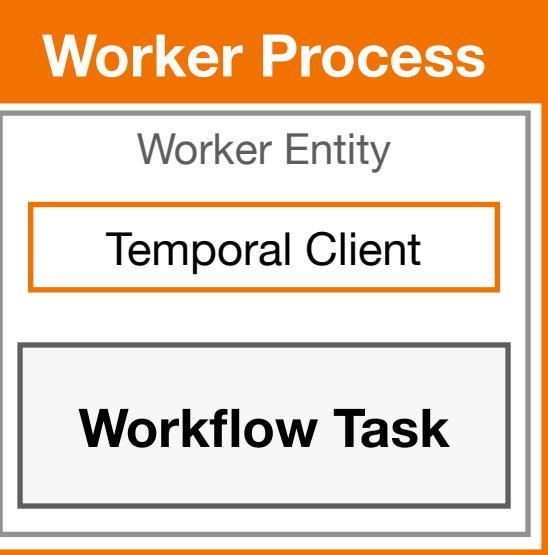
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



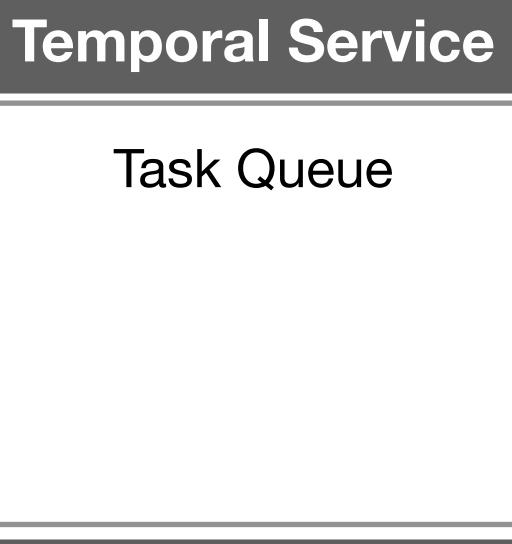
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes



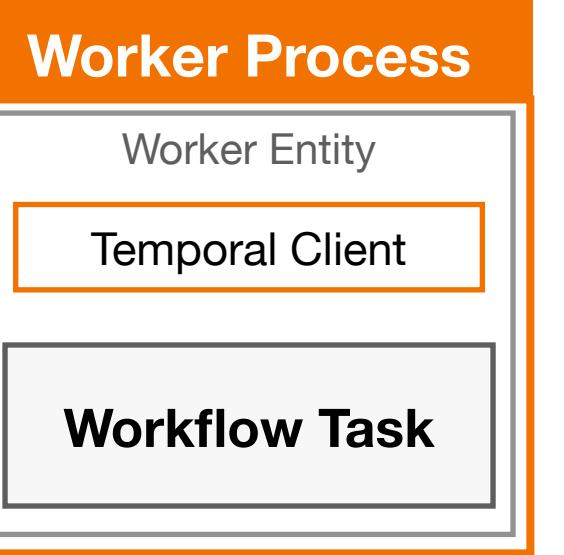
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
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31    future = workflow.ExecuteActivity(ctx, SendBill, bill)
32    _ = future.Get(ctx, &confirmation)
33
34    return confirmation, nil
}

```



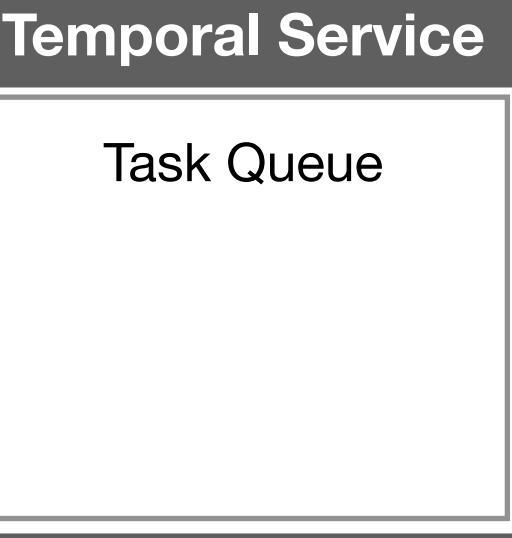
## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
 Type: `GetDistance`  
 Input: `"OrderNumber": "Z1238", ...`

### StartTimer

`30 minutes`



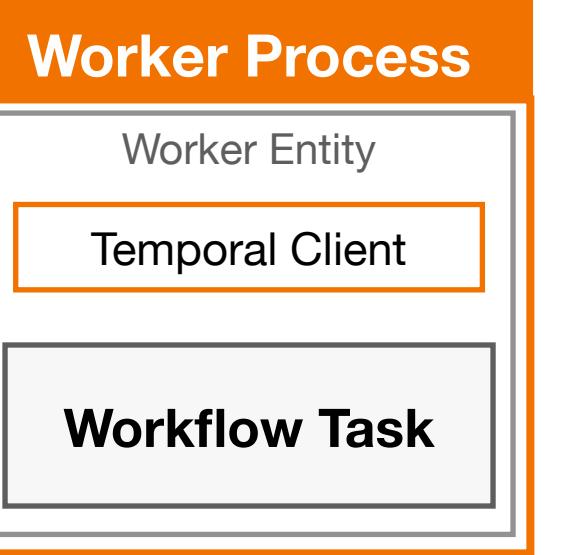
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	<code>(GetDistance)</code>
ActivityTaskStarted	
ActivityTaskCompleted	<code>(distance=15)</code>
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	<code>(30 Minutes)</code>
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



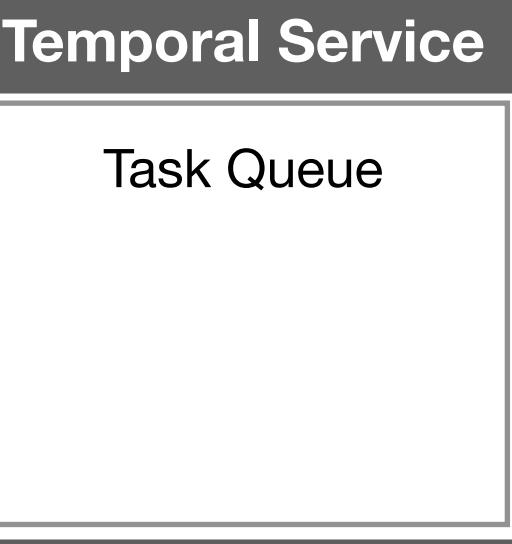
## Commands

### ScheduleActivityTask

Queue: `pizza-tasks`  
 Type: `GetDistance`  
 Input: `"OrderNumber": "Z1238", ...`

### StartTimer

`30 minutes`



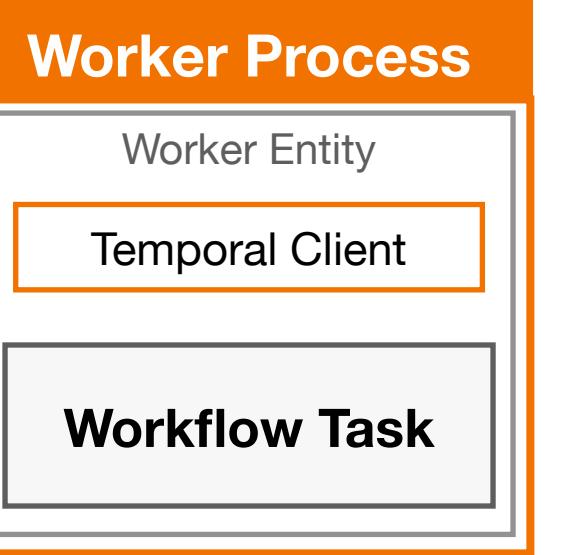
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	<code>(GetDistance)</code>
ActivityTaskStarted	
ActivityTaskCompleted	<code>(distance=15)</code>
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	<code>(30 Minutes)</code>
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

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30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
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33    return confirmation, nil
34}

```



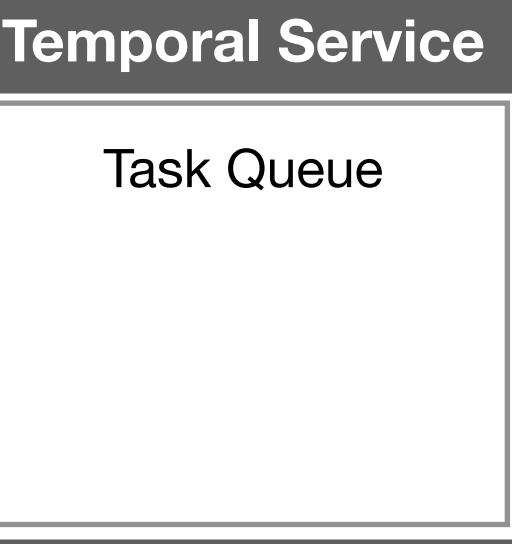
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes



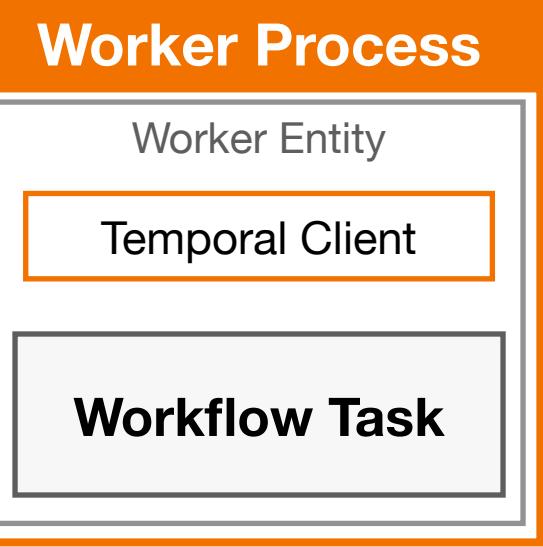
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
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```

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34    return confirmation, nil
}

```



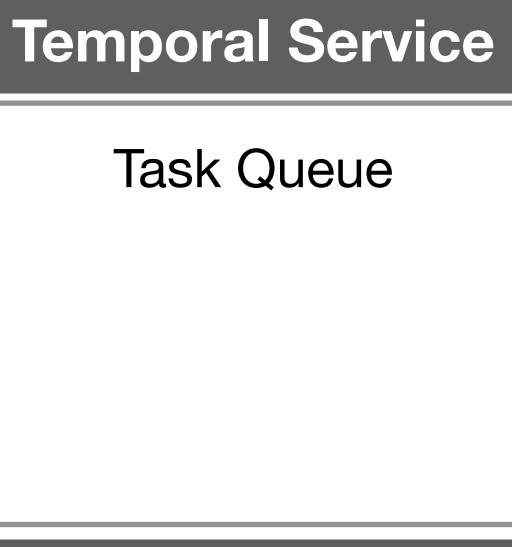
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes



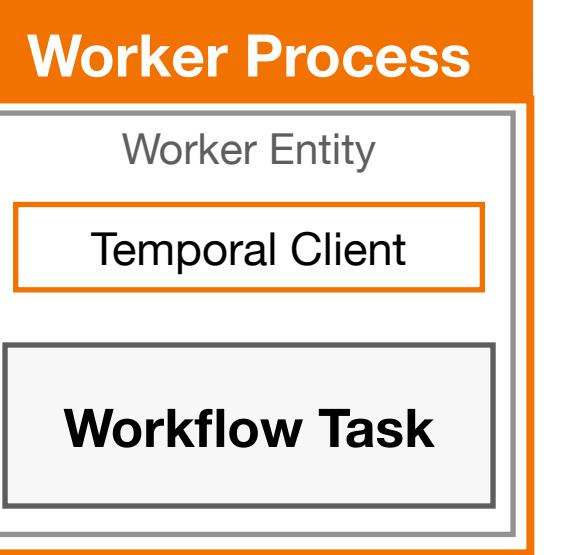
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
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}

```



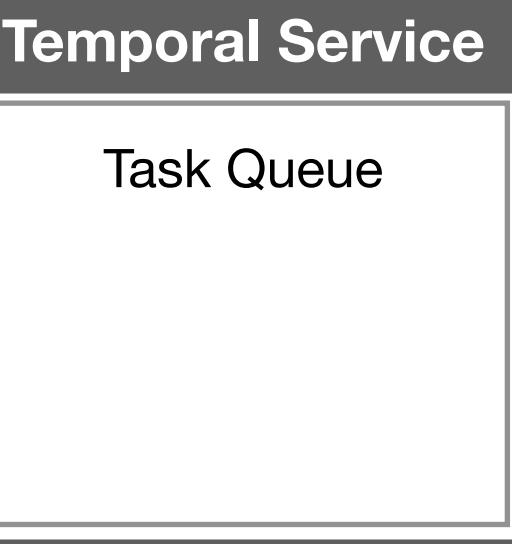
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes



