

Evolving the Application Easily, Thanks to DDD



Steve Smith

Force Multiplier for
Dev Teams

@ardalis | ardalisc.com

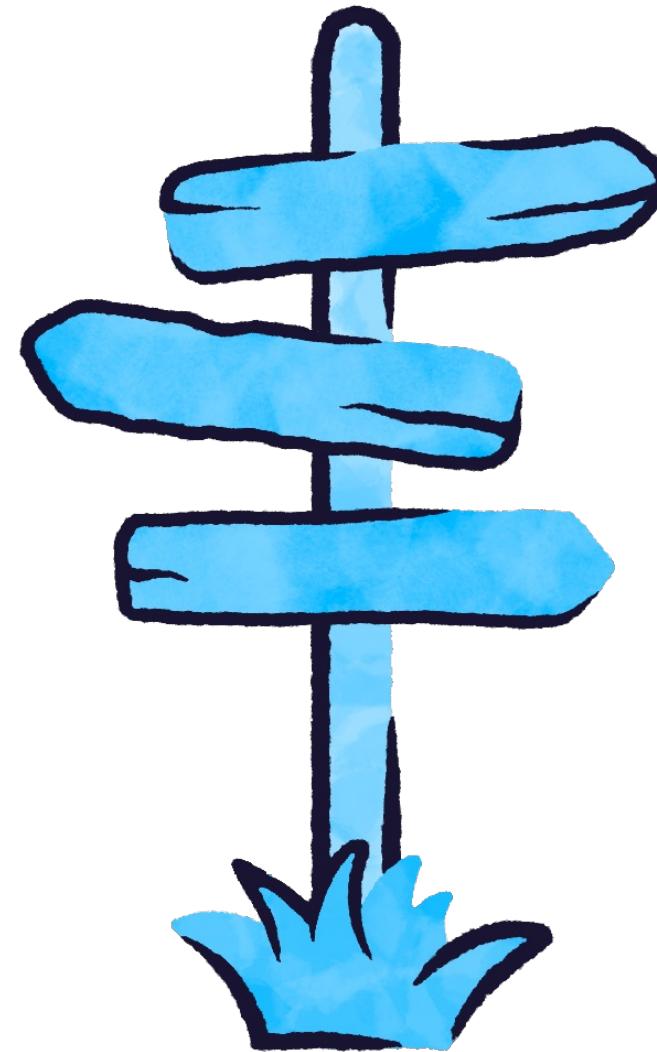


Julie Lerman

Software Coach,
DDD Champion

@julielerman | thedatafarm.com

Module Overview



- Review current system design**
- Discuss a new feature with customer**
- Introduce message queues**
- Implement the new feature**



Reviewing Our Current System Design

FrontDesk.Blazor x + Front Desk

localhost:5100

Client: Select a Client...

Today ▶ Monday, September 23, 2030 Day Work Week Agenda

	Exam Room 1	Exam Room 2	Exam Room 3	Exam Room 4	Exam Room 5
	Mon 9/23	Mon 9/23	Mon 9/23	Mon 9/23	Mon 9/23
8:00 AM					(DE) BenFranklin - Michael Jenkins
9:00 AM					(DE) Sugar - Patrick Neborg
10:00 AM	(WE) Darwin - Steve Smith (WE) Arya - Steve Smith		(DE) Max - David Batten		(DE) Mim - Shelley Benhoff
11:00 AM	(WE) Rosie - Steve Smith	(DE) Sampson - Julie Lerman	(DE) Gusto - James Millar		(DE) Jasper - Steve Gordon

Front Desk

Schedule Clients Doctors Rooms Public Site Sent Emails RabbitMQ

Appointments

High Level of Front Desk Scheduling App

FrontDesk.Core

Schedule Aggregate

**Schedule Entity
(Root)**

Appointment Entity

Appointment Entity

Appointment Entity

Appointment Entity

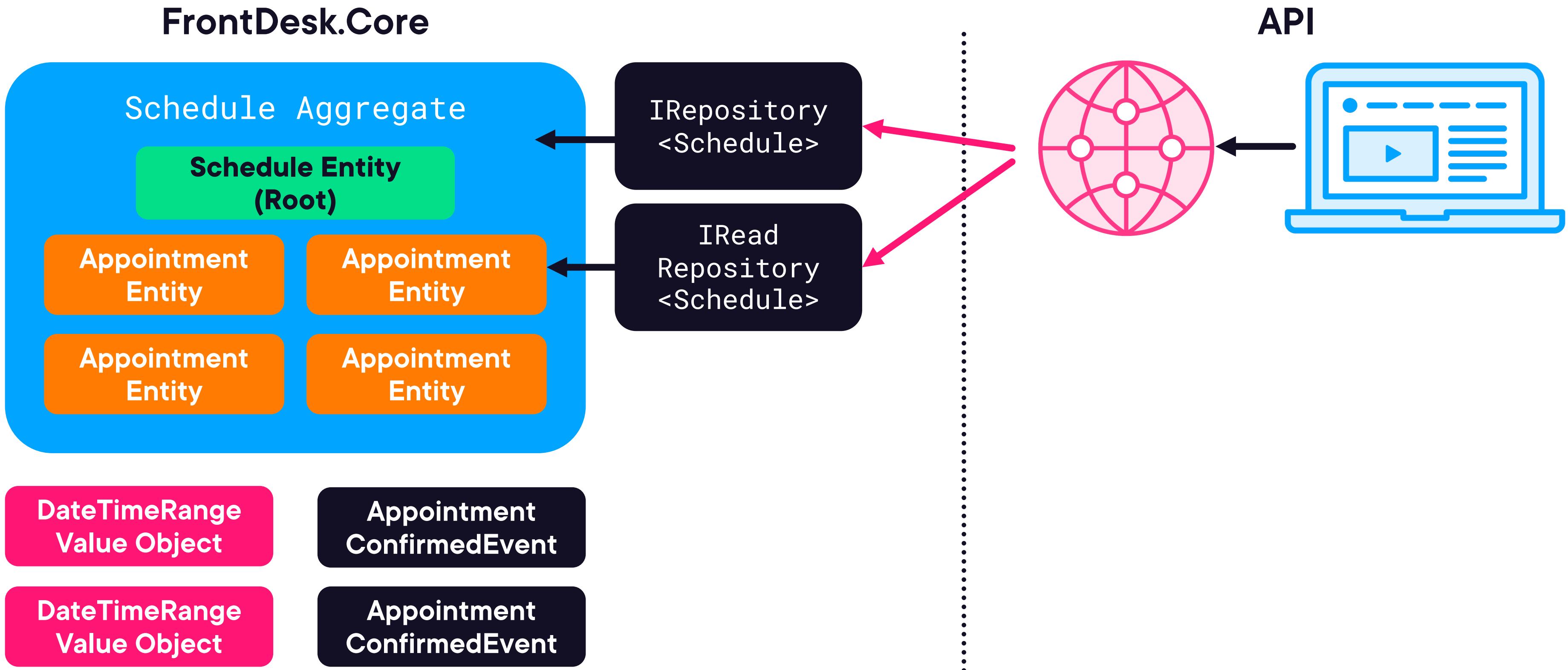
**DateTimeRange
Value Object**

**Appointment
ConfirmedEvent**

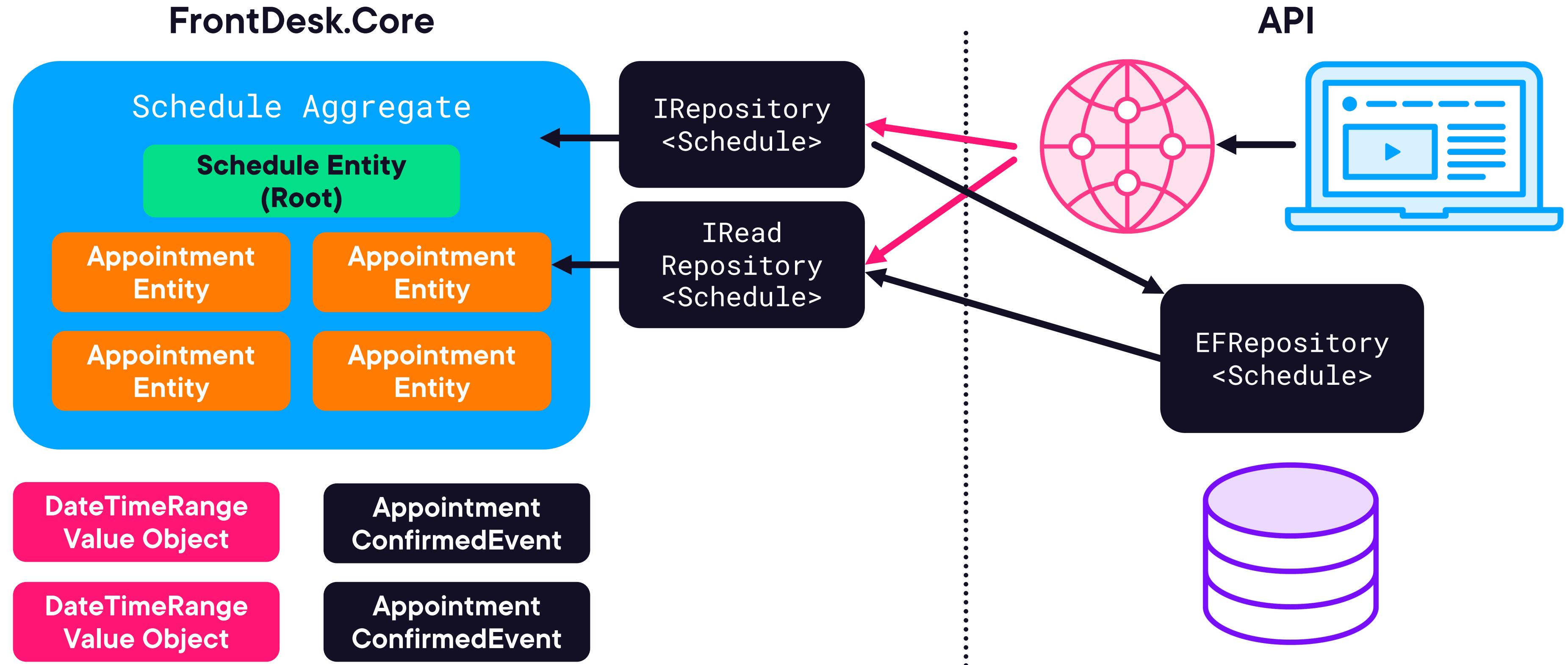
**DateTimeRange
Value Object**

**Appointment
ConfirmedEvent**

High Level of Front Desk Scheduling App



High Level of Front Desk Scheduling App



You've learned techniques
that will help you expand
this application in a clean
and uncomplicated way.



Addressing a New Feature with the Domain Expert

Gathering (more) Requirements



Michelle's Feedback

Scheduling application is well-received so far

But...clients still frequently forget appointments

Staff doesn't have time to call every client

New Features

Send a confirmation email when the appointment is scheduled

Send a reminder email the day before client's appointment

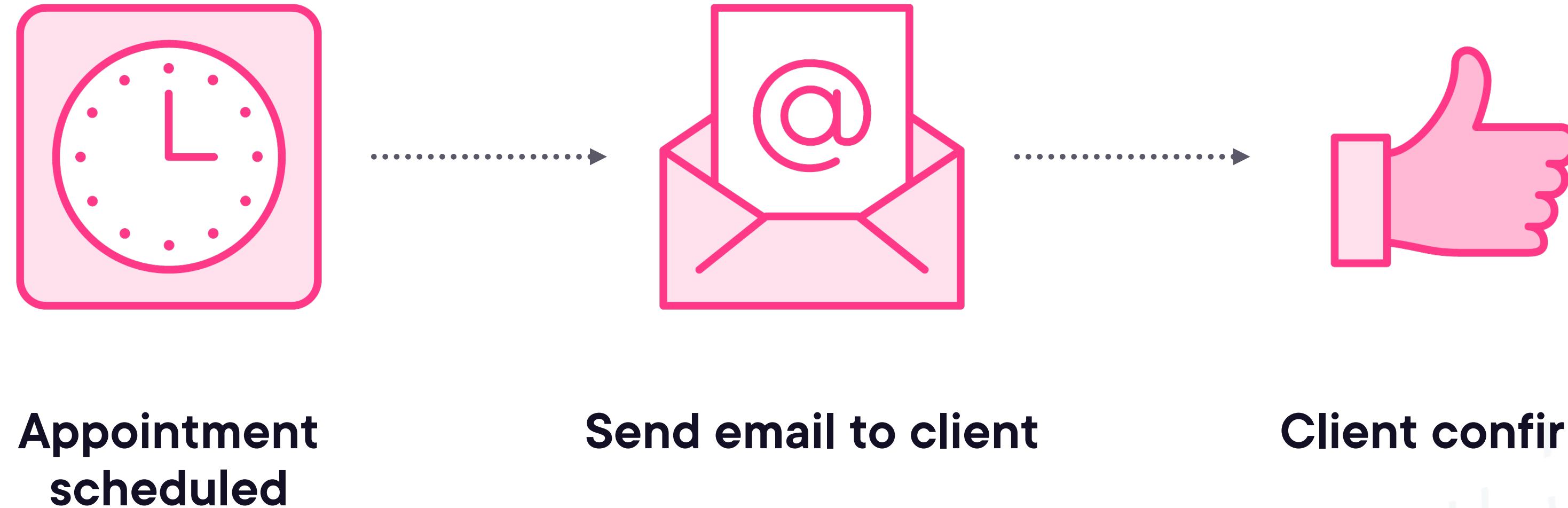
Provide a link in the emails for the client to confirm the appointment





Planning Our Implementation Steps

Appointment Confirmation [High Level Workflow]



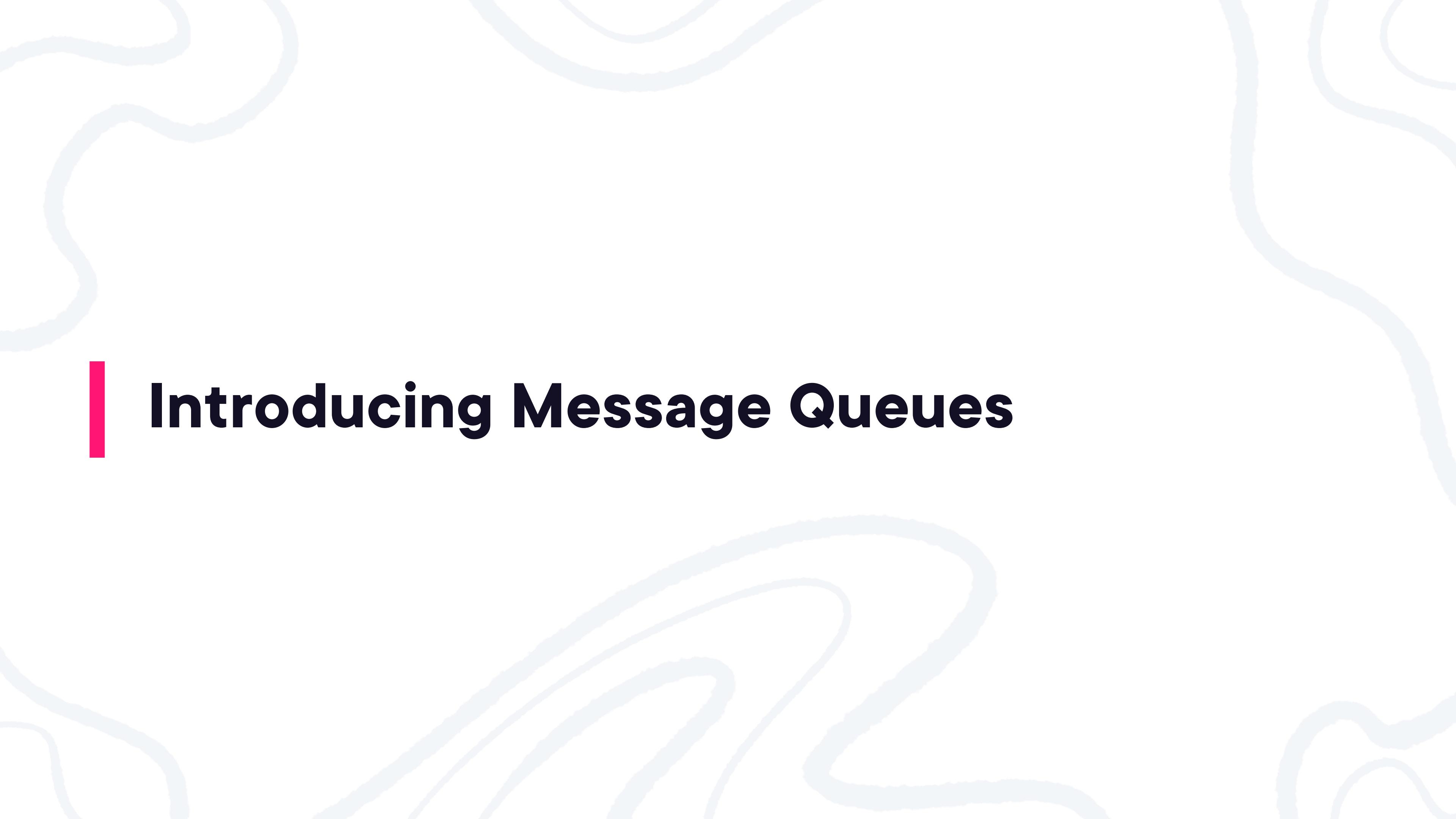
Using What We've Already Learned and Built