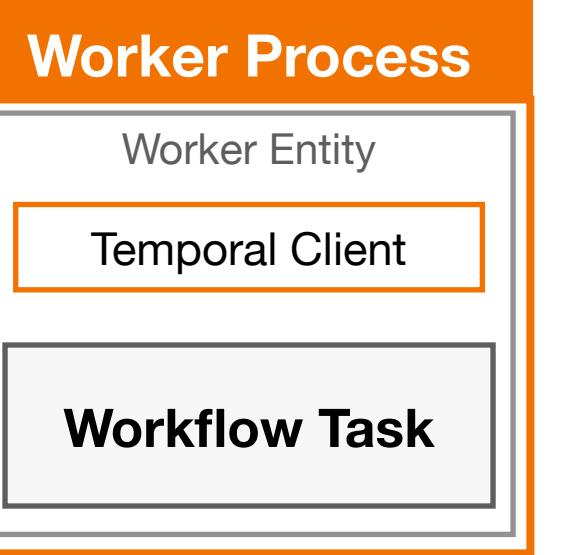
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
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WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
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WorkflowTaskStarted	
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34}

```



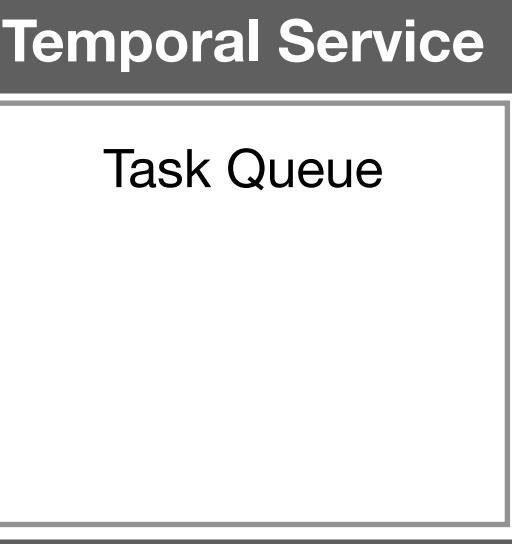
## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes



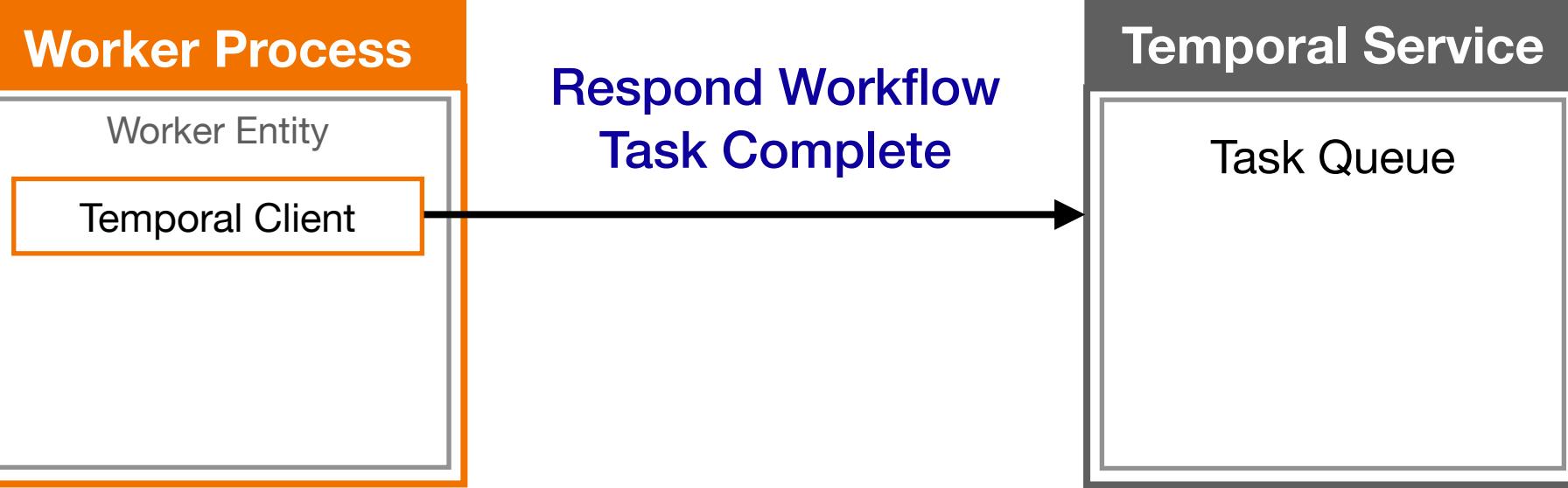
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
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WorkflowTaskStarted	
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31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

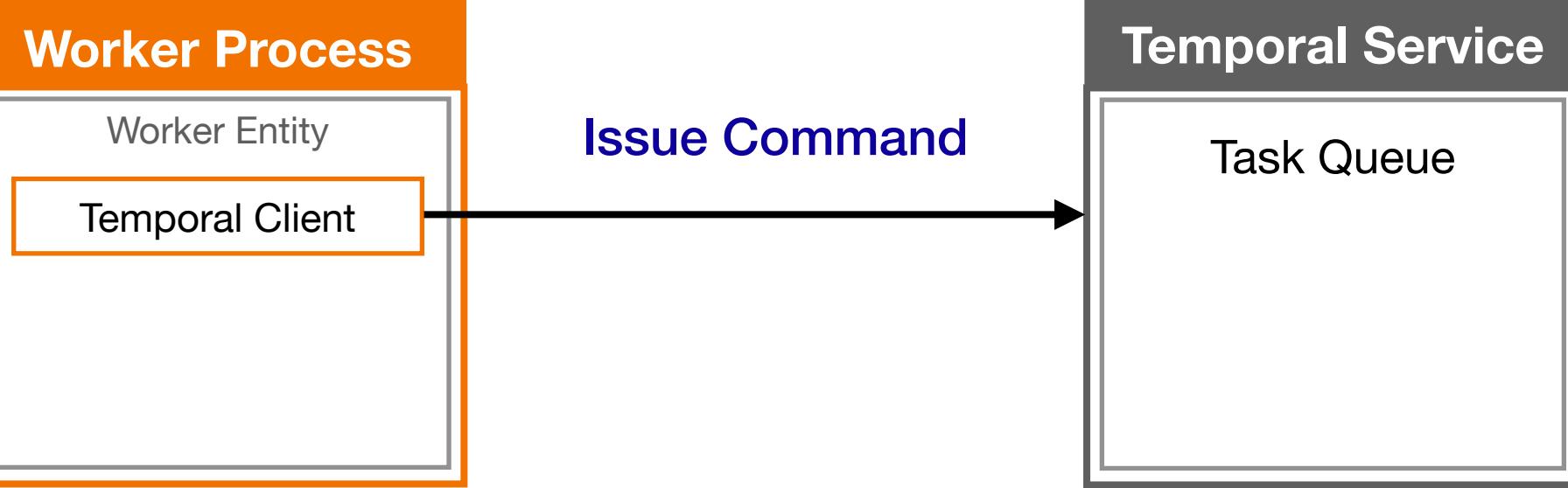
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
<b>WorkflowTaskCompleted</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

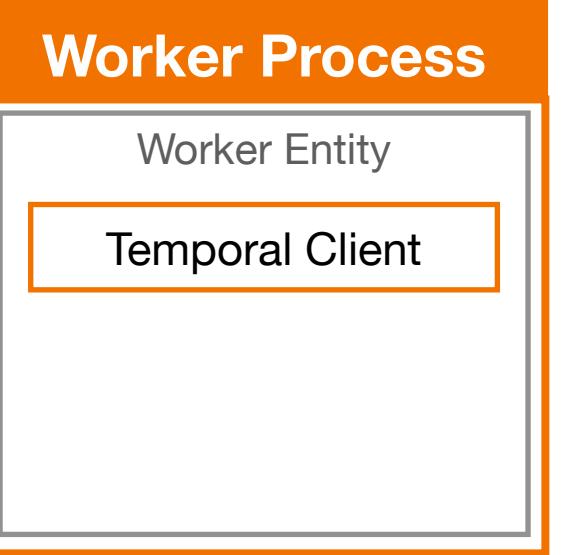
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

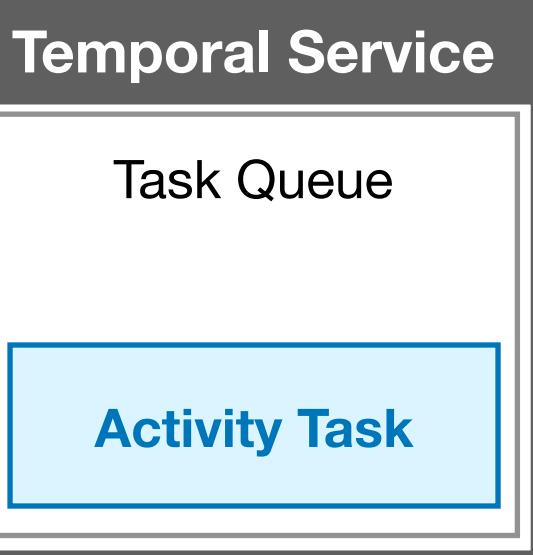
Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...



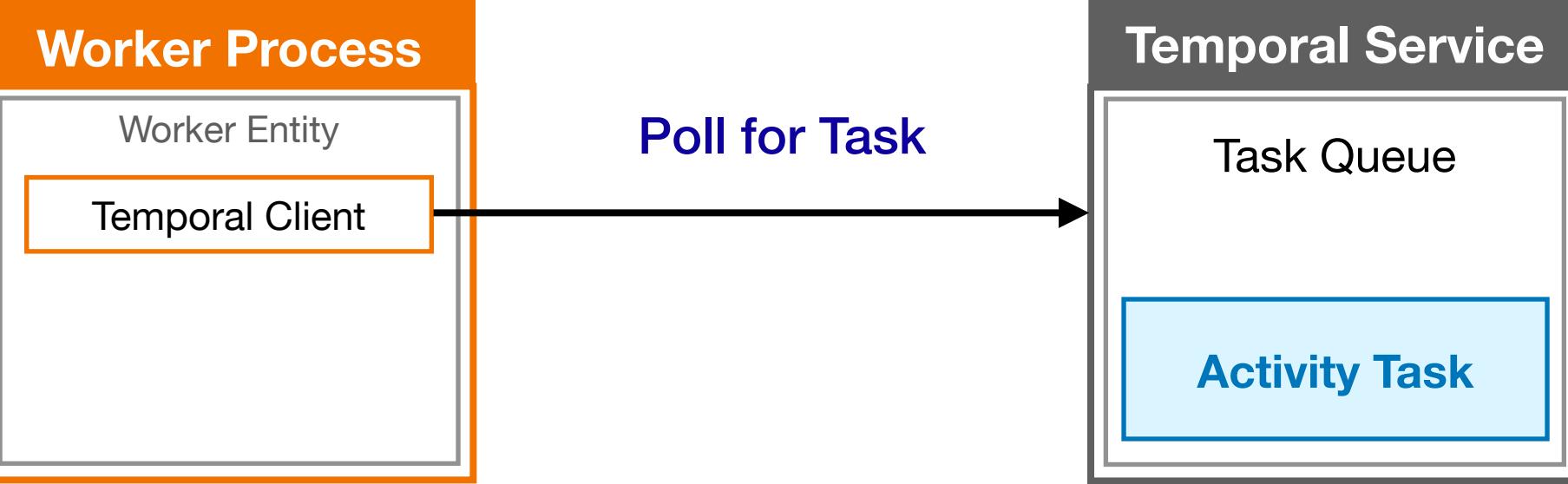
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

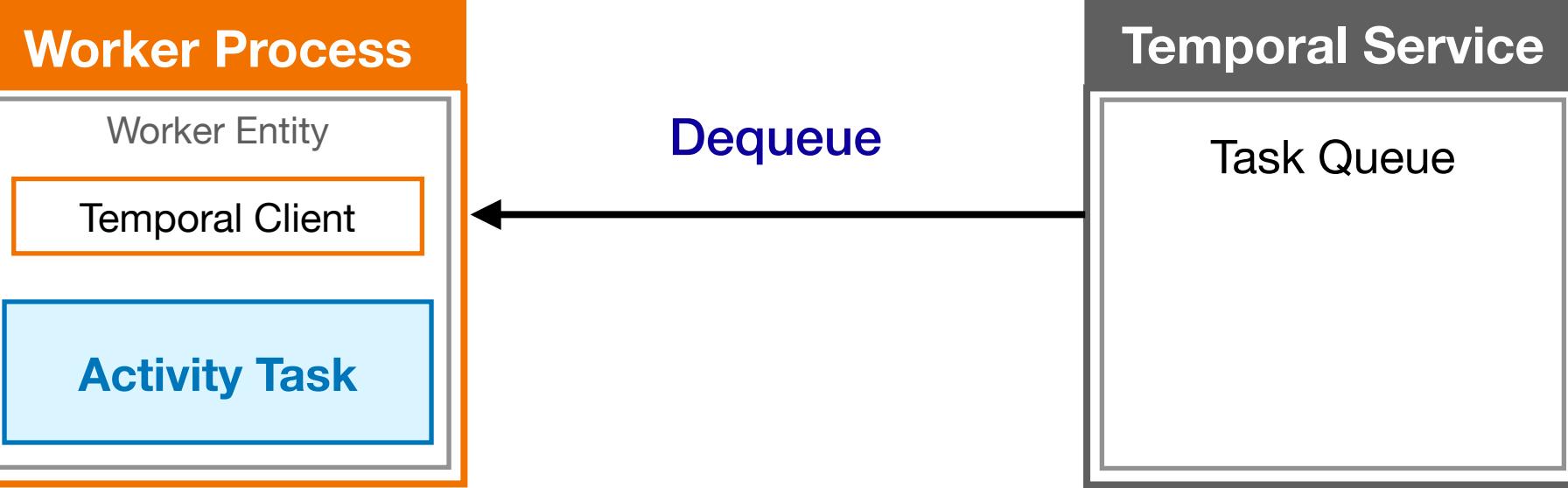
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

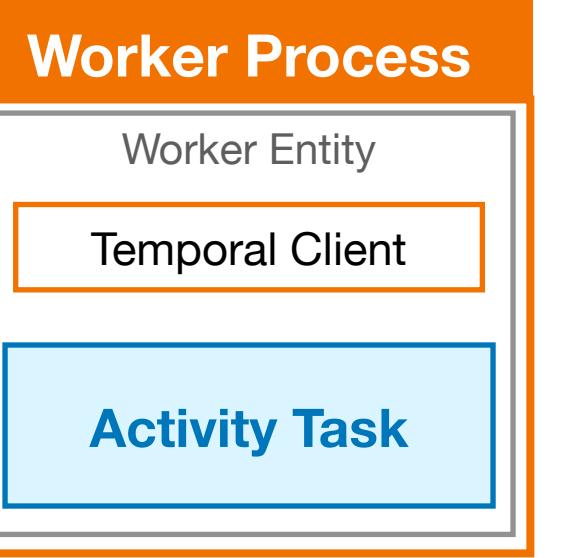
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
<b>ActivityTaskStarted</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
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26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

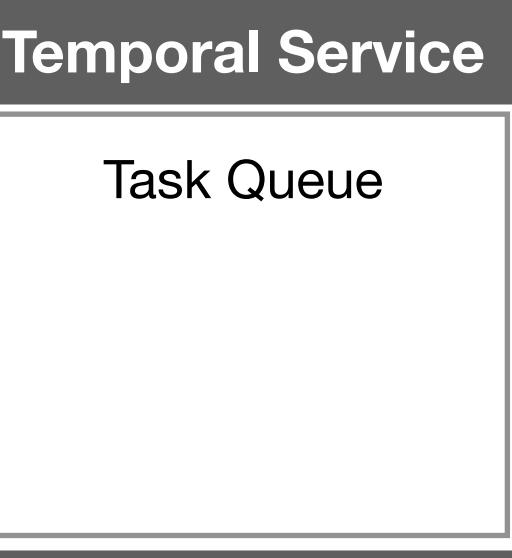
Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...



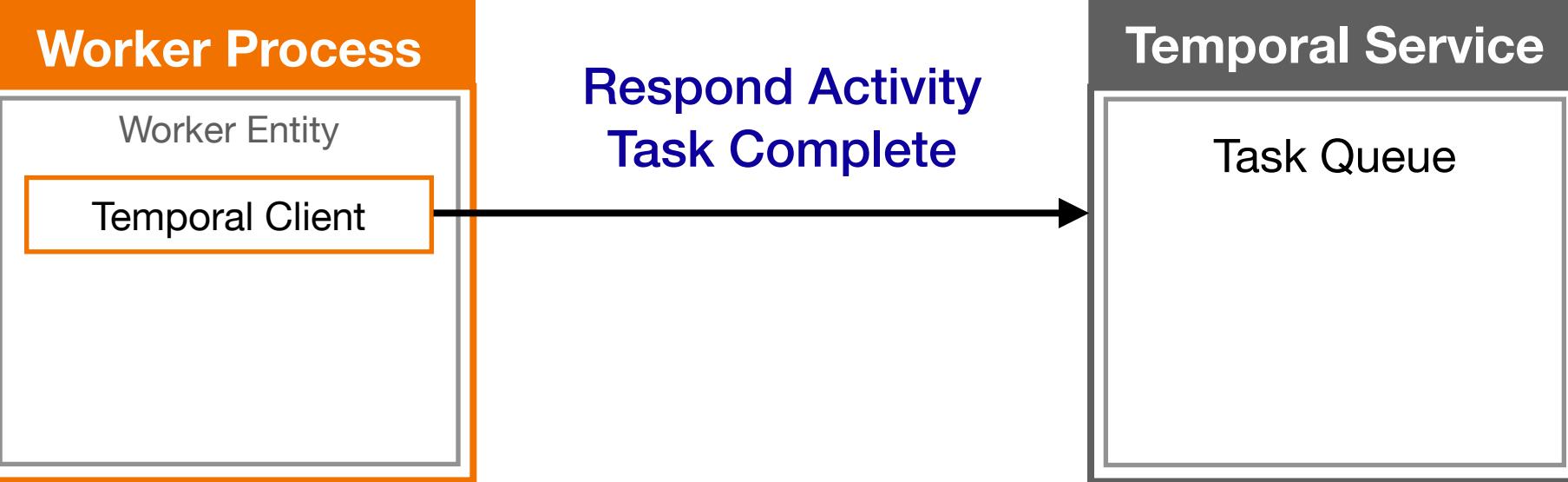
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
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13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

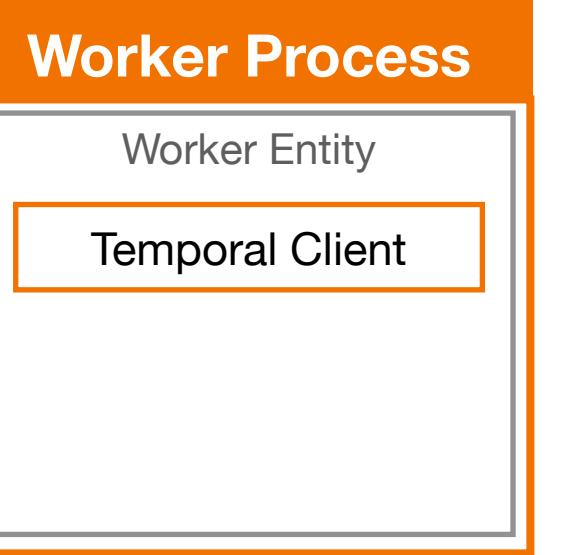
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

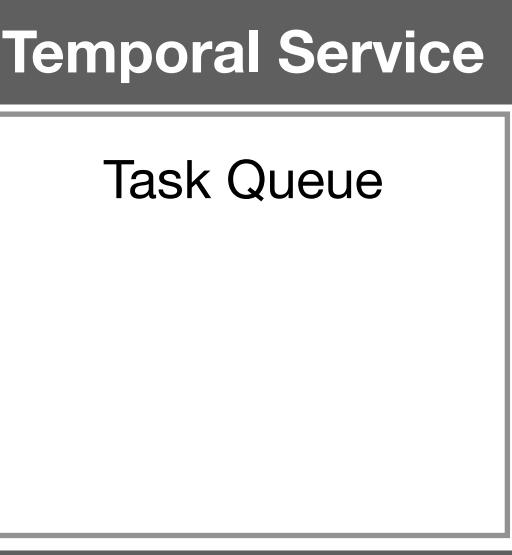
Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...



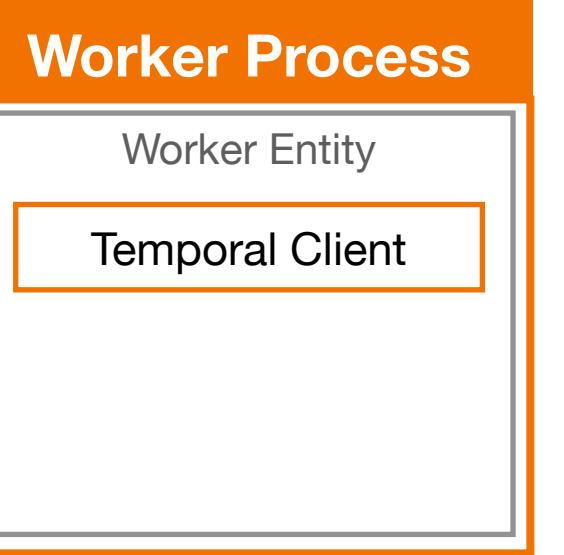
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
<b>ActivityTaskCompleted</b>	(confirmation=...)

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
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19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
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23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
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26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

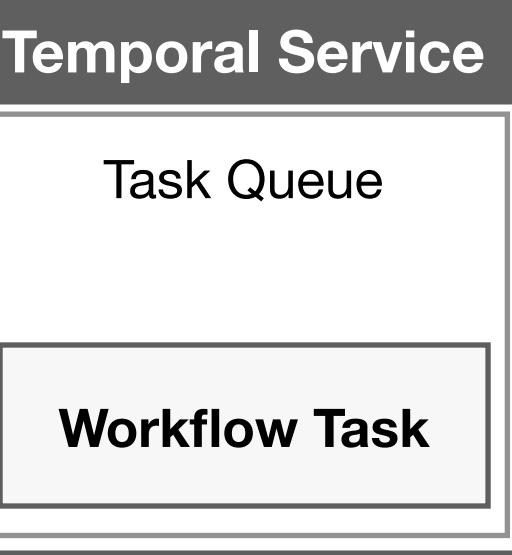
Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...



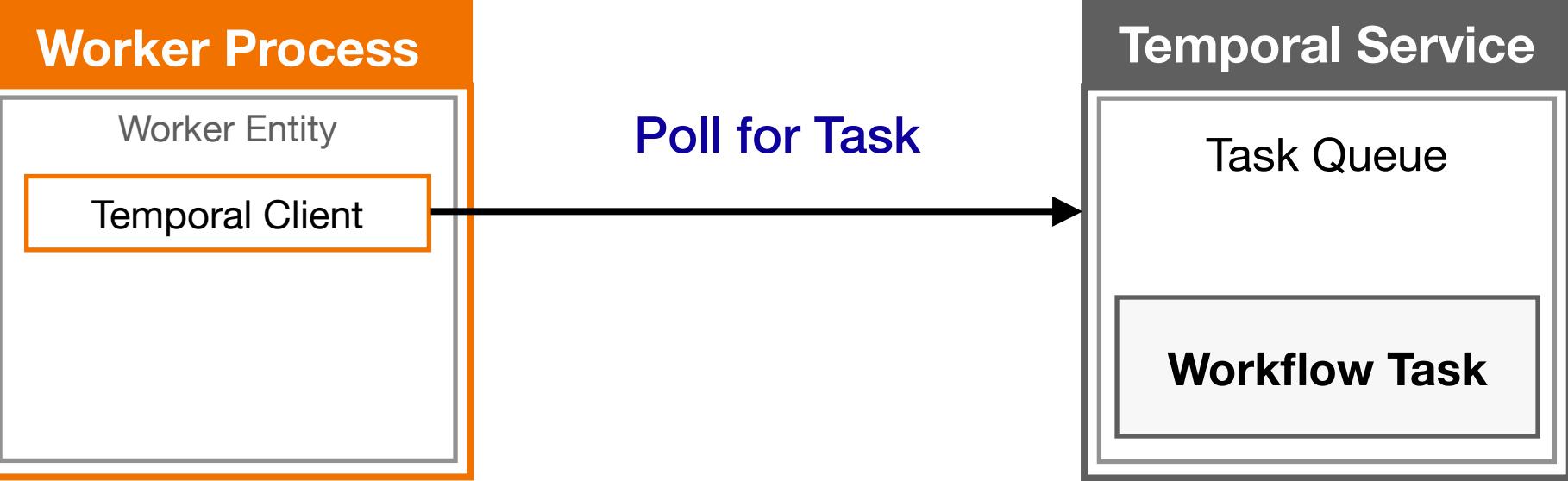
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
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15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
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26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

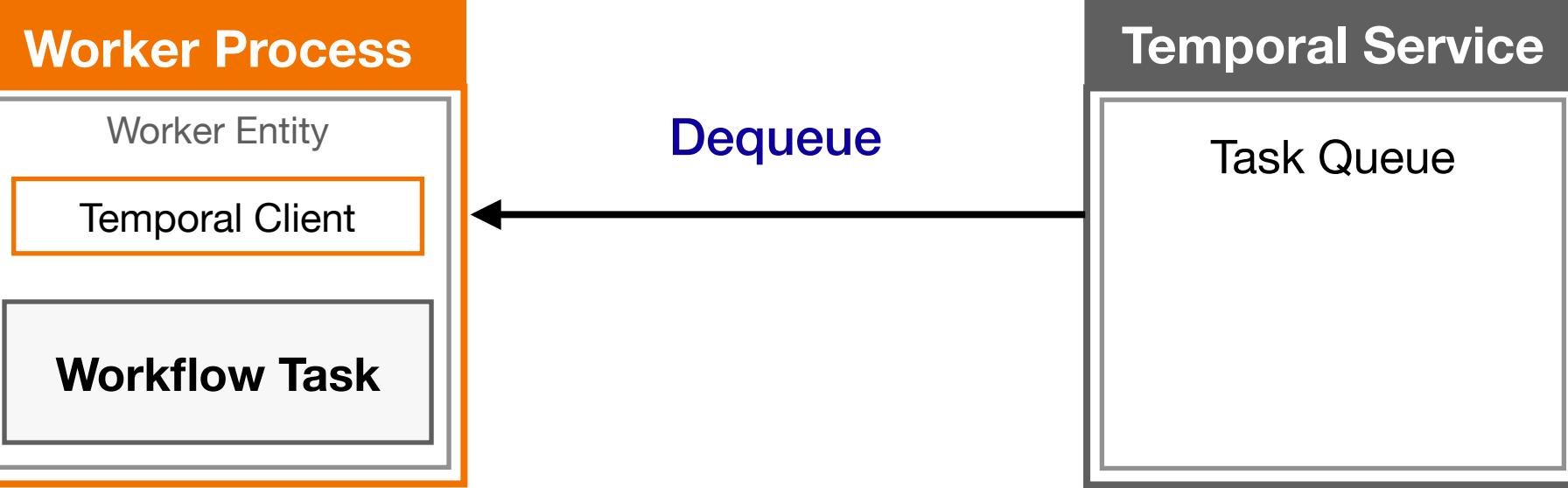
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
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11        totalPrice += pizza.Price
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15
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19
20    if order.IsDelivery && distance.Kilometers > 25 {
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27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

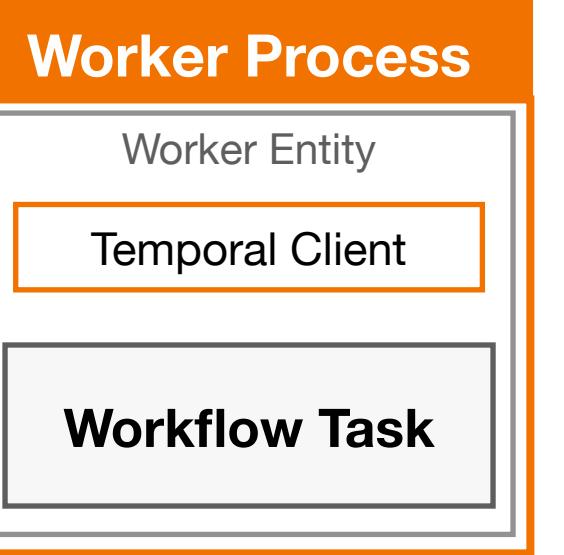
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	
<b>WorkflowTaskStarted</b>	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
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14    logger.Info("Calculated cost of order", "Total", totalPrice)
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16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34 }

```



## Commands

### ScheduleActivityTask

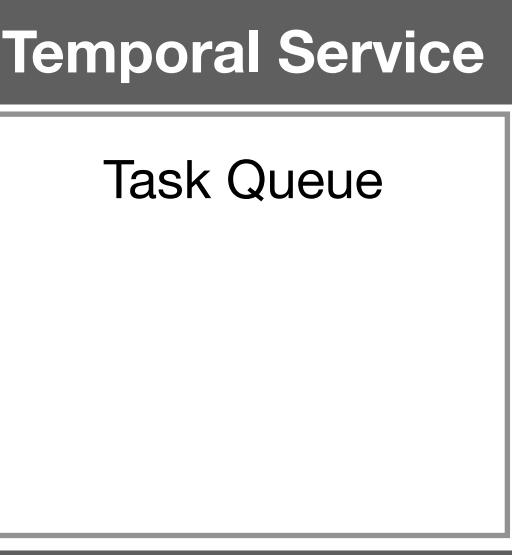
Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...



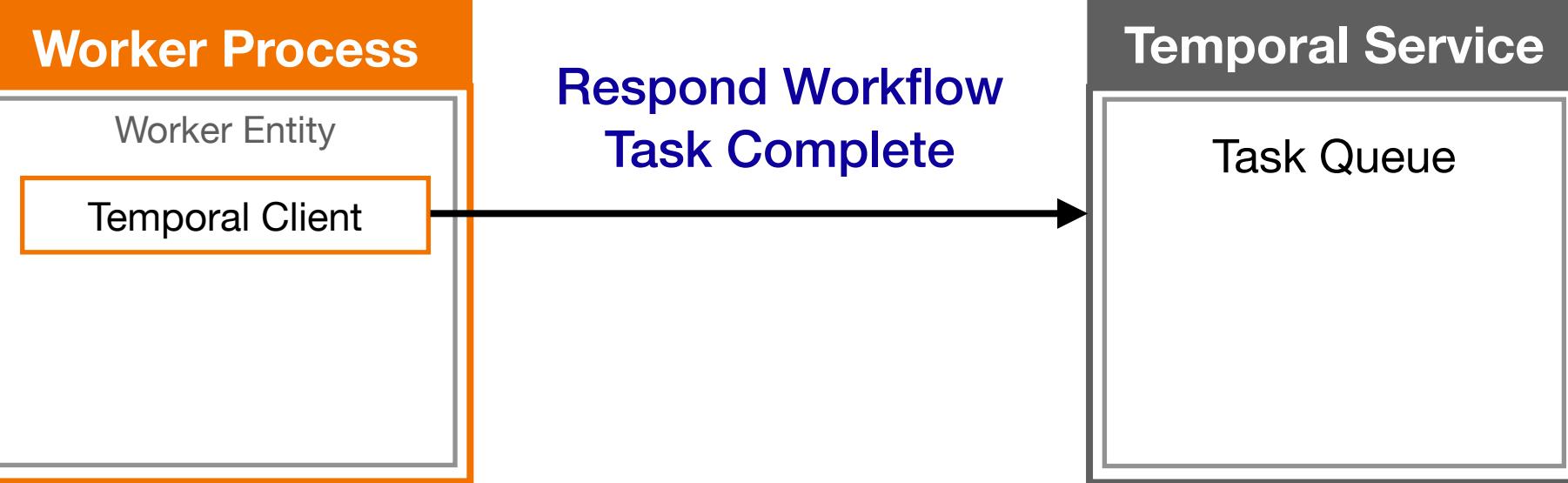
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

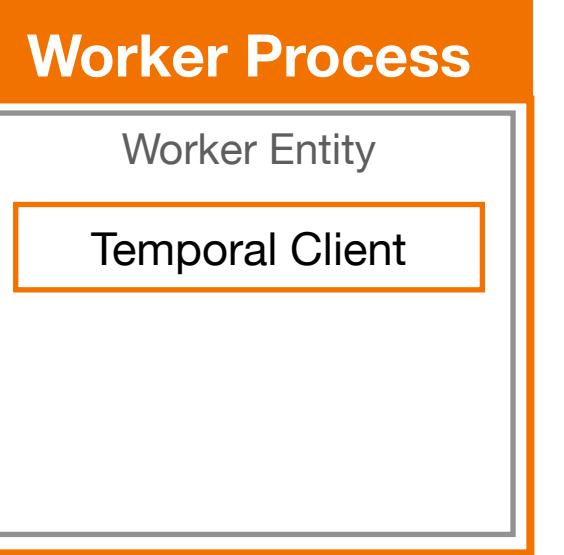
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	
WorkflowTaskStarted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

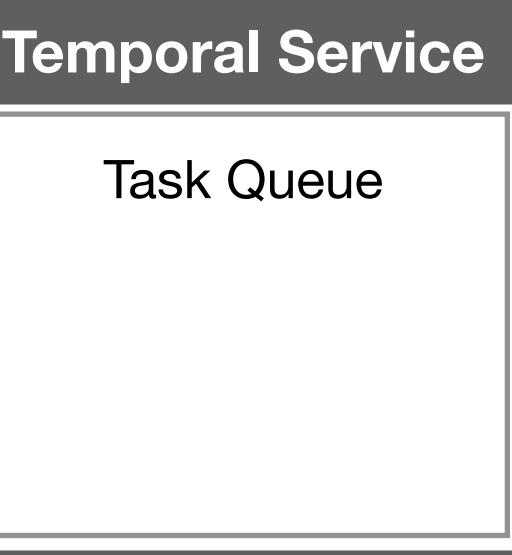
Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...