Domain and Integration Events

Event Handlers

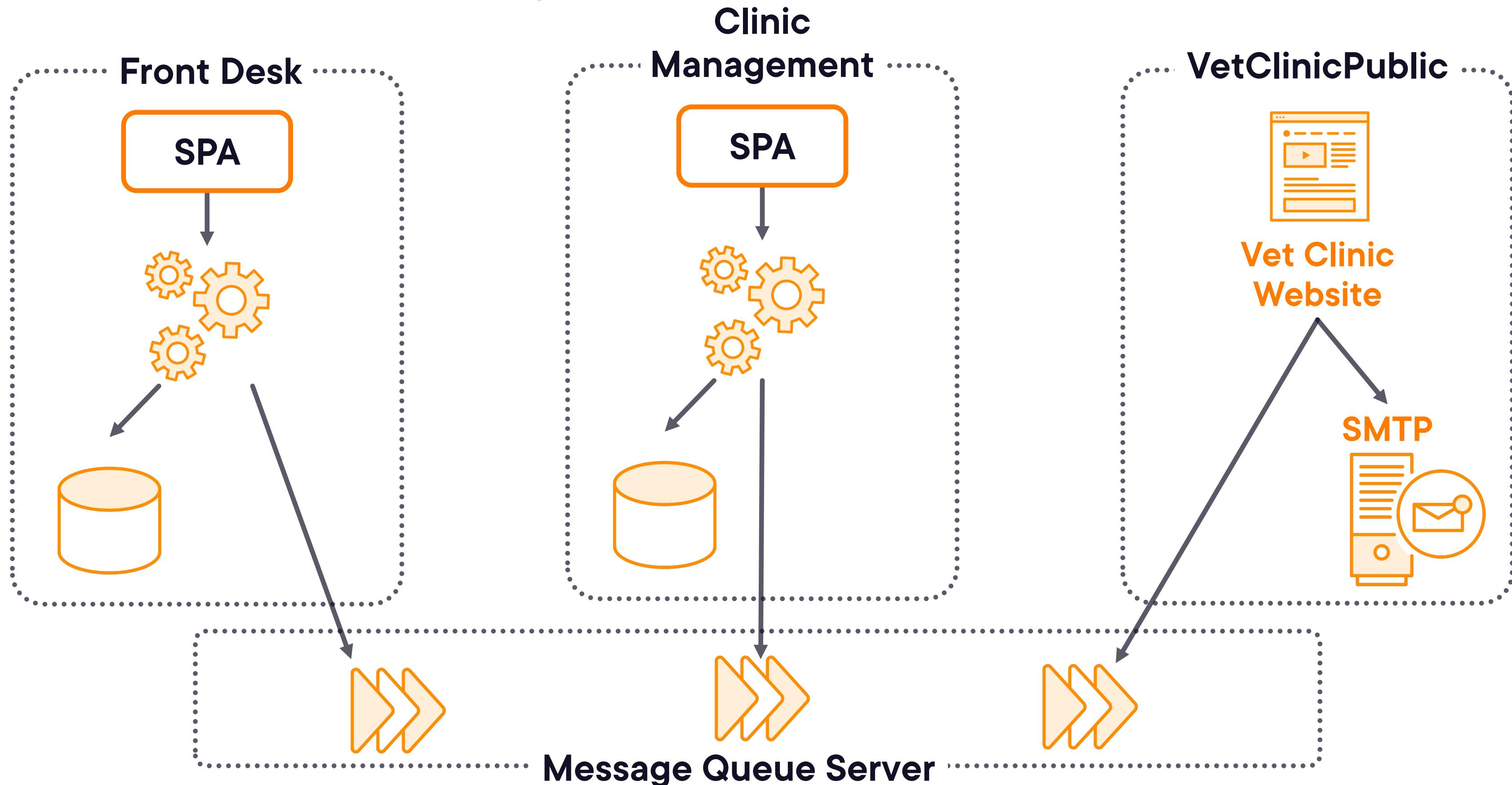
Services

Messaging Queues

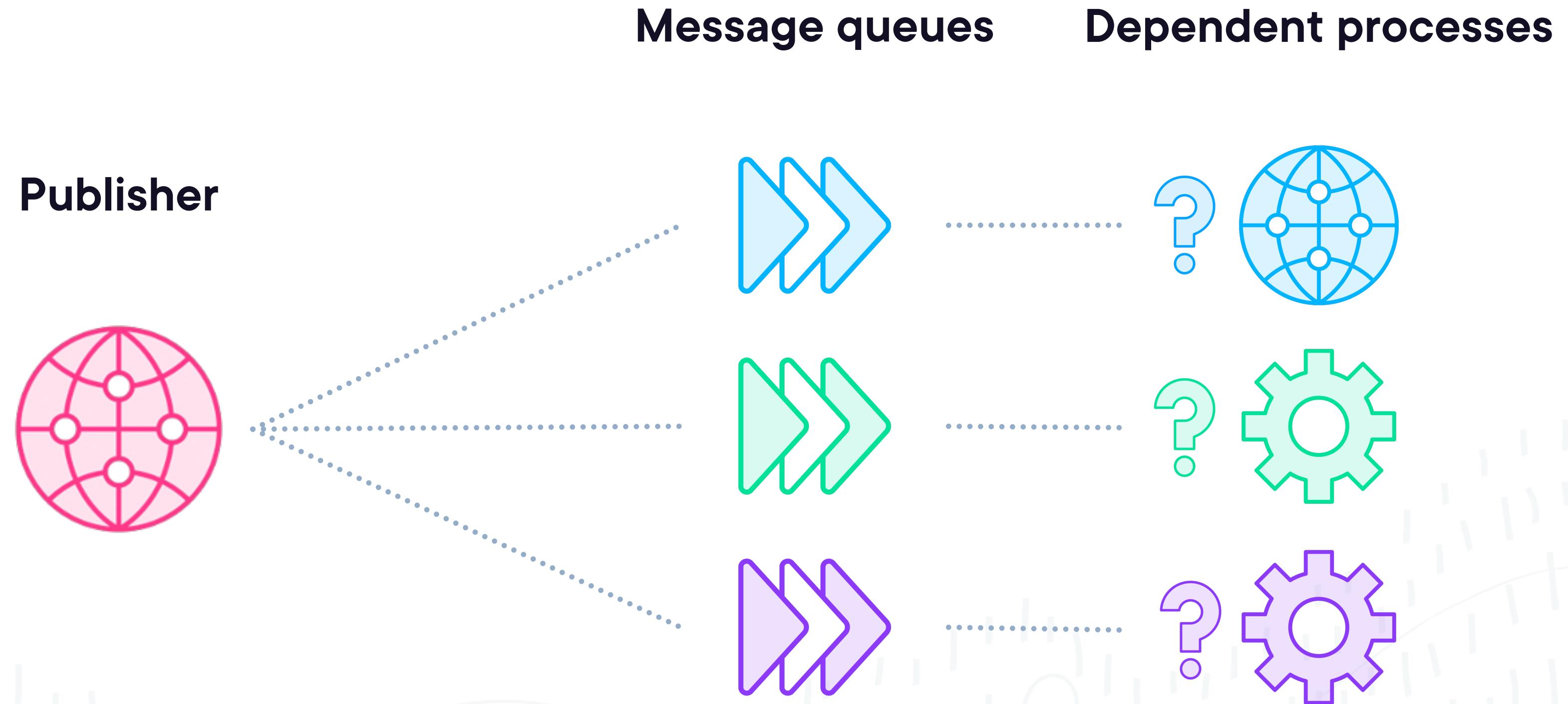


Introducing Message Queues

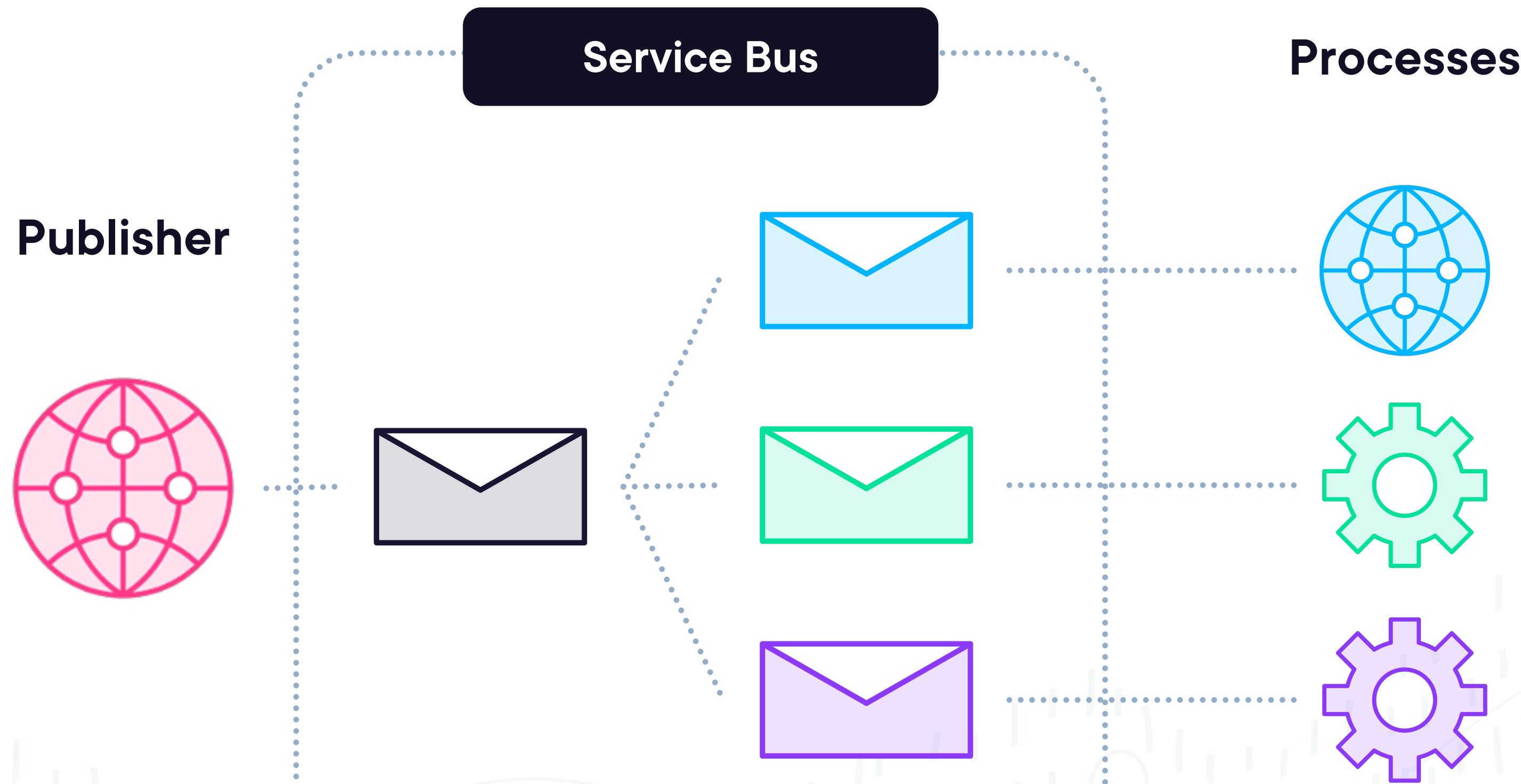
Where Does Message Queue Fit In?



Message Queues



Service Bus



Publish to Service Bus, Regardless of Who May Be Listening

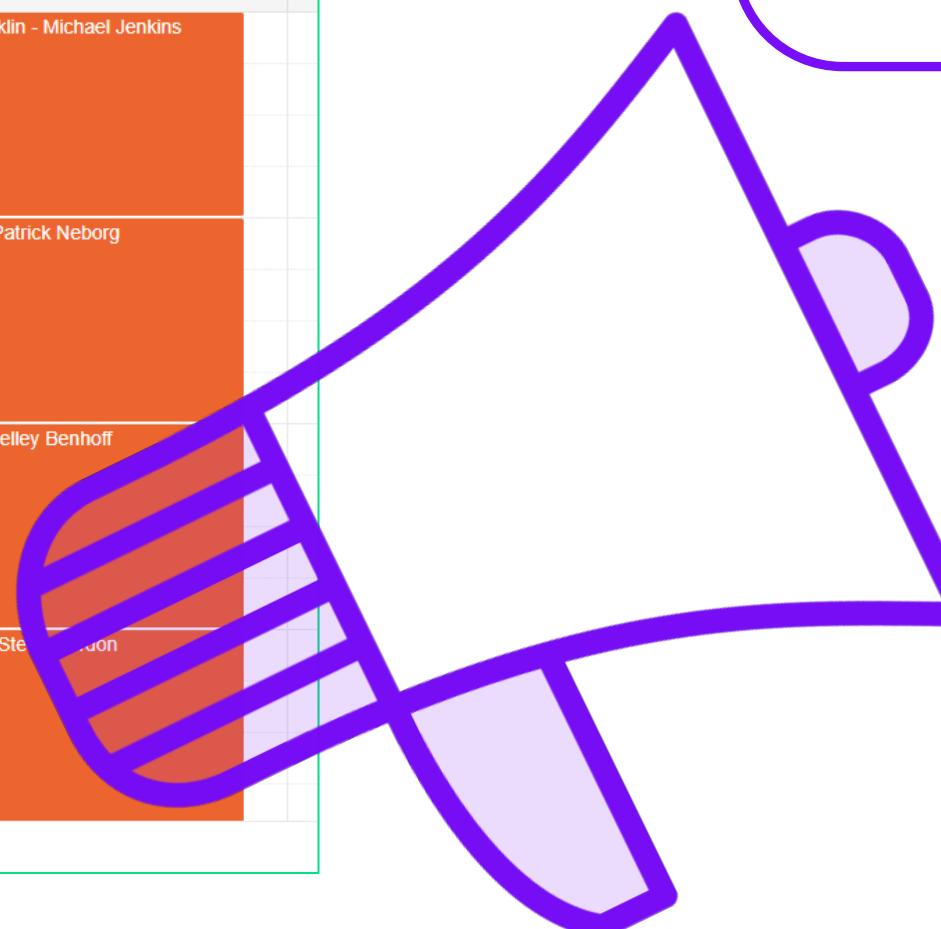
Appointments

Client: Select a Client...