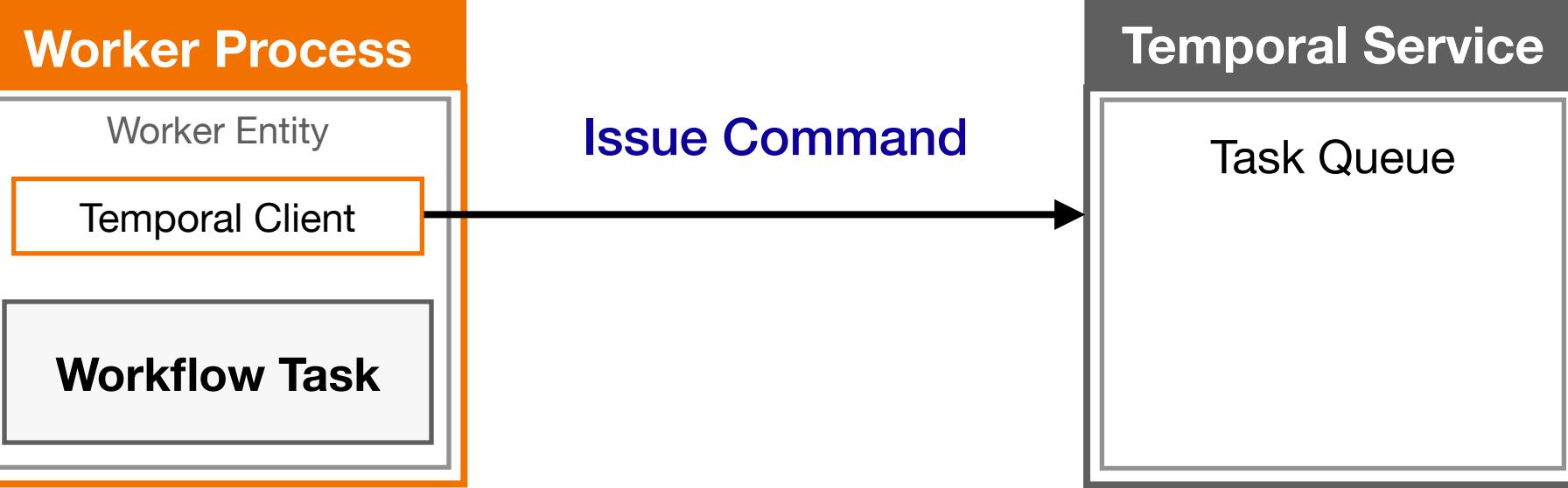
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

### CompleteWorkflowExecution

Result: "ConfirmationNumber": "TPD-26074139"

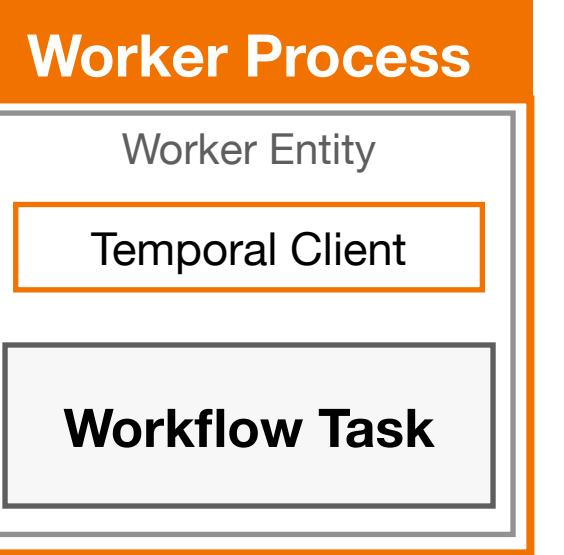
## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```

01 func PizzaWorkflow(ctx workflow.Context, order PizzaOrder) (string, error) {
02     logger := workflow.GetLogger(ctx)
03
04     options := workflow.ActivityOptions{
05         StartToCloseTimeout: time.Second * 5,
06     }
07     ctx = workflow.WithActivityOptions(ctx, options)
08
09     var totalPrice int
10    for _, pizza := range order.Items {
11        totalPrice += pizza.Price
12    }
13
14    logger.Info("Calculated cost of order", "Total", totalPrice)
15
16    var distance Distance
17    future := workflow.ExecuteActivity(ctx, GetDistance, order.Address)
18    _ = future.Get(ctx, &distance)
19
20    if order.IsDelivery && distance.Kilometers > 25 {
21        return "", errors.New("customer lives too far away for delivery")
22    }
23
24    _ = workflow.Sleep(ctx, time.Minute * 30)
25
26    // call a local function to create the input passed to next Activity
27    bill := createBill(order, totalPrice)
28
29    var confirmation OrderConfirmation
30    future = workflow.ExecuteActivity(ctx, SendBill, bill)
31    _ = future.Get(ctx, &confirmation)
32
33    return confirmation, nil
34}

```



## Commands

### ScheduleActivityTask

Queue: pizza-tasks  
Type: GetDistance  
Input: "OrderNumber": "Z1238", ...

### StartTimer

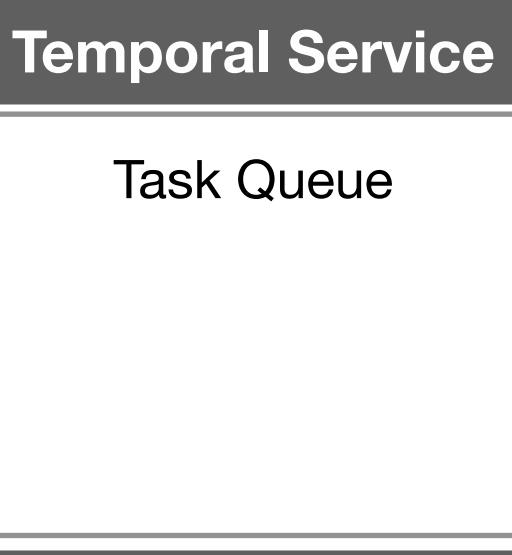
30 minutes

### ScheduleActivityTask

Queue: pizza-tasks  
Type: SendBill  
Input: "CustomerID": 12983, ...

### CompleteWorkflowExecution

Result: "ConfirmationNumber": "TPD-26074139"



## Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(GetDistance)
ActivityTaskStarted	
ActivityTaskCompleted	(distance=15)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	(30 Minutes)
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(SendBill)
ActivityTaskStarted	
ActivityTaskCompleted	(confirmation=...)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
WorkflowExecutionCompleted	

# Why Temporal Requirements Determinism for Workflows

---

## Workflow Definition

```
01 func DeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
09     if err != nil {
10         return err
11     }
12
13     workflow.Sleep(ctx, time.Hour * 4)
14
15     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
16     if err != nil {
17         return err
18     }
19
20     return nil
21 }
```

## Workflow Definition

```
01 func DeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
09     if err != nil {
10         return err
11     }
12
13     workflow.Sleep(ctx, time.Hour * 4)
14
15     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
16     if err != nil {
17         return err
18     }
19
20     return nil
21 }
```

### Commands

#### ScheduleActivityTask

Type: ImportSalesData

#### StartTimer

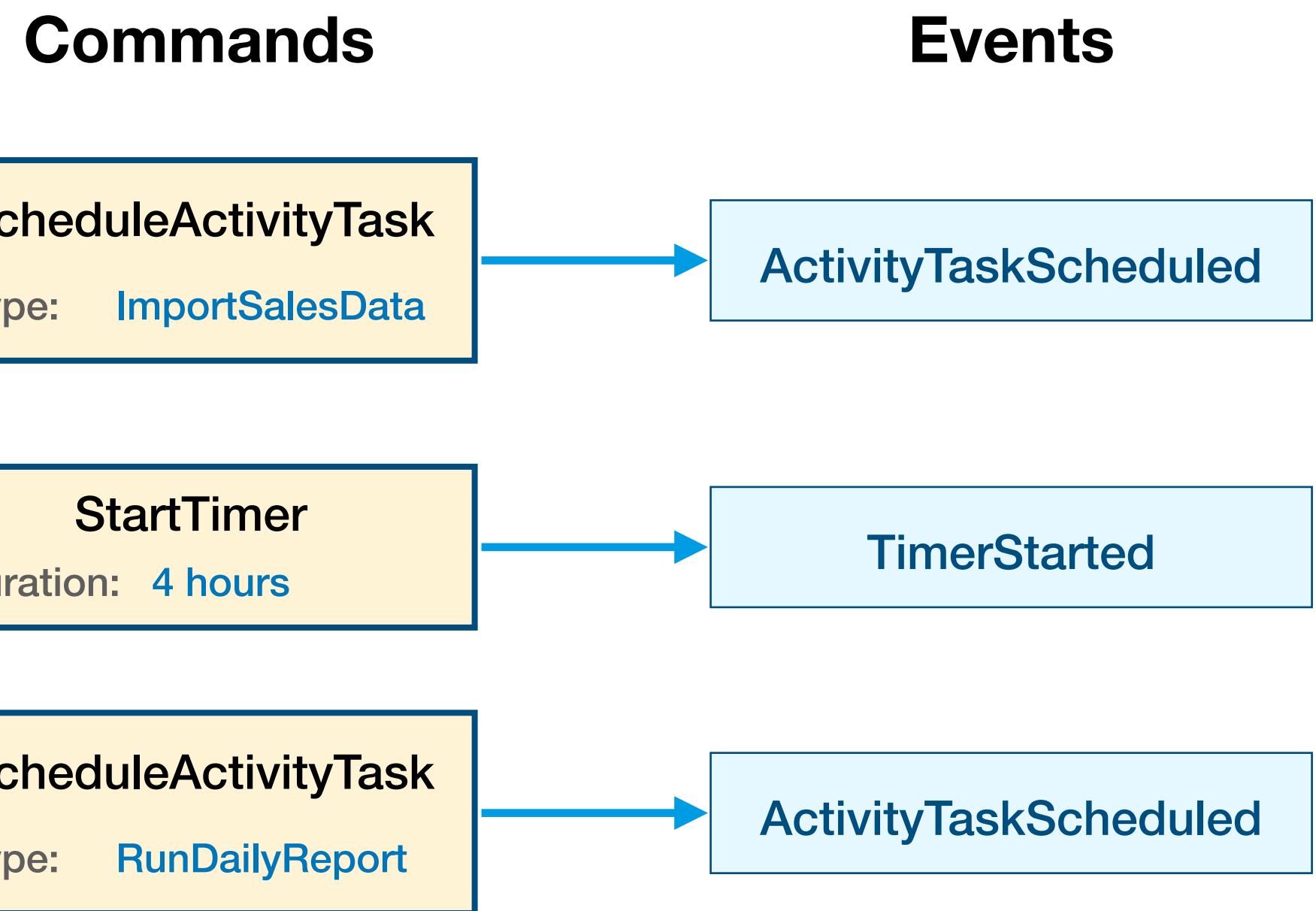
Duration: 4 hours

#### ScheduleActivityTask

Type: RunDailyReport

## Workflow Definition

```
01 func DeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
09     if err != nil {
10         return err
11     }
12
13     workflow.Sleep(ctx, time.Hour * 4)
14
15     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
16     if err != nil {
17         return err
18     }
19
20     return nil
21 }
```



# Commands

ScheduleActivityTask

StartTimer

# Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted

TimerFired

Activity Execution  
result is stored in  
this Event

## Workflow Definition

```
01 func DeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
09     if err != nil {
10         return err
11     }
12
13     |
14     workflow.Sleep(ctx, time.Hour * 4)
15
16     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
17     if err != nil {
18         return err
19     }
20
21     return nil
22 }
```

## Workflow Definition

```
01 func DeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
09     if err != nil {
10         return err
11     }
12
13     workflow.Sleep(ctx, time.Hour * 4)
14
15     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
16     if err != nil {
17         return err
18     }
19
20     return nil
21 }
```

## Commands

ScheduleActivityTask

Type: ImportSalesData

StartTimer

Duration: 4 hours

ScheduleActivityTask

Type: RunDailyReport

## Workflow Definition

```
01 func DeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
09     if err != nil {
10         return err
11     }
12
13     workflow.Sleep(ctx, time.Hour * 4)
14
15     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
16     if err != nil {
17         return err
18     }
19
20     return nil
21 }
```

## Commands

ScheduleActivityTask

Type: ImportSalesData

StartTimer

Duration: 4 hours

ScheduleActivityTask

Type: RunDailyReport

ActivityTaskScheduled

(ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted

(4 hours)

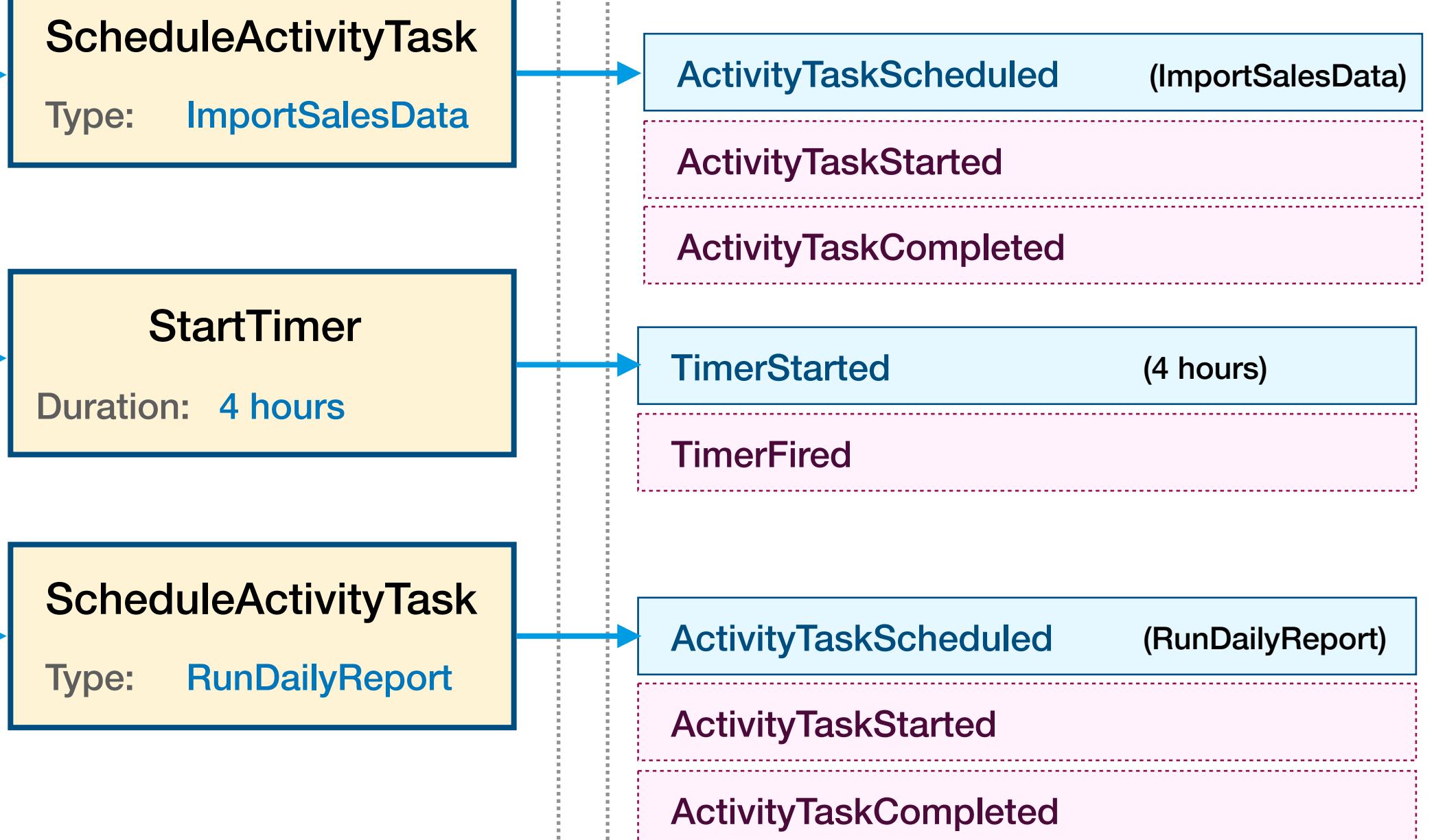
TimerFired

ActivityTaskScheduled

(RunDailyReport)

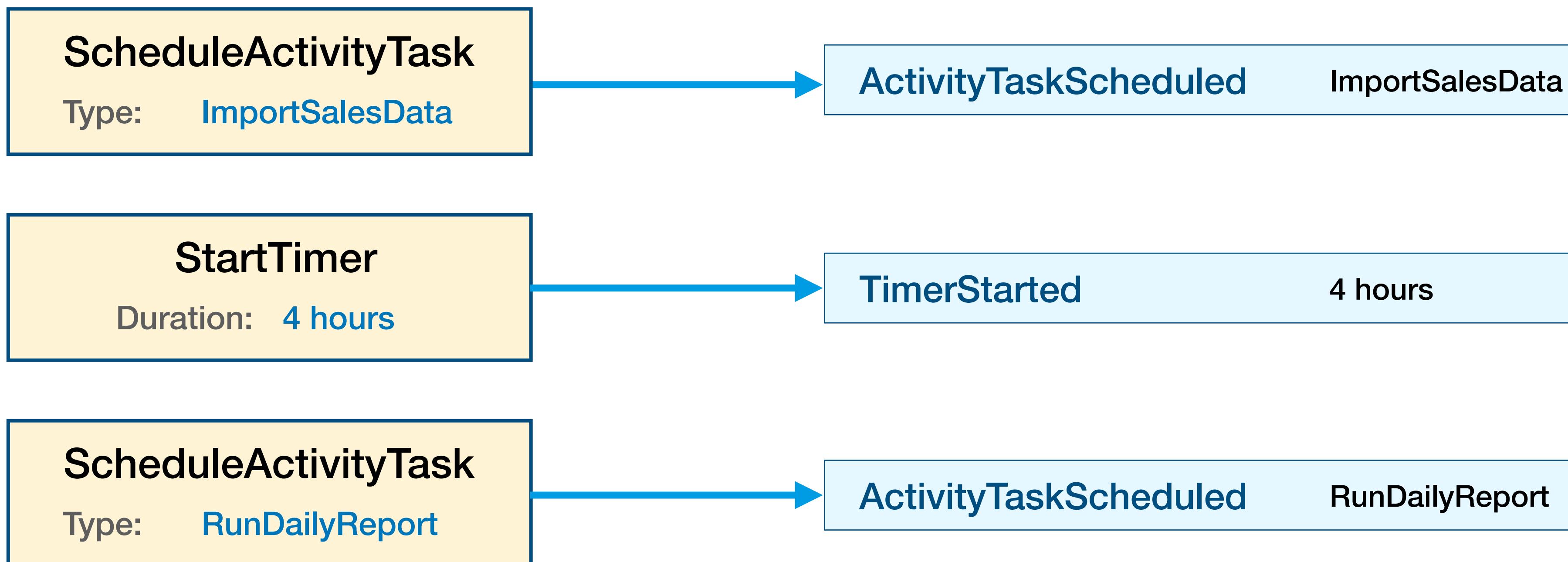
ActivityTaskStarted

ActivityTaskCompleted



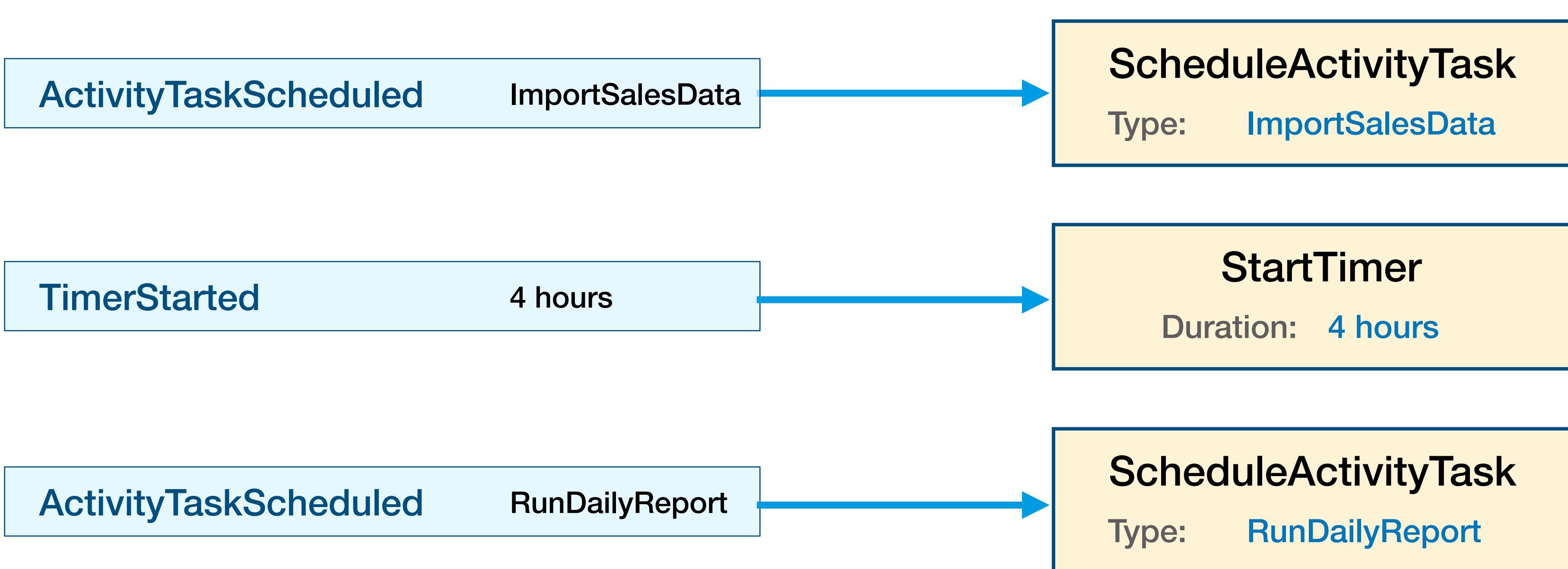
## Events

## Commands Generated



## Events from History

## Events from History



## Commands Expected

# **Example of a Non-Deterministic Workflow**

---

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10    if err != nil {
11        return err
12    }
13
14    if rand.Intn(100) >= 50 {
15        workflow.Sleep(ctx, time.Hour * 4)
16    }
17
18    workflow.GetLogger(ctx).Info("Preparing to run daily report")
19    err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20    if err != nil {
21        return err
22    }
23
24    return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant Events Logged

ActivityTaskScheduled (ImportSalesData)  
ActivityTaskStarted  
ActivityTaskCompleted

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant Events Logged

ActivityTaskScheduled (ImportSalesData)  
ActivityTaskStarted  
ActivityTaskCompleted

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

Happens to return 84 during this execution

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant Events Logged

ActivityTaskScheduled (ImportSalesData)  
ActivityTaskStarted  
ActivityTaskCompleted

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

StartTimer  
Duration: 4 hours

## Relevant Events Logged

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {  
02  
03     options := workflow.ActivityOptions{  
04         StartToCloseTimeout: time.Minute * 45,  
05     }  
06     ctx = workflow.WithActivityOptions(ctx, options)  
07  
08     // this Activity is always executed  
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)  
10     if err != nil {  
11         return err  
12     }  
13  
14     if rand.Intn(100) >= 50 {  
15         workflow.Sleep(ctx, time.Hour * 4)  
16     }  
17  
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")  
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)  
20     if err != nil {  
21         return err  
22     }  
23  
24     return nil  
25 }
```

**Worker crashes here**



## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

StartTimer  
Duration: 4 hours

## Relevant Events Logged

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
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10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask

Type: ImportSalesData

StartTimer

4 hours

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask  
Type: ImportSalesData

StartTimer  
4 hours

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask  
Type: ImportSalesData



StartTimer  
4 hours

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask  
Type: ImportSalesData



StartTimer  
4 hours

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

Happens to return 14 during this execution

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask  
Type: ImportSalesData



StartTimer  
4 hours

# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

ScheduleActivityTask  
Type: RunDailyReport

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask  
Type: ImportSalesData

StartTimer  
4 hours



# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask  
Type: RunDailyReport

ScheduleActivityTask  
Type: ImportSalesData

StartTimer  
4 hours



# A Non-Deterministic Workflow Definition

```
01 func NonDeterministicWorkflow(ctx workflow.Context) error {
02
03     options := workflow.ActivityOptions{
04         StartToCloseTimeout: time.Minute * 45,
05     }
06     ctx = workflow.WithActivityOptions(ctx, options)
07
08     // this Activity is always executed
09     err := workflow.ExecuteActivity(ctx, ImportSalesData).Get(ctx, nil)
10     if err != nil {
11         return err
12     }
13
14     if rand.Intn(100) >= 50 {
15         workflow.Sleep(ctx, time.Hour * 4)
16     }
17
18     workflow.GetLogger(ctx).Info("Preparing to run daily report")
19     err = workflow.ExecuteActivity(ctx, RunDailyReport).Get(ctx, nil)
20     if err != nil {
21         return err
22     }
23
24     return nil
25 }
```

## Commands Created

ScheduleActivityTask  
Type: ImportSalesData

ScheduleActivityTask  
Type: RunDailyReport

## Relevant History Events

ActivityTaskScheduled (ImportSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

## Commands Expected (Based on History)

ScheduleActivityTask  
Type: ImportSalesData

StartTimer  
4 hours



Using random numbers in a Workflow Definition has resulted in Non-Deterministic Error

# Common Sources of Non-Determinism

---

# Things to Avoid in a Workflow Definition (1)

- **Accessing external systems, such as databases or network services**
  - Instead, use Activities to perform these operations
- **Writing business logic or calling functions that rely on system time**
  - Instead, use Workflow-safe functions such as `workflow.Now` and `workflow.Sleep`

# Things to Avoid in a Workflow Definition (2)

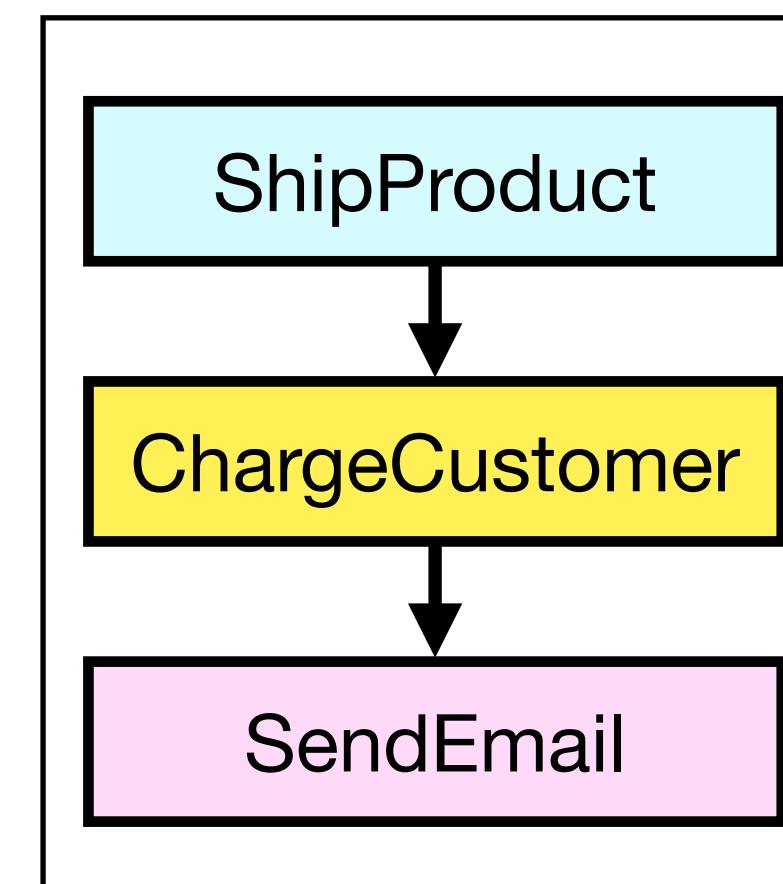
- **Working directly with threads or goroutines**
  - Instead, use the Workflow-safe `workflow.Go` function
  - To work with channels and selectors, use `workflow.Channel` and `workflow.Selector`
- **Do not iterate over data structures with unknown ordering**
- **We offer a static analyzer (`workflowcheck`) for Go**
  - This can identify many common non-deterministic violations in your code

# How Workflow Changes Can Lead to Non-Deterministic Errors

---

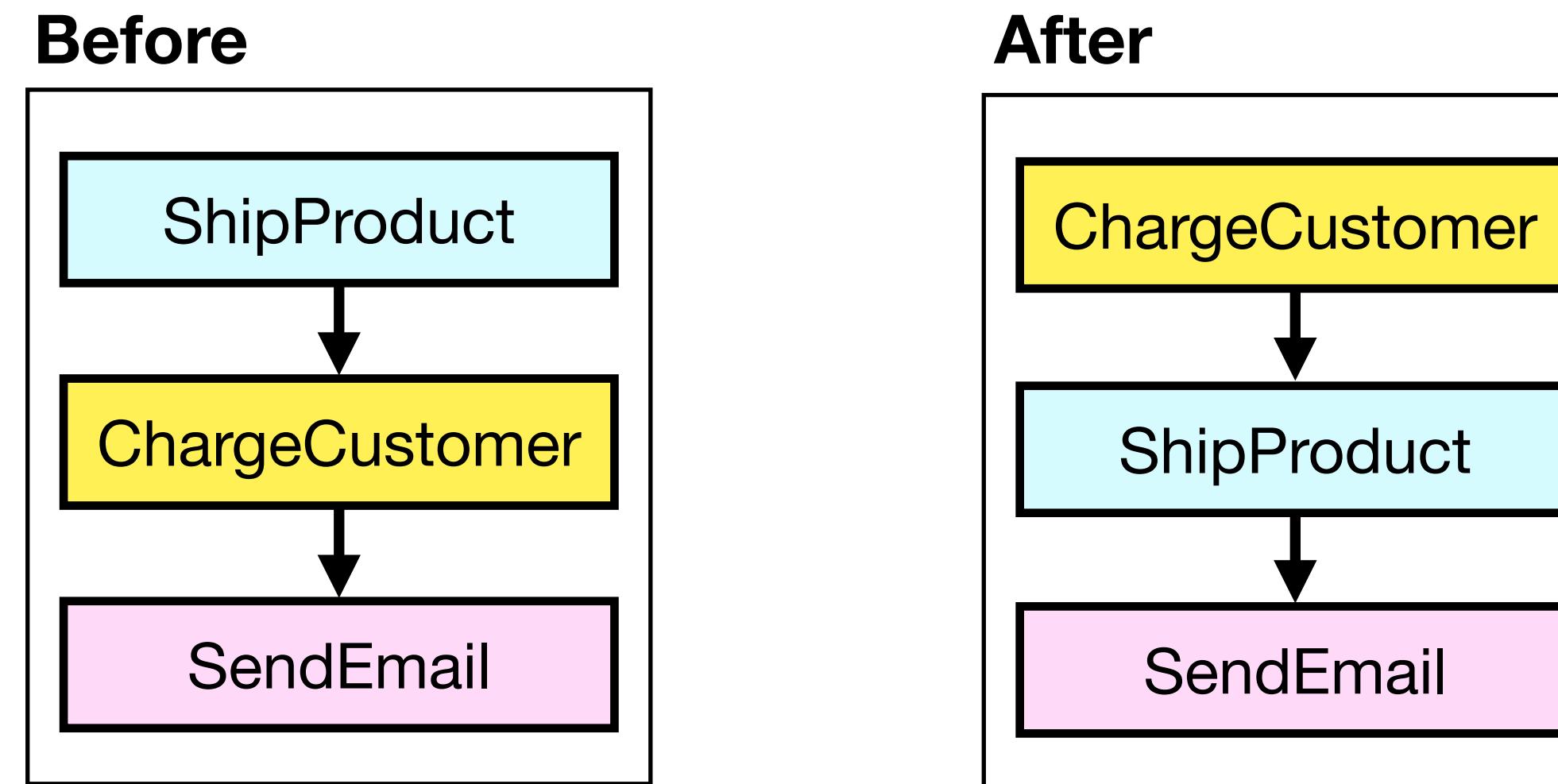
# Non-Deterministic Code Isn't the Only Danger

- As you've just learned, non-deterministic code can cause problems
  - However, there's also another source of non-deterministic errors
  - This is more subtle and can't be detected through static analysis
- Consider the following scenario
  - You deploy and execute the following Workflow, which calls three Activities...



# Deployment Leads to Non-Deterministic Error

- While that Workflow is running, you decide to update the code
  - You now want to charge the customer before shipping the product



- You deploy the updated code and restart the Worker(s) so that the change takes effect
- What happens to the open execution when you restart the Worker?