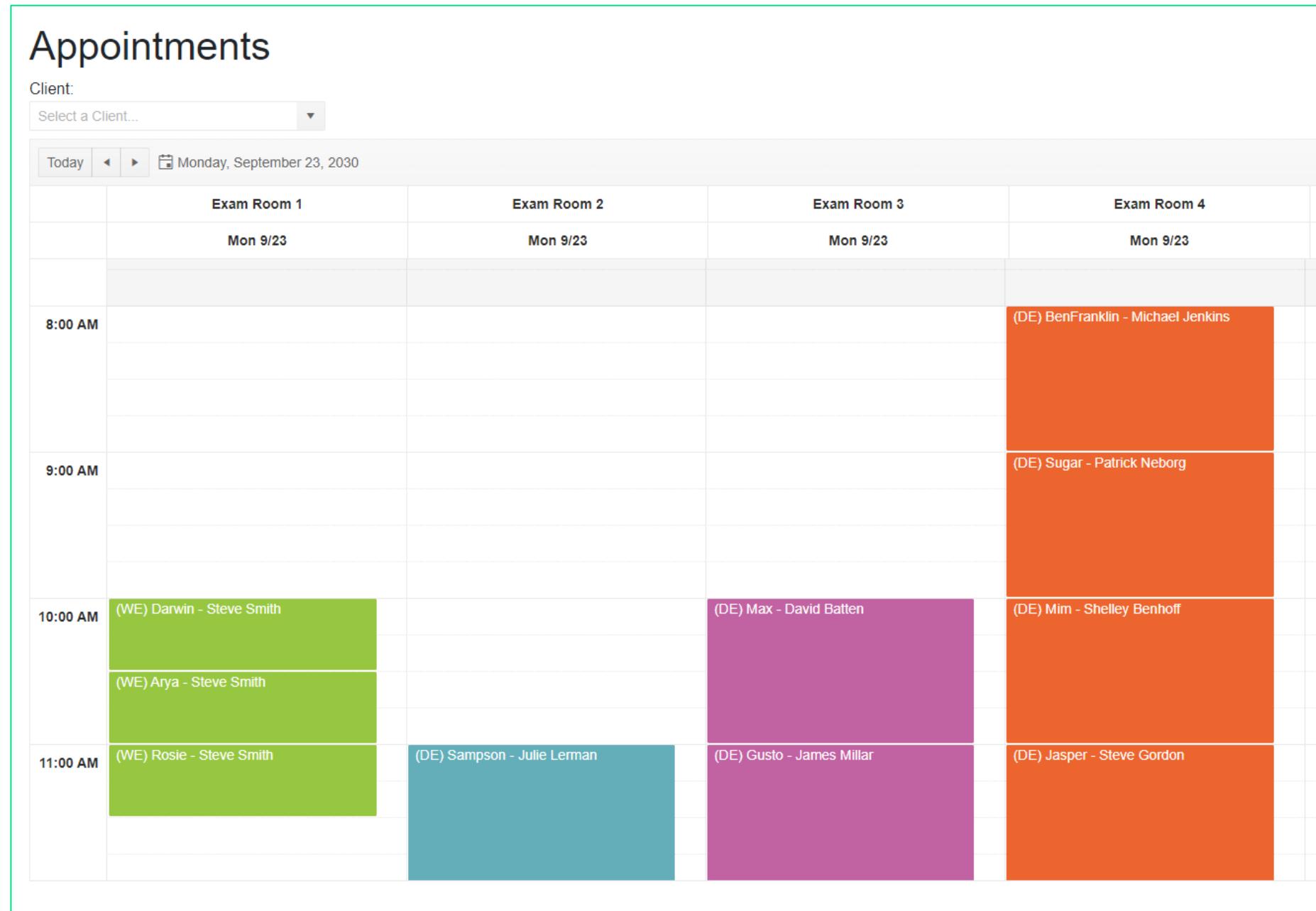
Today Monday, September 23, 2030

	Exam Room 1	Exam Room 2	Exam Room 3	Exam Room 4
Mon 9/23	Mon 9/23	Mon 9/23	Mon 9/23	Mon 9/23
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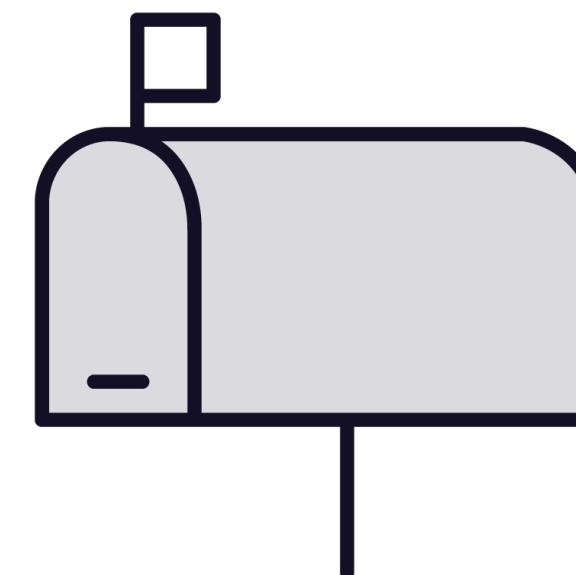
Hello! If anyone out there cares, here's a new appointment that just got scheduled!



Without Service Bus, Create a Specific Message Queue



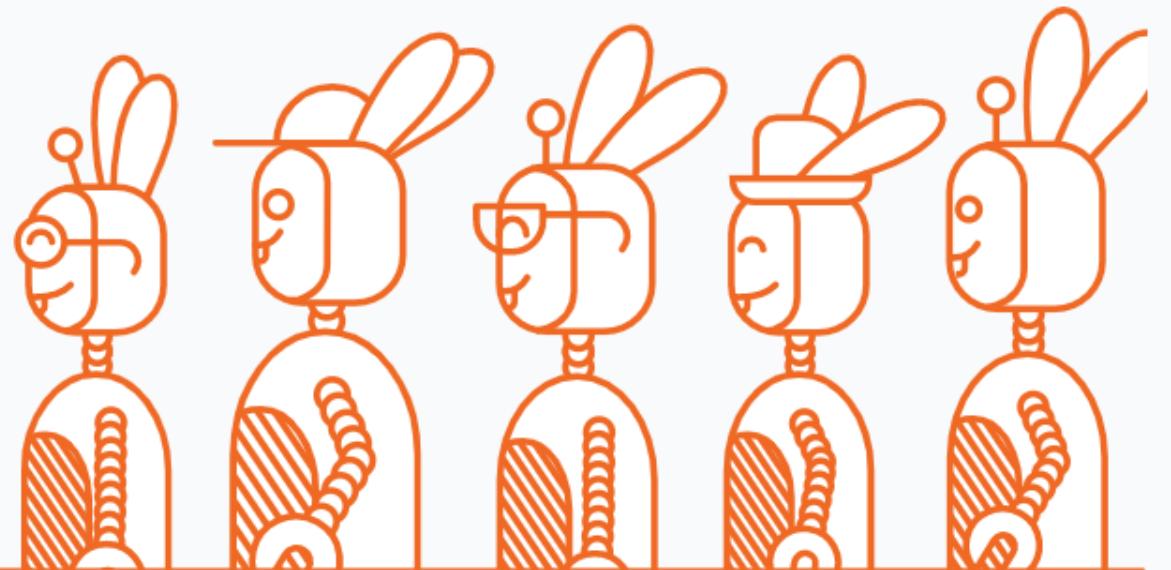
Hello! If anyone out there cares, here's a new appointment that just got scheduled!



Quorum queues

A webinar on high availability and data safety in messaging

[Learn more](#)



RabbitMQ is the most widely deployed open source message broker.

With tens of thousands of users, RabbitMQ is one of the most popular open source message brokers. From [T-Mobile](#) to [Runtastic](#), RabbitMQ is used worldwide at small startups and large enterprises.

RabbitMQ is lightweight and easy to deploy on premises and in the cloud. It supports multiple messaging protocols. RabbitMQ can be deployed in distributed and federated configurations to meet high-scale, high-availability requirements.

RabbitMQ runs on many operating systems and cloud environments, and provides a [wide range of developer tools for most popular languages](#).

See how other people are using RabbitMQ:

Updates

1. [Erlang 24](#) 24 Mar 2021
[Support and Erlang 22 Retirement Timeline](#)
2. [RabbitMQ 3.8.14](#) 02 Mar 2021
3. [RabbitMQ 3.8.13](#) 27 Feb 2021

[More updates →](#)

Tweets



In less than two weeks time, Bintray is going to be shut down. If you provision RabbitMQ from Bintray, please migrate ASAP
[blog.rabbitmq.com/posts/2021/03/...](http://blog.rabbitmq.com/posts/2021/03/)

Rabbit MQ

The screenshot shows the Docker Hub interface for the 'rabbitmq' repository. At the top, there's a search bar with the placeholder 'Search for great content (e.g., mysql)'. Below the search bar, the navigation menu includes 'Explore', 'Repositories', 'Organizations', 'Get Help', and a user profile for 'julielerman'. The main content area shows the 'rabbitmq' repository, which is a 'Docker Official Image'. The repository has over 1B+ pulls. It features a 'RabbitMQ' logo and a brief description: 'RabbitMQ is an open source multi-protocol messaging broker.' Below the description are filter buttons for 'Container', 'Linux', 'IBM Z', 'ARM 64', 'ARM', 'x86-64', 'PowerPC 64 LE', '386', 'Messaging Services', and 'Official Image'. A large button with the command 'docker pull rabbitmq' and a copy icon is prominently displayed. Below this button is a link to 'View Available Tags'. The page also includes sections for 'Description', 'Reviews', and 'Tags', and a 'Quick reference' section with links to community resources like the Docker Community and forums.

rabbitmq ☆

Docker Official Images

RabbitMQ is an open source multi-protocol messaging broker.

1B+

Container Linux IBM Z ARM 64 ARM x86-64 PowerPC 64 LE 386 Messaging Services Official Image

Description Reviews Tags

Quick reference

- Maintained by: the Docker Community
- Where to get help: the Docker Community Forums, the Docker Community Slack, or Stack Overflow

Supported tags and respective Dockerfile links

- 3.8.15-rc.2, 3.8-rc
- 3.8.15-rc.2-management, 3.8-rc-management
- 3.8.15-rc.2-alpine, 3.8-rc-alpine

No need to install, just use a Docker container!

Overview

▼ Totals

Queued messages last minute ?

Currently idle

Message rates last minute ?

Currently idle

Global counts ?

Connections: 0

Channels: 0

Exchanges: 7

Queues: 0

Consumers: 0

▼ Nodes

Name	File descriptors ?	Socket descriptors ?	Erlang processes	Memory ?	Disk space	Uptime	Info	Reset stats	+/-
a@localhost	34 467109 available	0 420306 available	409 1048576 available	92MB 6.1GB high watermark	13GB 48MB low watermark	8m 57s	basic disc 6 rss	This node All nodes	
b@localhost	34 467109 available	0 420306 available	409 1048576 available	89MB 6.1GB high watermark	13GB 48MB low watermark	14m 28s	basic disc 6 rss	This node All nodes	