# Deployment Leads to Non-Deterministic Error

- Problem: Worker cannot restore previous state with the updated code
- How to detect?
  - Test changes by replaying history of previous executions using new code before deploying
  - Only necessary if there are open executions at time of deployment
- How to solve?
  - Versioning (see documentation for details)

The screenshot shows a workflow history page for a completed execution named "process-order-24577". The "Summary" section displays the workflow type as "ProcessOrder" and its ID as "77cd8a20-8de4-4681-b854-4568fbfc02e7". It also shows the task queue "wiffle-workflow-tasks", start time "2024-08-23 CDT 18:59:21.29", and close time "2024-08-23 CDT 19:00:37.57". The "Recent Events" section lists 24 events, with the last one being a "WorkflowExecutionCompleted" event at 2024-08-23 CDT 19:00:37.57. A blue arrow points from the "WorkflowID" in the "Summary" section to the "WorkflowID" in the "Recent Events" table. A red box highlights the "Download" button in the top right corner of the "Recent Events" table.

```
replayer := worker.NewWorkflowReplayer()
replayer.RegisterWorkflow("ProcessOrder")
err := replayer.ReplayWorkflowHistoryFromJSONFile("/Users/twheeler/Downloads/myhistory.json")
```

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## ▶ **06. Testing Your Temporal Application Code**

- 07. Debugging Workflow Execution
- 08. Deploying Your Application to Production
- 09. Conclusion

# The testify Library

- **Go's built-in testing support is basic**
  - It lacks features such as assertions, mock objects, and test suites
- **The open source testify library adds these features**
  - You will execute your tests the same way, whether or not you use testify
- **This example illustrates how assertions reduce code needed for a unit test**
  - Replace assert with require if you want halt all tests upon the first failure

```
func TestSum(t *testing.T) {
    assert.Equal(t, 7, Sum(2, 5))
}
```

# Validating Correctness of Temporal Application Code

- Go SDK's **testsuite** package supports Workflow and Activity testing
- Most tests involve some combination of three types from this package
  - **TestWorkflowEnvironment**
    - Provides a runtime environment used to test a Workflow
    - Some aspects of its execution will work differently to better support testing (e.g., time skipping)
  - **TestActivityEnvironment**
    - Provides a runtime environment used to test Activities
  - **WorkflowTestSuite**
    - A test suite used to define a collection of tests, and optionally, Setup and TearDown functions

# Activity Definition Example

- Imagine that you have written the following Activity Definition

```
package example

import (
    "context"

    "go.temporal.io/sdk/activity"
)

func SquareActivity(ctx context.Context, number int) (int, error) {
    logger := activity.GetLogger(ctx)
    logger.Info("Preparing to calculate the square")

    result := number * number

    logger.Debug("Finished calculating the square")
    return result, nil
}
```

# Activity Test Example (Slide 1 of 3)

- The following code can verify that it behaves as expected
  - Observe the packages imported: Go's testing, Testify's assert, and SDK's testsuite

```
package example

import (
    "testing"

    "github.com/stretchr/testify/assert"
    "go.temporal.io/sdk/testsuite"
)

// code continues on next slide
```

# Activity Test Example (Slide 2 of 3)

- The following code verifies that the Activity works with positive numbers

```
// code continued from previous slide

func Test_SquareActivityPositive(t *testing.T) {
    testSuite := &testsuite.WorkflowTestSuite{}
    env := testSuite.NewTestActivityEnvironment()
    env.RegisterActivity(SquareActivity)

    val, err := env.ExecuteActivity(SquareActivity, 3)
    assert.NoError(t, err)

    var result int
    assert.NoError(t, val.Get(&result))
    assert.Equal(t, 9, result)
}

// code continues on next slide
```

# Activity Test Example (Slide 3 of 3)

- The following code verifies that the Activity works with negative numbers

```
// code continued from previous slide

func Test_SquareActivityNegative(t *testing.T) {
    testSuite := &testsuite.WorkflowTestSuite{}
    env := testSuite.NewTestActivityEnvironment()
    env.RegisterActivity(SquareActivity)

    val, err := env.ExecuteActivity(SquareActivity, -4)
    assert.NoError(t, err)

    var result int
    assert.NoError(t, val.Get(&result))
    assert.Equal(t, 16, result)
}
```

# Workflow Definition Example (Slide 1 of 2)

- Imagine that you have written the following Workflow Definition

```
package example

import (
    "time"

    "go.temporal.io/sdk/workflow"
)

func SumOfSquaresWorkflow(ctx workflow.Context, numbers PairOfInts) (int, error) {
    options := workflow.ActivityOptions{
        StartToCloseTimeout: time.Second * 5,
    }
    ctx = workflow.WithActivityOptions(ctx, options)

    n1 := numbers.First
    n2 := numbers.Second

    // code continues on next slide
```

# Workflow Definition Example (Slide 2 of 2)

- Imagine that you have written the following Workflow Definition

```
// code continued from previous slide

var squareOne int
err := workflow.ExecuteActivity(ctx, SquareActivity, n1).Get(ctx, &squareOne)
if err != nil {
    return -1, err
}

var squareTwo int
err = workflow.ExecuteActivity(ctx, SquareActivity, n2).Get(ctx, &squareTwo)
if err != nil {
    return -1, err
}

result := squareOne + squareTwo

return result, nil
}
```

# Workflow Test Example (Slide 1 of 3)

- The following code can verify that the Workflow behaves as expected
  - The same packages are imported as with the Activity Definition test

```
package example

import (
    "testing"

    "github.com/stretchr/testify/assert"
    "go.temporal.io/sdk/testsuite"
)

// code continues on next slide
```

# Workflow Test Example (Slide 2 of 3)

```
// code continued from previous slide

func Test_SumOfSquaresWorkflowPositive(t *testing.T) {
    testSuite := &testsuite.WorkflowTestSuite{}
    env := testSuite.NewTestWorkflowEnvironment()
    env.RegisterActivity(SquareActivity)

    input := PairOfInts{
        First: 2,
        Second: 5,
    }

    env.ExecuteWorkflow(SumOfSquaresWorkflow, input)
    assert.True(t, env.IsWorkflowCompleted())
    assert.NoError(t, env.GetWorkflowError())

    var result int
    assert.NoError(t, env.GetWorkflowResult(&result))
    assert.Equal(t, 29, result)
}

// code continued on next slide
```

# Workflow Test Example (Slide 3 of 3)

```
// code continued from previous slide

func Test_SumOfSquaresWorkflowNegative(t *testing.T) {
    testSuite := &testsuite.WorkflowTestSuite{}
    env := testSuite.NewTestWorkflowEnvironment()
    env.RegisterActivity(SquareActivity)

    input := PairOfInts{
        First: -3,
        Second: 7,
    }

    env.ExecuteWorkflow(SumOfSquaresWorkflow, input)
    assert.True(t, env.IsWorkflowCompleted())
    assert.NoError(t, env.GetWorkflowError())

    var result int
    assert.NoError(t, env.GetWorkflowResult(&result))
    assert.Equal(t, 58, result)
}
```

# Mocking Activities for Workflow Tests

- **The previous Workflow invoked two Activities**
  - These Activities were called as part of the test
  - Therefore, the Workflow is tightly coupled to the Activity implementation
- **Using mock Activities allows you to test your Workflow logic in isolation**
  - This is a function used in place of the Activity during the test
  - Mocking also makes it easier to set up and test unusual conditions
    - For example, if the Activity returns a certain type of error

# Workflow Test Example - No Mock (Slide 1 of 2)

- **Scenario: A Workflow uses an Activity to call a microservice that estimates someone's age based on their first name**

```
package example

import (
    "testing"

    "github.com/stretchr/testify/assert"
    "go.temporal.io/sdk/testsuite"
)

// code continues on next slide
```

# Workflow Test Example - No Mock (Slide 2 of 2)

```
// code continued from previous slide

func Test_EstimateAge_EndToEnd(t *testing.T) {
    testSuite := &testsuite.WorkflowTestSuite{}
    env := testSuite.NewTestWorkflowEnvironment()
    env.RegisterActivity(RetrieveEstimate)

    // Provide a name as input to the Workflow. This value is
    // passed to the Activity, which calls the remote API
    env.ExecuteWorkflow(EstimateAge, "Betty")
    assert.True(t, env.IsWorkflowCompleted())

    // The Workflow combines the name and age into a message,
    // and the code below verifies that it is as expected
    var result string
    assert.NoError(t, env.GetWorkflowResult(&result))
    expected := "Betty has an estimated age of 76"
    assert.Equal(t, expected, result)
}
```

# Workflow Test Example - with Mock (Slide 1 of 2)

- Same scenario as before, but this time using a mock Activity

```
package example

import (
    "testing"

    "github.com/stretchr/testify/assert"
    "github.com/stretchr/testify/mock"
    "go.temporal.io/sdk/testsuite"
)

// code continues on next slide
```

# Workflow Test Example - with Mock (Slide 2 of 2)

```
// code continued from previous slide

func Test_EstimateAge_WithMockActivity(t *testing.T) {
    testSuite := &testsuite.WorkflowTestSuite{}
    env := testSuite.NewTestWorkflowEnvironment()

    // Define a mock Activity that returns an estimated age for Betty
    env.OnActivity(RetrieveEstimate, mock.Anything, "Betty").Return(76, nil)

    env.ExecuteWorkflow(EstimateAge, "Betty")
    assert.True(t, env.IsWorkflowCompleted())

    var result string
    assert.NoError(t, env.GetWorkflowResult(&result))
    expected := "Betty has an estimated age of 76"
    assert.Equal(t, expected, result)
}
```

# **Instructor-Led Demo #1**

**Testing the Translation Workflow**

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# Instructor-Led Demo #2

**Debugging a Workflow  
that Does Not Progress**

# Instructor-Led Demo #3

**Interpreting Event History  
for Workflow Executions**

# Instructor-Led Demo #4

**Terminating a Workflow Execution  
with the Web UI**

# Instructor-Led Demo #5

**Identifying and Fixing a Bug  
in an Activity Definition**

# **Exercise #2: Debugging and Fixing an Activity Failure**

- **During this exercise, you will**
  - Start a Worker and run a basic Workflow for processing a pizza order
  - Use the Web UI to find details about the execution
  - Diagnose and fix a latent bug in the Activity Definition
  - Test and deploy the fix
  - Verify that the Workflow now completes successfully
- **Refer to this exercise's README.md file for details**
  - The code is below the **exercises/debug-activity** directory
  - Don't forget to make your changes in the practice subdirectory

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# Temporal Service is Composed of Four Roles

## Frontend

An API Gateway that validates and routes inbound calls

## History

Maintains history and moves execution progress forward

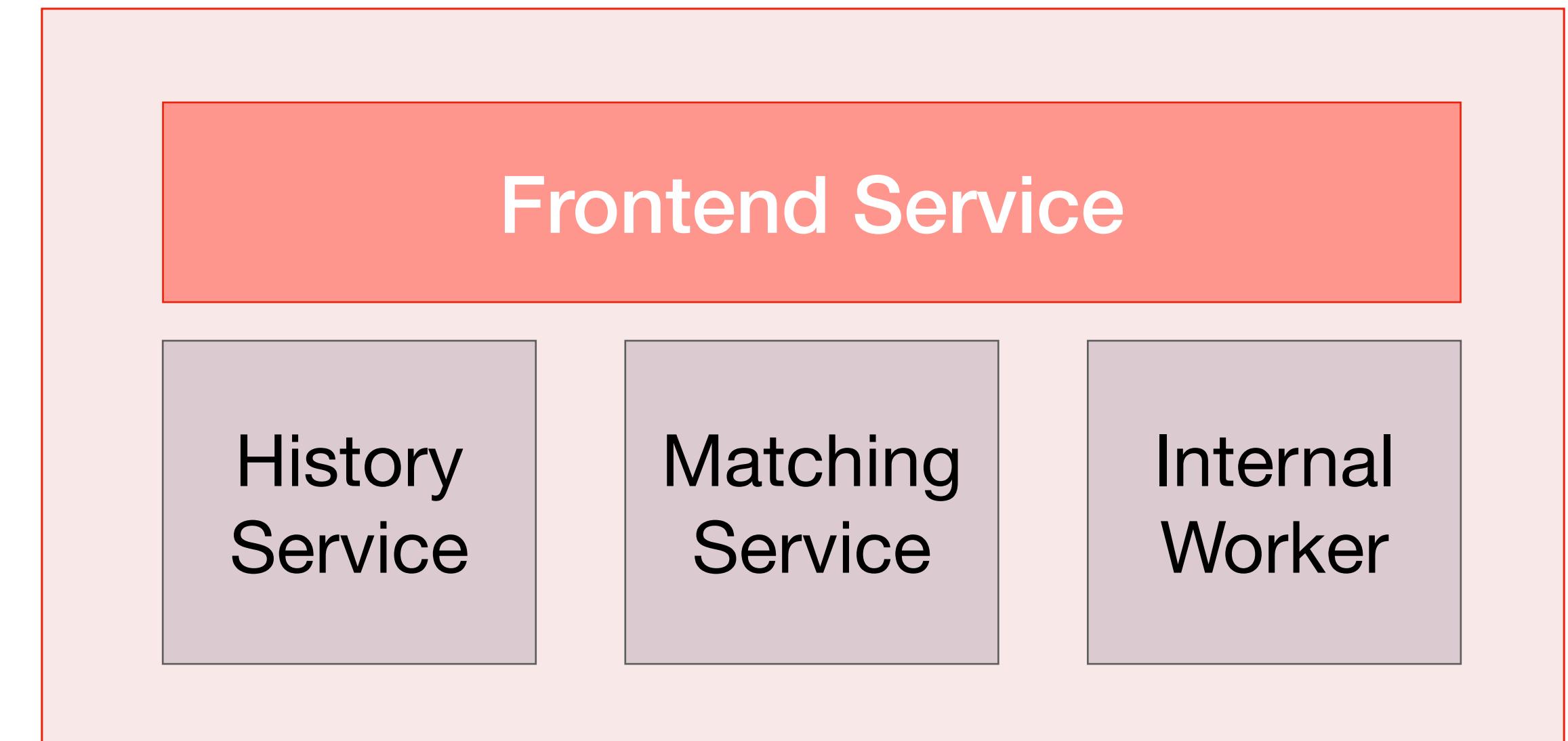
## Matching

Hosts Task Queues and matches Workers with Tasks

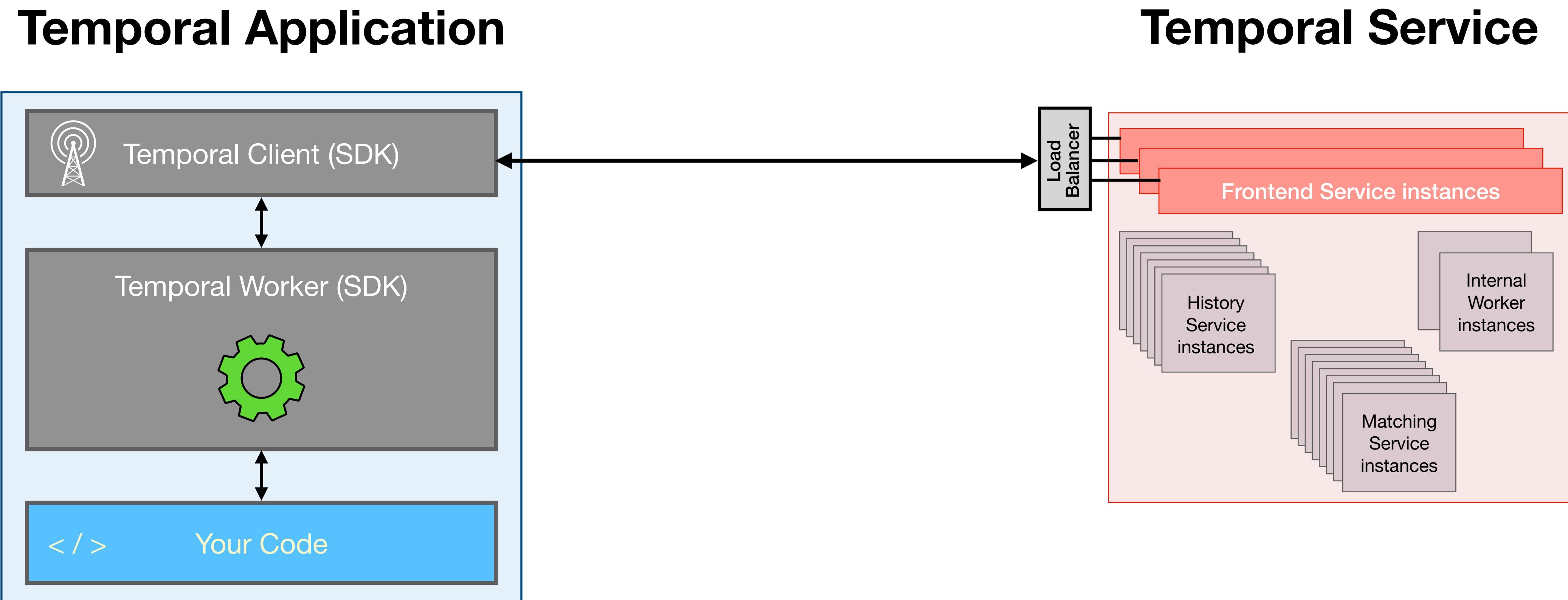
## Internal Worker

Runs internal system Workflows, such as those that delete Workflow Execution data after Retention Period elapses