► Churn statistics

► Ports and contexts

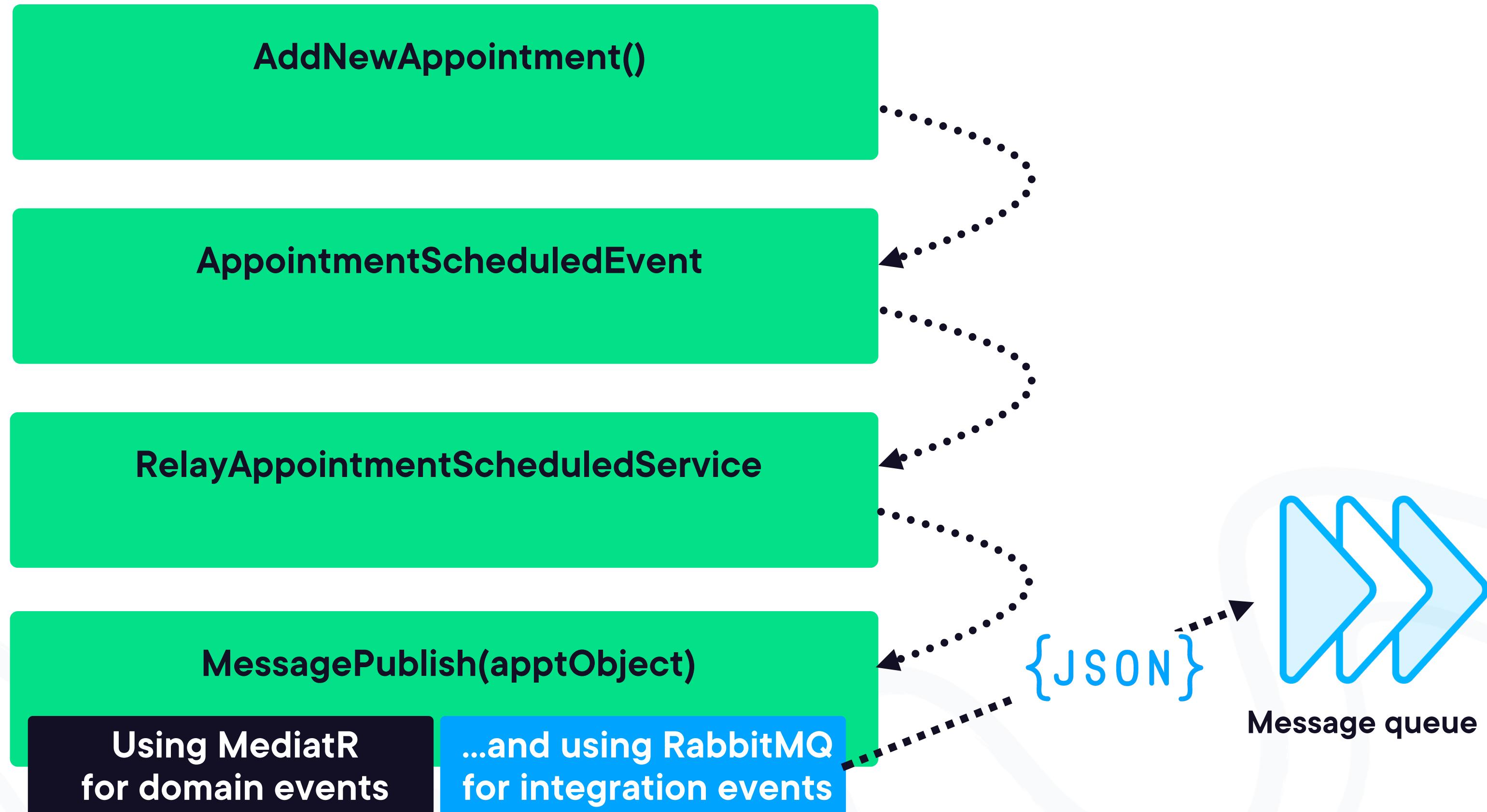
► Export definitions

► Import definitions



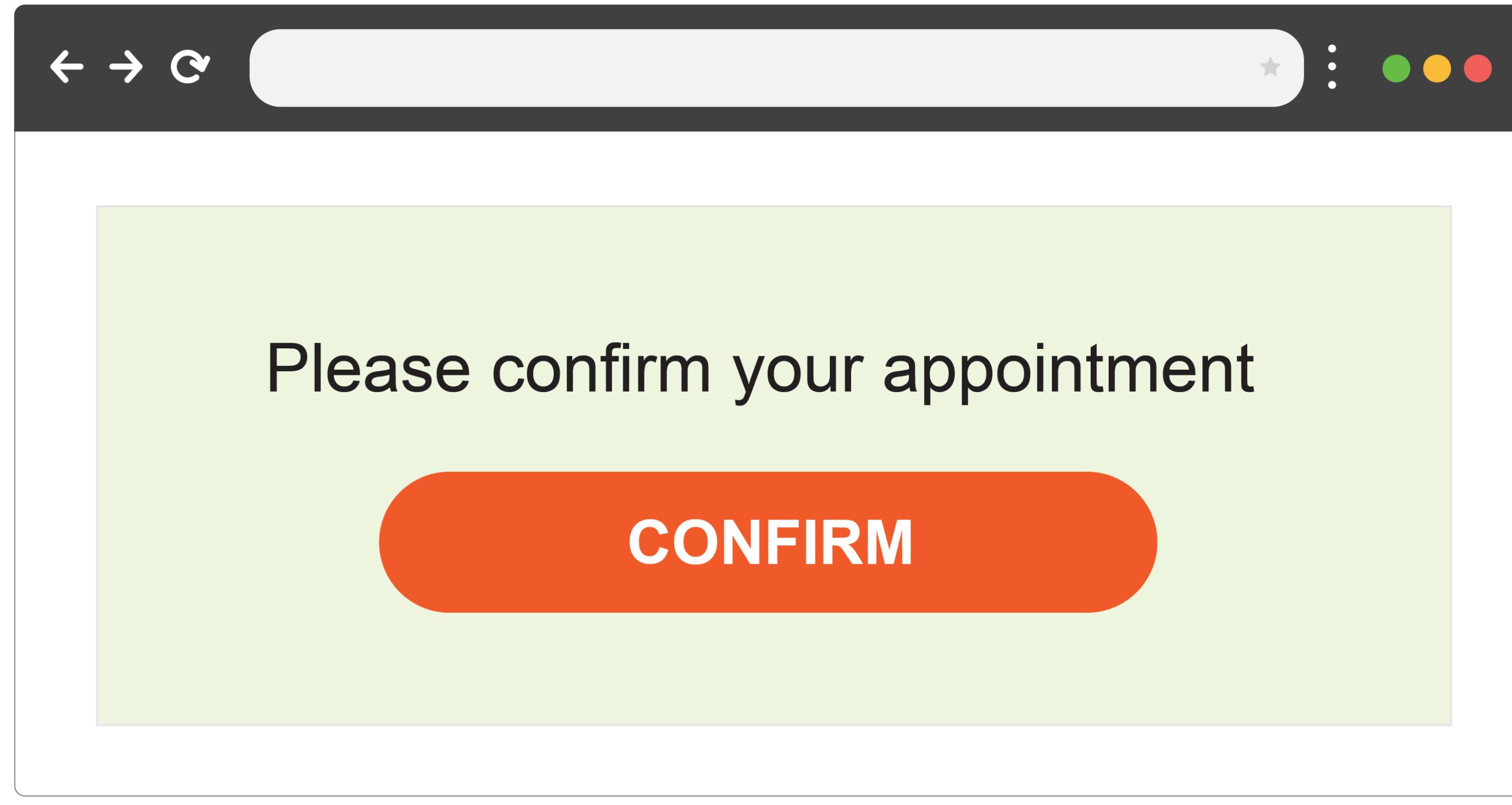
Sending a Message to the Queue

Appointment Scheduled Workflow

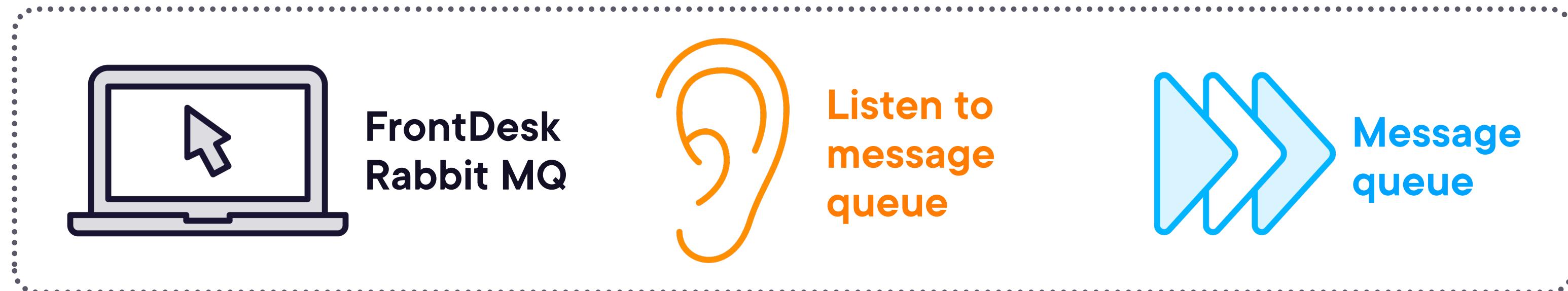


Reading From the Message Queue and Acting on the Message

Email and Confirmation Logic on Public Website



Send Email via Message Queue



For messages found, retrieves appointment details and...



Send confirmation email

ConfirmationEmailSender.cs

```
public void SendConfirmationEmail(Models.SendAppointmentConfirmationCommand appointment)
{
    _logger.LogInformation($"Sending email to confirm appointment: {appointment}");

    string confirmUrl =
        $"http://localhost:{_config.Port}/appointment/confirm/{appointment.AppointmentId}";

    string to = appointment.ClientEmailAddress;

    string from = "donotreply@thevetclinic.com";

    string subject = "Vet Appointment Confirmation for " + appointment.PatientName;

    string body = String.Format("<html><body>Dear {0},<br/><p>Please click the link below to confirm {1}'s appointment for a {2} with {3} on {4}.</p><p>Thanks!</p><p><a href='{5}'>CONFIRM</a></p><p>Please call the office to reschedule if you will be unable to make it for your appointment.</p><p>Have a great day!</p></body></html>", appointment.ClientName, appointment.PatientName, appointment.AppointmentType,
appointment.DoctorName, appointment.AppointmentStartTime.ToString(), confirmUrl);

    _emailSender.SendEmail(to, from, subject, body);
}
```

Papercut-SMTP | Papercut SMTP

papercut-smtp.com

[View on GitHub](#)

Papercut-SMTP

Papercut SMTP—The Simple Desktop Email Server

Papercut The Simple Desktop Email Helper

[build](#) [passing](#) [gitter](#) [join chat](#) [Say Thanks!](#)

The problem

If you ever send emails from an application or web site during development, you're familiar with the fear of an email being released into the wild. Are you positive none of the 'test' emails are addressed to colleagues or worse, customers? Of course, you can set up and maintain a test email server for development – but that's a chore. Plus, the delay when you are waiting to view new test emails can radically slow your development cycle.

Papercut to the rescue!

Papercut is a 2-in-1 quick email viewer AND built-in SMTP server (designed to receive messages only). Not only does it not enforce any restrictions how you prepare your email, but it allows you to view the whole email-chilada: body, html, headers, attachment down right down to the naughty raw encoded bits. Papercut can be configured to run on startup and sit quietly (minimized in the tray) only providing a notification when a new message has arrived.

Download Now

[Latest Release](#)

Download Papercut.Setup.exe installer.

Papercut-SMTP

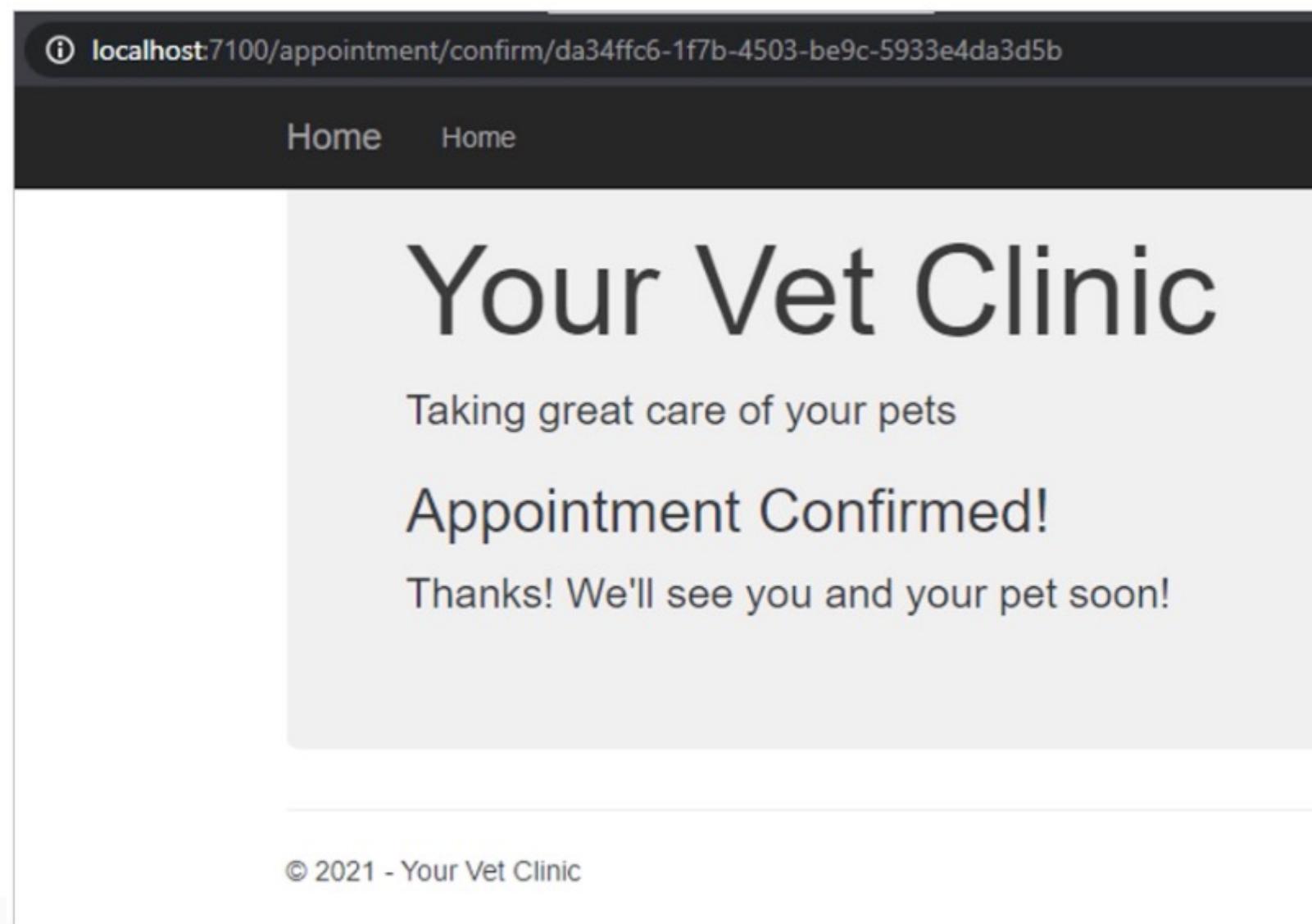
Can be used to emulate email sending

Free and open source

Email is confirmed by customer

Browser open to confirmation page

User clicks confirm button



App sends an appointmentID to message queue

Multiple Queues in Our System

RabbitMQ TM Refresh

RabbitMQ 3.8.14 Erlang 23.3.2

Overview Connections Channels Exchanges **Queues** Admin

Queues

▼ All queues (3)

Pagination

Page of 1 - Filter: Regex ?

Overview				Messages			Message rates			+/-
Name	Type	Features	State	Ready	Unacked	Total	incoming	deliver / get	ack	
fdcm-frontdesk-in	classic	D	idle	0	0	0				
fdvcp-frontdesk-in	classic	D	idle	0	0	0				
fdvcp-vetclinicpublic-in	classic	D	idle	1	0	1				

Multiple Queues in Our System

Front Desk

Appointments

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11:00 AM	(WE) Rosie - Steve Smith	(DE) Sampson - Julie Lerman	(DE) Gusto - James Millar	(DE) Jasper - Steve Gordon



Vet Clinic Public

localhost:7100/appointment/confirm/da34ffc6-1f7b-4503-be9c-5933e4da3d5b

Home Home

Your Vet Clinic

Taking great care of your pets

Appointment Confirmed!

Thanks! We'll see you and your pet soon!