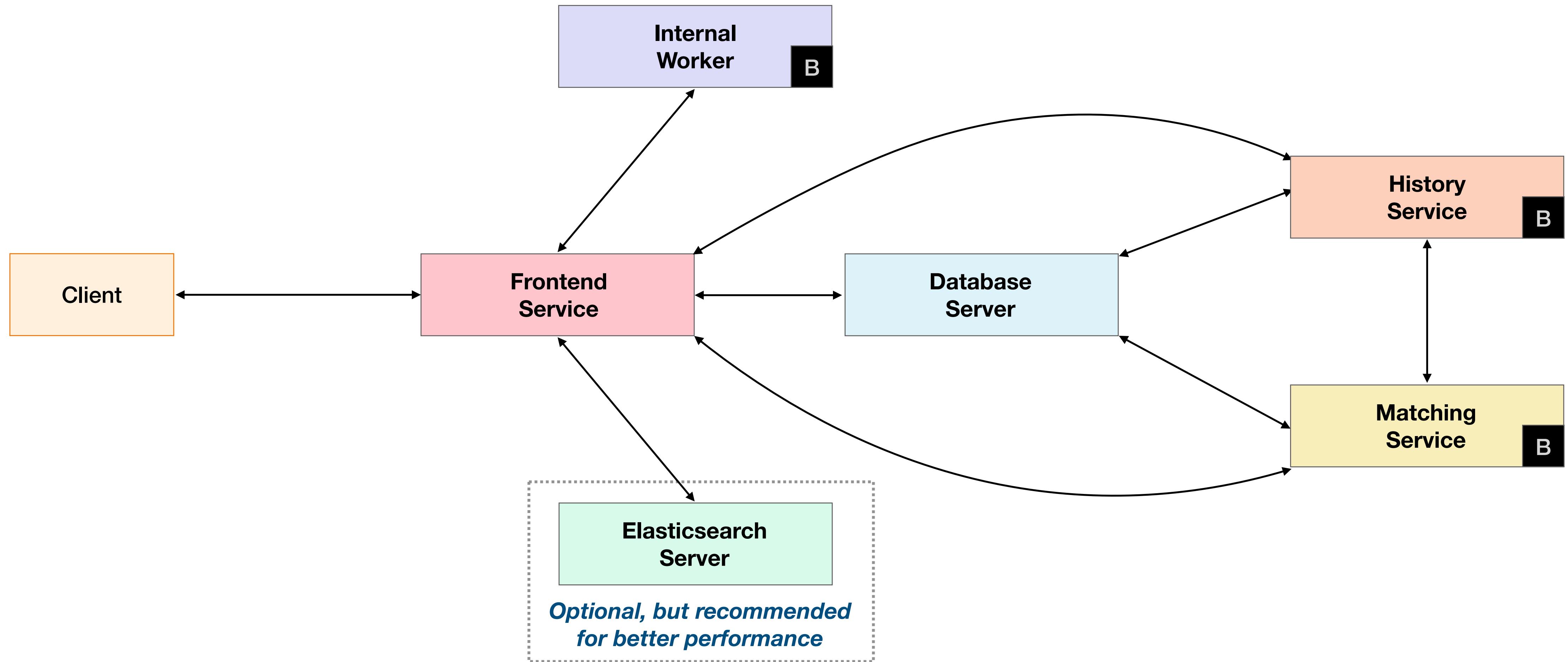
This is distinct from the Worker that executes your application code, which is external to the Temporal Service



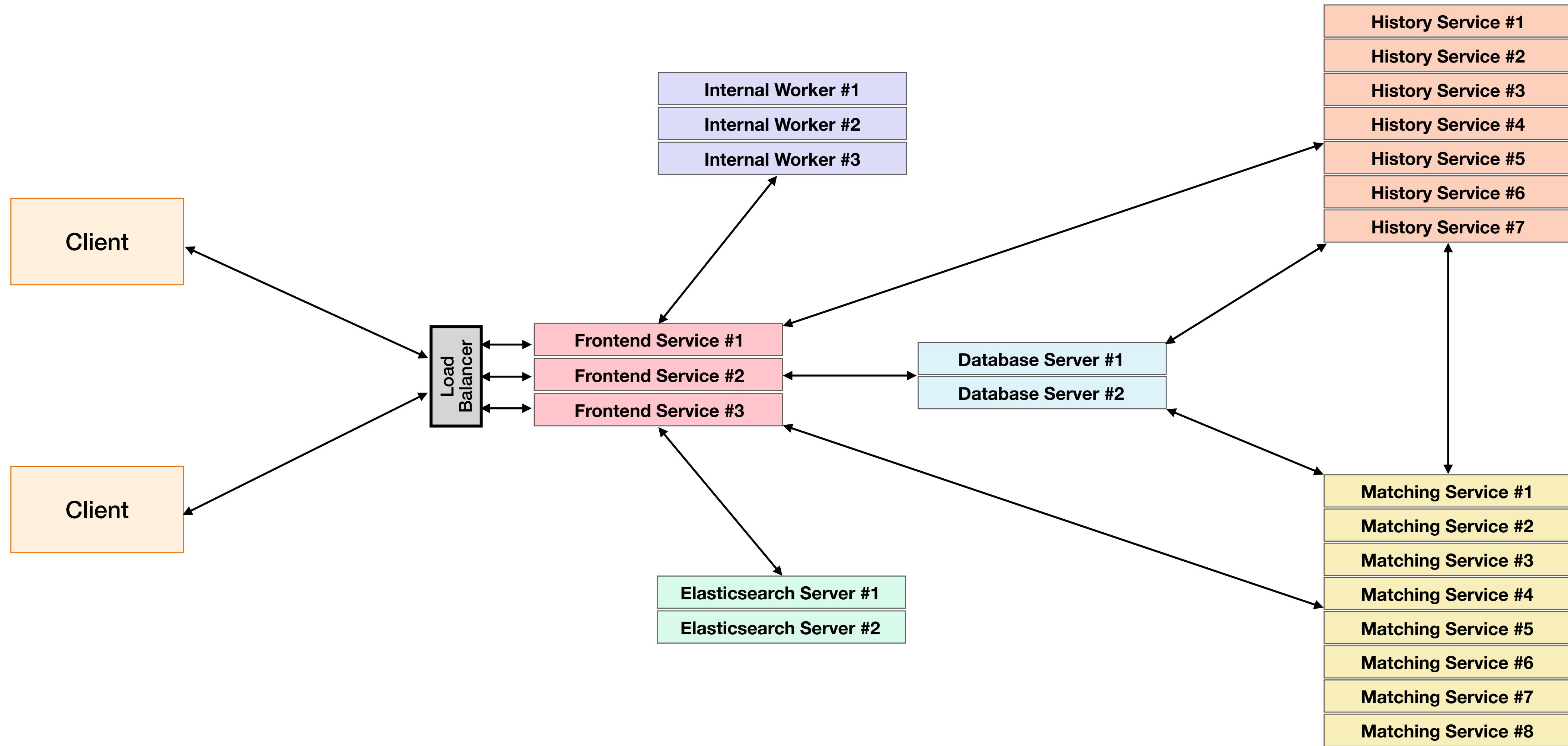
# Temporal Service Scalability



# Connectivity (Logical)



# Connectivity (Physical)



# Default Options for a Temporal Client

- **The following code example shows how to create a Temporal Client**
  - This will expects a Frontend Service running on localhost at TCP port 7233

```
c, err := client.Dial(client.Options{})
if err != nil {
    log.Fatalln("Unable to create client", err)
}
```

# Customizing a Temporal Client

- **Specify attributes in `client.Options` to configure the Client**
  - **HostPort**: A colon-delimited string containing the hostname and port for the Frontend Service
    - Example: `fe.example.com:7233`
  - **Namespace**: A string specifying the namespace to use for requests sent by this Client
  - **ConnectionOptions**: A `ConnectionOptions` instance used to specify TLS parameters

# Configuring Client for a Non-Local Cluster

- This example specifies a Namespace, but not parameters needed for TLS

```
clientOptions := client.Options{
    HostPort: "mycluster.example.com:7233",
    Namespace: "operations",
}
c, err := client.NewClient(clientOptions)
if err != nil {
    log.Fatalln("unable to create Temporal client", err)
}
defer c.Close()
```

- The options shown above are equivalent to those in the following temporal command

```
$ temporal --address mycluster.example.com:7233 workflow list --namespace operations
```

# Configuring Client for a Secure Temporal Service

- This applies to Temporal Cloud or a secure self-hosted Temporal Cluster

```
ClientCertFile = "/home/myuser/tls/certificate.pem"
ClientCertPrivateKey = "/home/myuser/tls/private.key"

clientCert, err := tls.LoadX509KeyPair(ClientCertFile, ClientCertPrivateKey)
if err != nil {
    return nil, err
}

opts := client.Options{
    HostPort: "mycluster.example.com:7233",
    Namespace: "operations",
    ConnectionOptions: client.ConnectionOptions{
        TLS: &tls.Config{
            Certificates: []tls.Certificate{clientCert},
        },
    },
}

return client.NewClient(opts)
```

# Building a Temporal Application

- **Application deployment is usually preceded by a build process**
  - The tools used to do this vary by language, based on the SDK(s) used
  - Temporal does not require the use of any particular tools
  - You can use what is typical for the language or mandated by your organization
- **With the Go SDK, you can build the Worker to create an executable**
  - The result is what you would deploy and run in production
  - It must contain all dependencies required at runtime

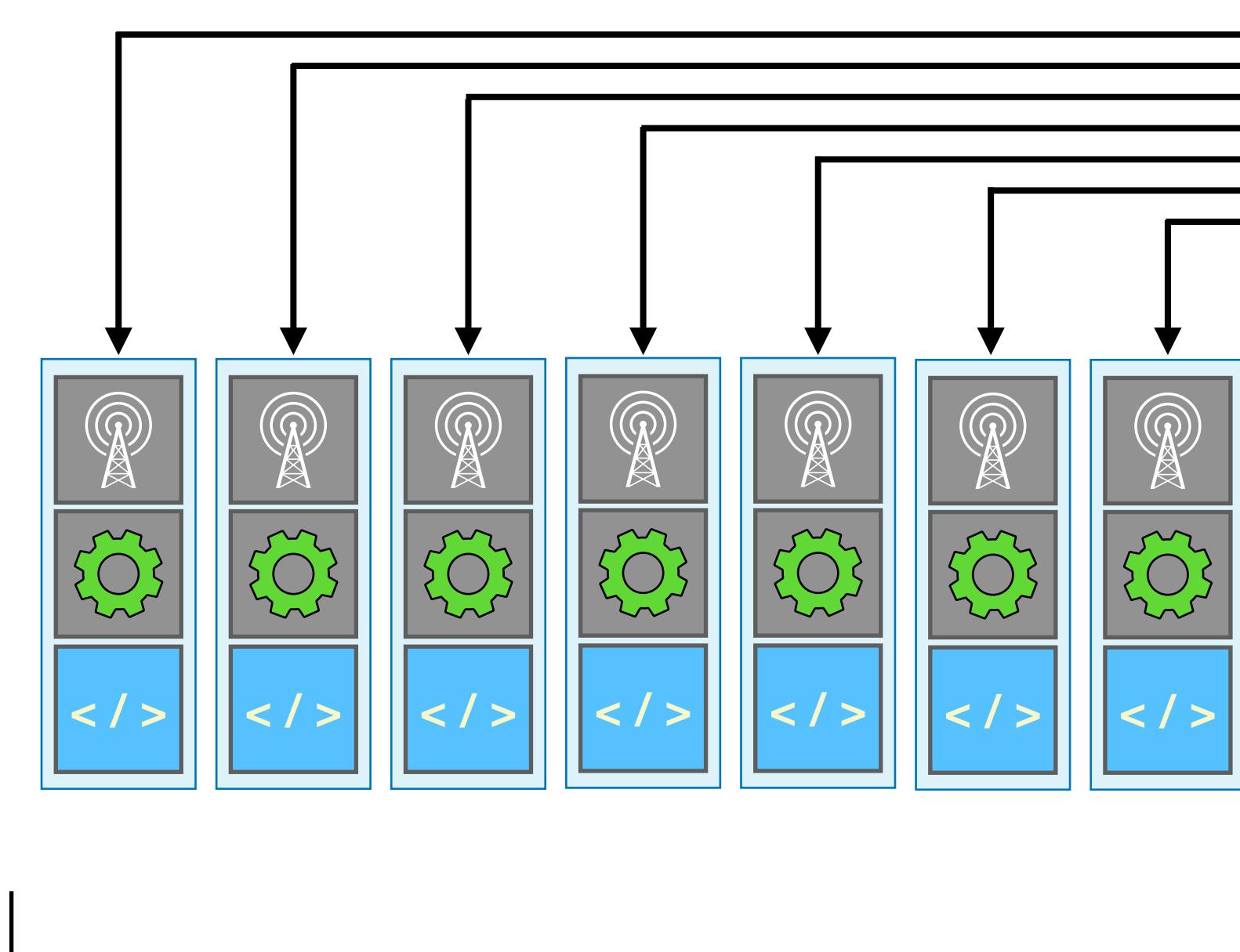
```
$ go build worker/main.go
```

# Temporal Application Deployment

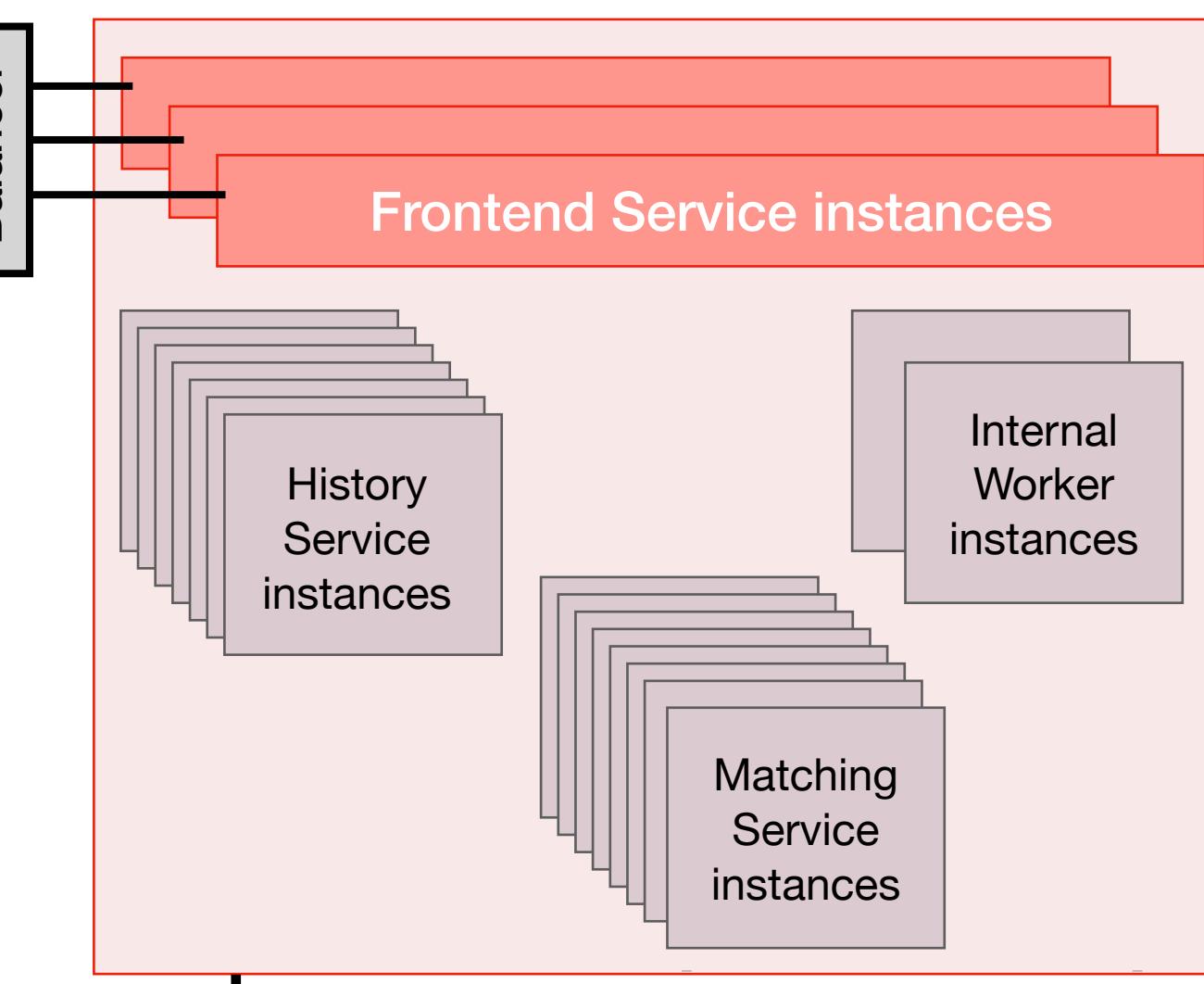
- **Once built, you'll deploy the application to production**
  - This will contain your compiled code, plus compile-time dependencies (e.g., Worker, Client, etc.)
  - Ensure any needed dependencies are available at runtime
    - For example, database drivers used by your application
    - For example, the Java runtime or Python interpreter for polyglot Temporal applications
- **Temporal is not opinionated about how or where you deploy the code**
  - Key point: Workers run externally to the Temporal Service (Temporal Cluster or Temporal Cloud)
  - It's up to you how you run the Workers: bare metal, virtual machines, containers, etc.
  - Let's quickly look at two possible examples

# Deployment Scenario #1

## Your Application



## Temporal Cluster



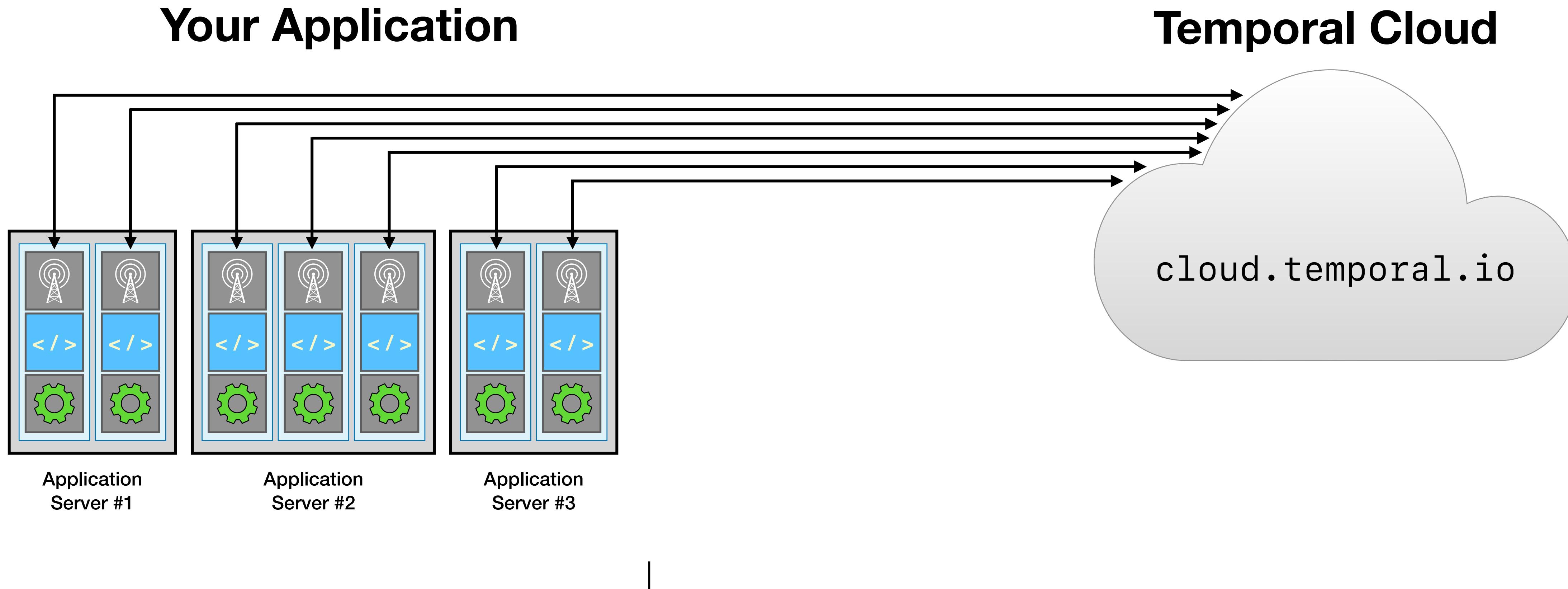
Example: Each Worker running in its own container

Database  
(required)

Elasticsearch  
(recommended)

Grafana  
(optional)

# Deployment Scenario #2



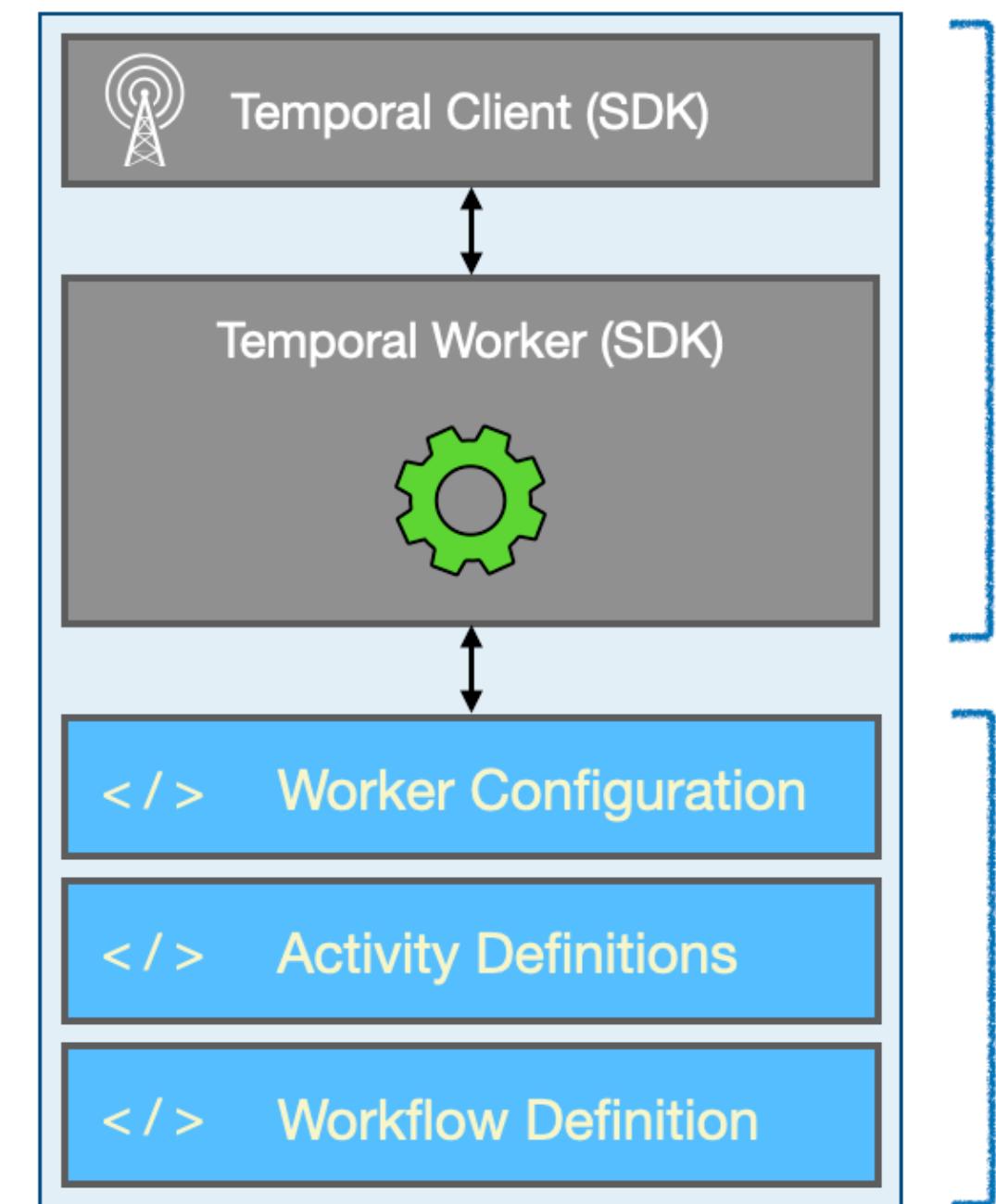
Example: Multiple Worker Processes distributed across bare metal

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# Essential Points (1)

- **Temporal applications contain code that you develop**
  - Workflow and Activity Definitions, Worker Configuration, etc.
- **Temporal applications also contain SDK-provided code**
  - Such as the implementations of the Worker and Temporal Client
- **Temporal guarantees durable execution of Workflows**
  - If the Worker crashes, another Worker uses History Replay to automatically recreate pre-crash state, then continues execution
  - From the developer perspective, it's as if the crash never even happened



Provided by  
SDK

You  
develop

# Essential Points (2)

- **The Temporal Service performs orchestration via Task Queues**
  - A Worker polls a Task Queue, accepts a Task, executes the code, and reports back with status/results
  - Communication takes place by Workers initiating requests via gRPC to the Frontend Service
  - **Key point:** Execution of the code is external to Temporal Service (whether self-hosted or Temporal Cloud)
- **As Workers run your code, they send Commands to the Temporal Service**
  - For example, when encountering calls to `workflow.ExecuteActivity` or `workflow.Sleep` or when returning a result from the Workflow Definition
- **Commands sent by the Worker lead to Events logged by the Temporal Service**

# Essential Points (3)

- **The Event History documents the details of a Workflow Execution**
  - It's an ordered append-only list of Events
  - Temporal enforces limits on the size and item count of the Event History
- **Every Event has three attributes in common: ID, timestamp, and type**
  - They will also have additional attributes, which vary by Event Type
  - Examining the Event History and attributes of individual Events can help you debug Workflow Executions

# Essential Points (4)

- **A single Workflow Definition can be executed any number of times**
  - Each time potentially having different input data and a different Workflow ID
    - At most, one open Workflow Execution with a given Workflow ID is allowed per Namespace
    - This rule applies to *all* Workflow Executions, not just ones of the same Workflow Type
- **Once started, Workflow Execution enters the Open state**
  - Execution typically alternates between making progress and awaiting a condition
  - When execution concludes, it transitions to the Closed state
  - There are several subtypes of Closed, including Completed, Failed, and Terminated

# Essential Points (5)

- **Temporal requires that your Workflow code is deterministic**
  - This constraint is what makes durable execution possible
  - Temporal's definition of determinism: Every execution of a given Workflow Definition must produce an identical sequence of Commands, given the same input
  - Non-deterministic errors can occur because of something inherently non-deterministic in the code
    - Can also occur after deploying a code change that changes the Command sequence, if there were open executions of the same Workflow Type at the time of deployment
- **Activities are used for code that interacts with the outside world**
  - Activity code isn't required to be deterministic (but it should be idempotent)
  - Activities are automatically retried upon failure, according to a configurable Retry Policy

# Essential Points (6)

- **Recommended best practices for Temporal app development**
  - Use structs (not individual fields) as input/output of your Workflow and Activity definitions
  - Be aware of the platform's limits on Event History size and item count
  - Use `workflowcheck` (Go-specific) to scan your Workflow Definitions for non-deterministic code
  - Replace non-deterministic code in Workflow Definitions with Workflow-safe counterparts
  - Use Temporal's replay-aware logging API, ideally integrating with a 3rd-party logging package

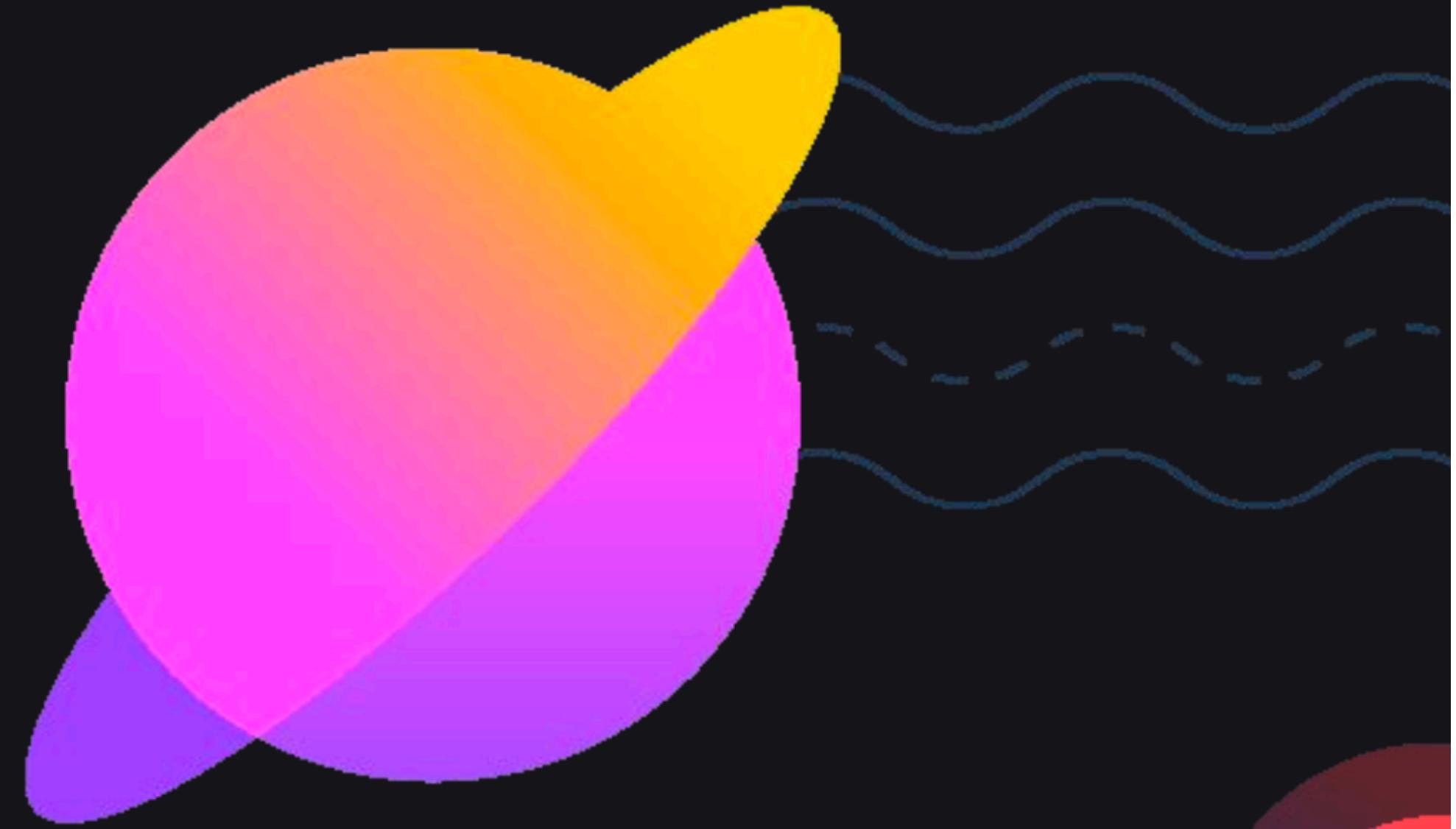
# Essential Points (7)

- **We don't dictate how to build, deploy, or run Temporal applications**
  - Typical advice: Build, deploy, and run as you would any other application in that language
  - However, we recommend running  $\geq 2$  Workers per Task Queue (availability/scalability)

TEMPORAL'S CODE EXCHANGE

# Share what you've built with Temporal

Temporal has a thriving community building  
code for each other – we'd love to see what  
you've built!



TEMPORAL.IO/CODE-EXCHANGE





# Thank You