© 2021 - Your Vet Clinic

Using Multiple Queues to Handle Various Communications

Multiple Queues in Our System

Front Desk

Appointments

Client: Select a Client... Today Monday, September 23, 2030

	Exam Room 1	Exam Room 2	Exam Room 3	Exam Room 4
Mon 9/23	Mon 9/23	Mon 9/23	Mon 9/23	
8:00 AM				(DE) BenFranklin - Michael Jenkins
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Vet Clinic Public

localhost:7100/appointment/confirm/da34ffc6-1f7b-4503-be9c-5933e4da3d5b

Home Home

Your Vet Clinic

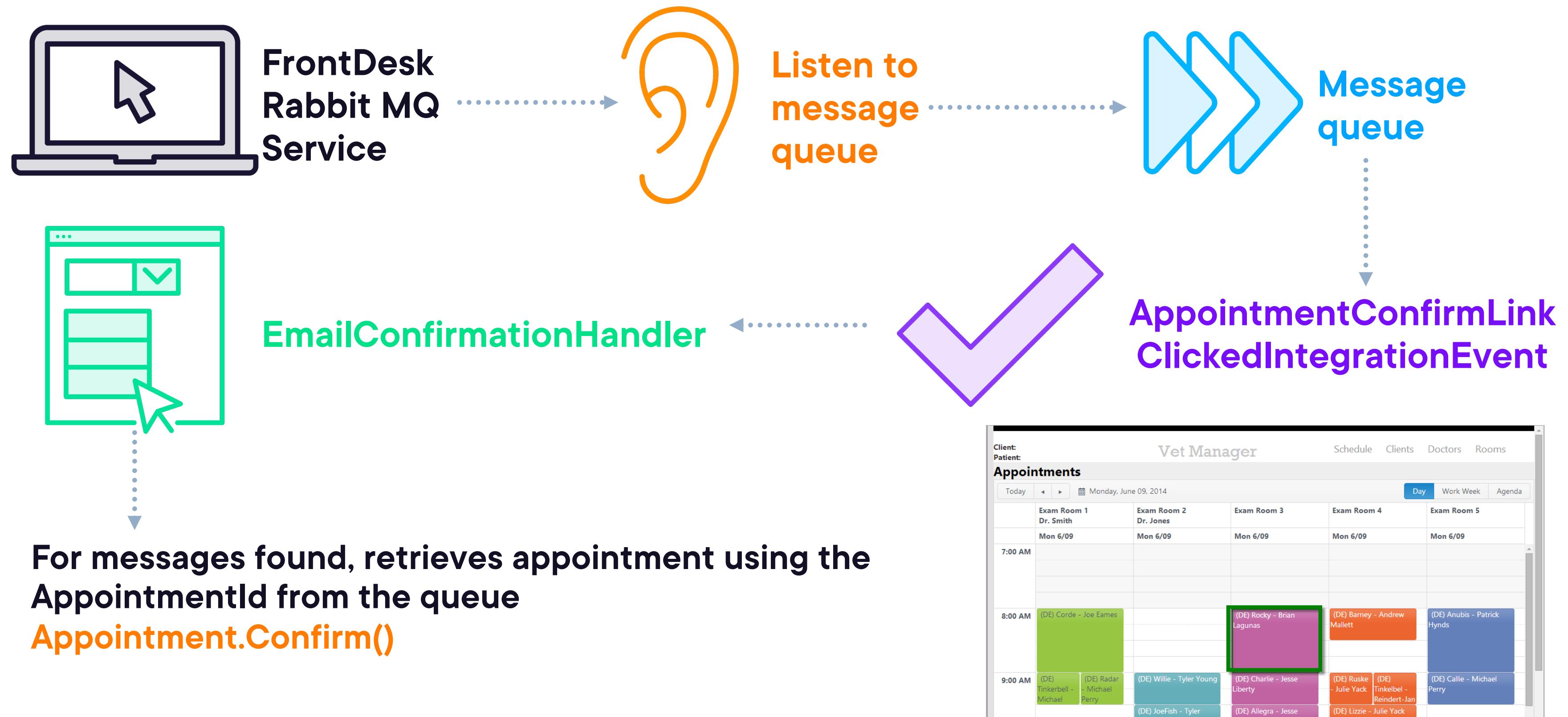
Taking great care of your pets

Appointment Confirmed!

Thanks! We'll see you and your pet soon!

© 2021 - Your Vet Clinic

Sending the Confirmation to Front Desk





Debugging to See the Detailed Implementation in Code



Considering Microservices

Microservices Basic Tenets

Self-contained

No dependency on other microservices

Independently deployable

Changing internals should not break communications

Microservices Basic Tenets

Microservice A

Microservice B

Microservice C

Microservice D

Are These Bounded Contexts?

Microservice A

Microservice B

Microservice C

Microservice D

**Bounded context
is not necessarily equal to
a microservice**





More Information

Bounded Contexts, Microservices and Everything In Between

Vladik Khononov at KanDDDinsky 2018
bit.ly/vladonmicro (YouTube)

**Microservice design can
learn a lot from
Domain-Driven Design**

Microservices Basic Tenets

FrontDeskRabbitMQService



Self-contained



No dependency on other microservices



Independently deployable



Changing internals should not break communications

Service Is Hosted by One of Our Apps

Vet Clinic Public App

OurRabbitMQService

Extract the Service into a Microservice

Vet Clinic Public App

Now we can remove additional complexity from the app!

OurRabbitMQService

Sharing Some Tips for Extending and Running the Sample Application

Extra Credit – Reminder Emails Service



An image chunking option for when you have longer text



Be concise and keep each bullet to two lines or fewer



Avoid sending duplicate emails if run multiple times



Avoid sending to clients who haven't opted in



Considering the UI in the Domain Design



**Is it an anti-pattern to think about the UI when
we are focused on the domain?**

No!

The demands of the user interface can impact parts of your application.



Jimmy Nilsson

Factor10.com

**Author of “Applying
Domain-Driven Design
and Patterns”**

Jimmy Nilsson

**“Most likely I’m learning stuff
[with UI sketching] that
affects my story and
scenario”**

Citation: Developing Core Business Applications with DDD and Microsoft .NET
TechEd NA 2013

**Scheduling is
not our domain.**

Modeling with Event Storming and Other Techniques

Event Storming



EVENT STORMING

The smartest approach to collaboration
beyond silo boundaries

TO SAVE TIME, LET'S JUST ASSUME
I'M NEVER WRONG

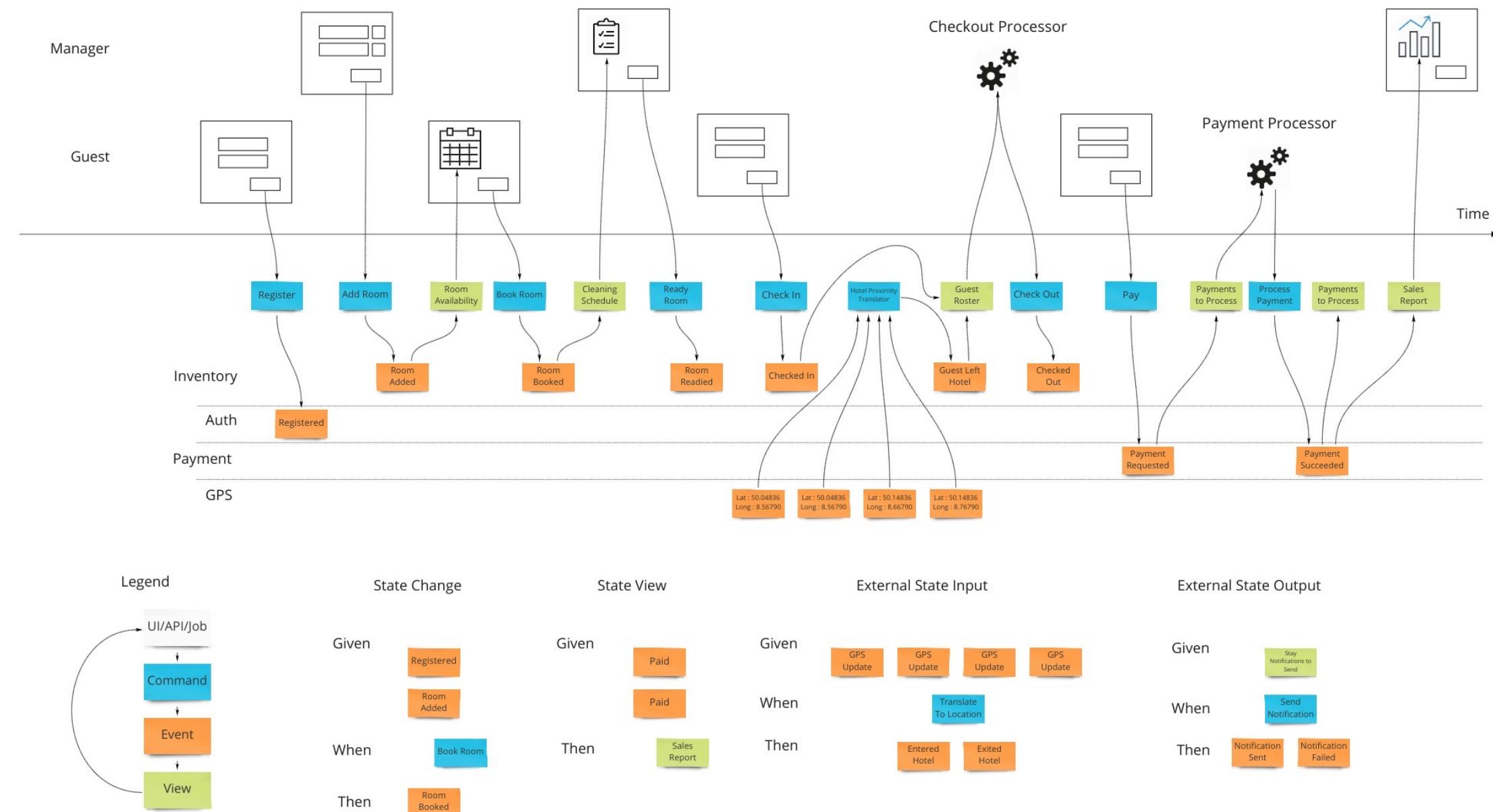
Chaotic Discovering During Event Storming



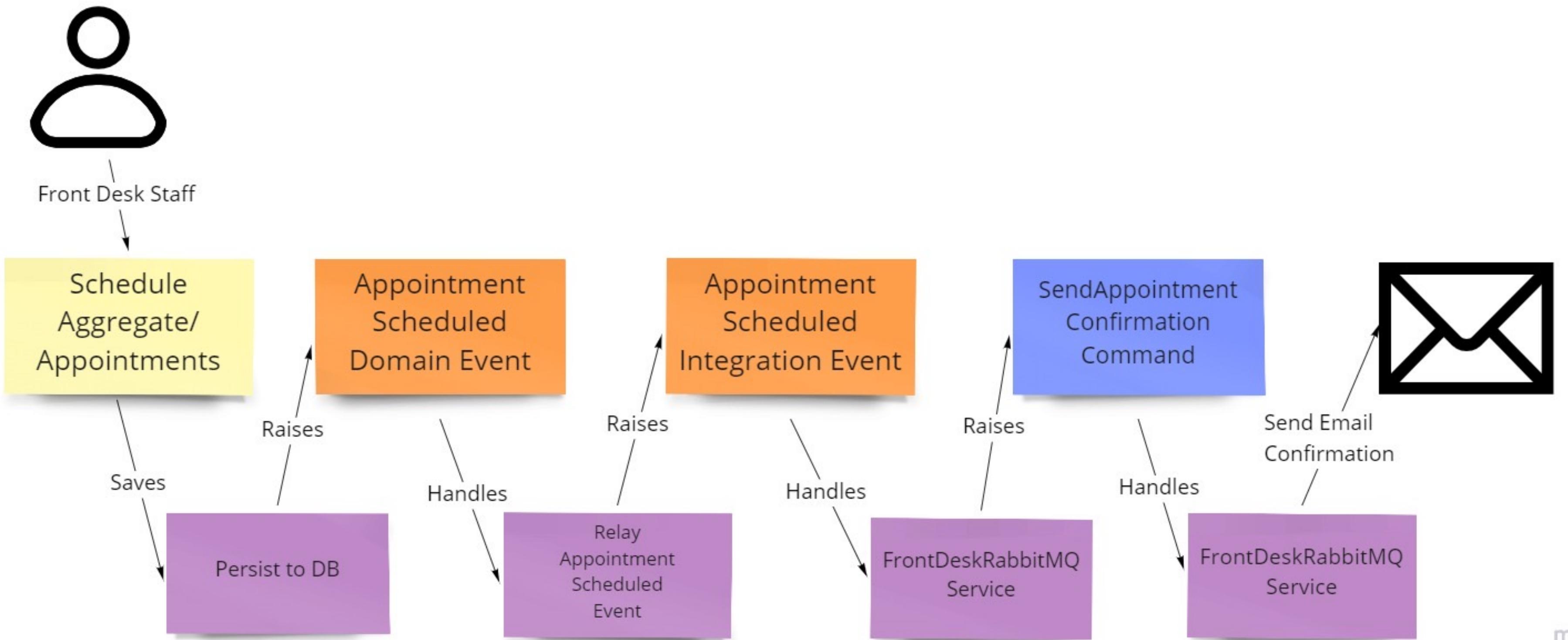
Event Modeling



Adam Dymitruk
EventModeling.org



A Model Designed Using Miro.com



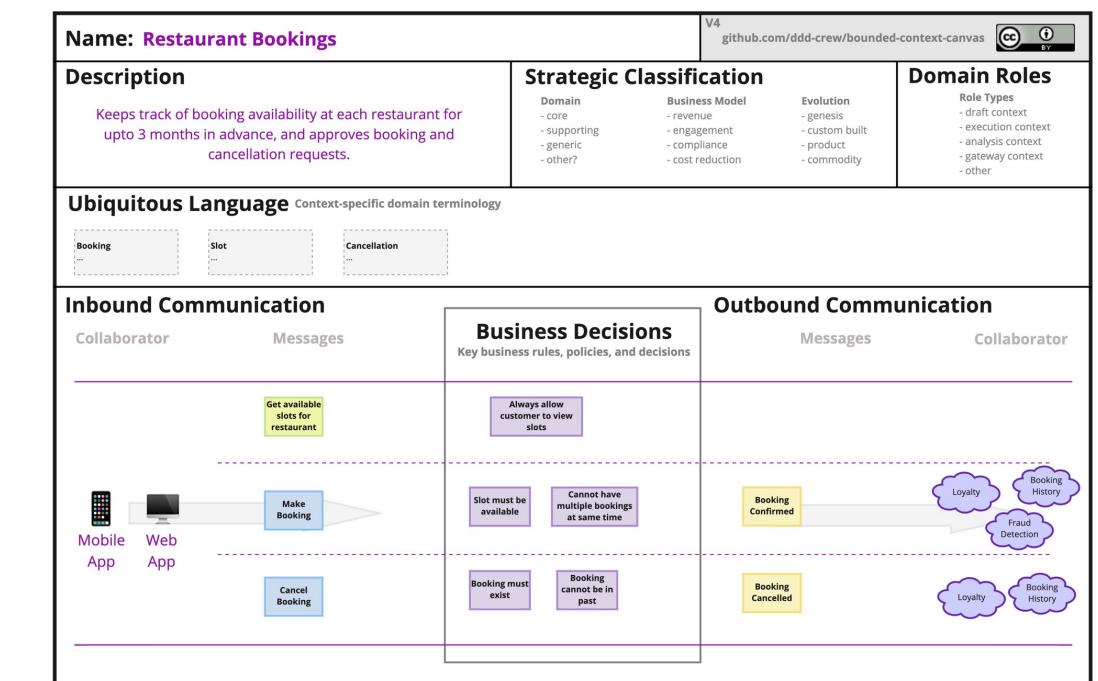
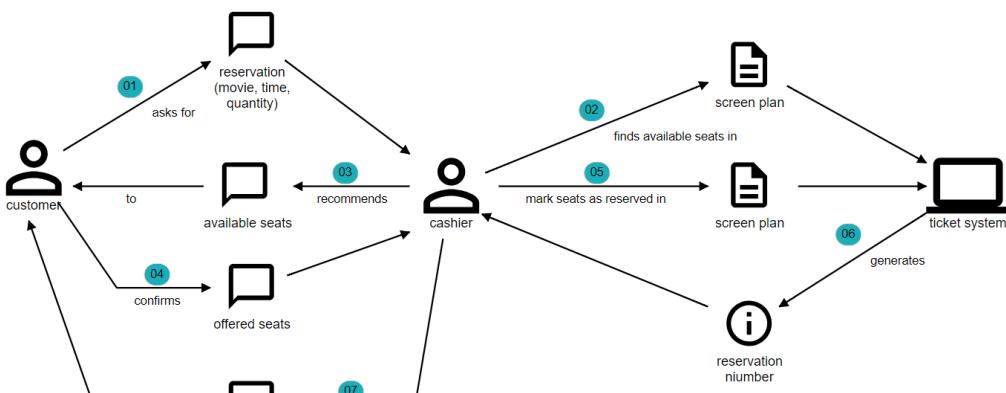
Some More Modeling Processes and Tools



The best way to learn a language is to listen to other people speak that language. Try to repeat what you hear and mind their feedback. Gradually, you will progress from individual words to phrases and to complete sentences. The more you speak, the faster you will learn.

With **Domain Storytelling** you can employ the same principle when learning a new domain language. Let domain experts tell their domain stories. While listening, you record the domain stories using a pictographic language. The domain experts can see immediately if you understand their story correctly. After very few stories, you are able to talk about the people, tasks, tools, work items, and events in that domain.

The best way to explain Domain Storytelling is to see it in action.
Watch this live modeling session (hosted by the Virtual Domain-Driven Design Meetup):



Domain Storytelling
domainstorytelling.org

Domain Storytelling Modeler
egon.io/app/

Bounded Context Canvas
github.com/ddd-crew/bounded-context-canvas



Beware!

Analysis Paralysis



Eric Evans on the Fallacy of Perfectionism

**Domain-Driven Design
provides guidance, not
rules.**

Eric Evans

“There’s something about DDD that brings out the perfectionist in people... they say, this model’s not really good enough...and basically churn and churn. I’m here to say, no model is going to be perfect.”

Eric Evans

“We need to know what we’re doing with this thing, the scenarios we’re trying to address. We want a model that helps us do that, that makes it easier to make software that solves those problems. That’s it.”

All models are wrong.

Some models are useful.



Lessons Learned Since Earlier Versions of this Course

Thanks for the Feedback!

The course fills the gaps between theory and practice

That course is amazing! We included it in our must-take list last year.

"I have read several books on DDD but here is the best explanation about value objects."

Loved your #DDD course with @ardalis! Your dialog was as good as an NPR interview with Terri Gross. I really enjoyed the pace of information and how you both kept things fresh. Would watch again!

A great introduction to DDD and really well explained! The code samples, and downloads, were especially helpful to see an implementation. Fabulous work!"

It's by far one of the epic courses out there.

Domain-Driven Design Fundamentals

Version 1: 2014
Version 2: 2021
Version 3: 2024

The screenshot shows the Pluralsight website interface. At the top, there is a navigation bar with links for INDIVIDUALS, BUSINESS, ACADEMIC, FREE TRIAL, BLOG, SUPPORT, and Sign in. Below the navigation bar is a search bar labeled "Search the library". The main content area features a course thumbnail for "Domain-Driven Design Fundamentals", which includes a clock icon and the text "Software Practices". To the right of the thumbnail, the course title is displayed in orange, followed by a brief description: "This course teaches the fundamentals of Domain-Driven Design (DDD) through a demonstration of customer interactions and a complex demo application, along with advice from Eric Evans." Below the description, author information is listed: "Authored by: Smith , Lerman", "Duration: 4h 16m", "Level: Intermediate", "Released: 6/25/2014", and "Course Rating: ★★★★★". Below the course details are social sharing buttons for Twitter and LinkedIn. At the bottom of the page, there is a table of contents with sections like "Introducing DDD", "Introduction", "10 Years of Domain-Driven Design", "What's in This Course?", "Eric Evans' Participation in This Course", and "Why Should You Care About Domain-Driven Design?". Each section has a progress bar and a duration value.

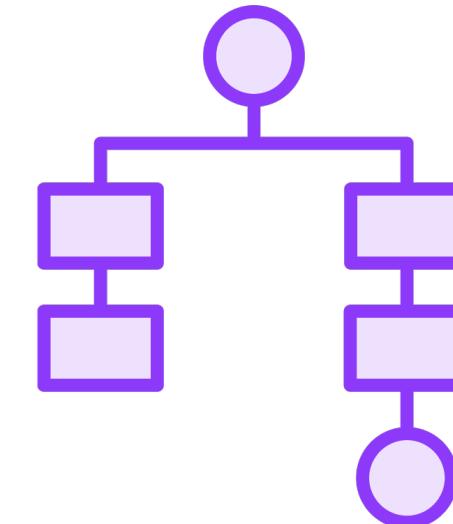
Progress	Duration
expand all	collapse all
00:24:18	00:23
01:00	01:27
00:29	02:13

DDD Is Growing and Evolving

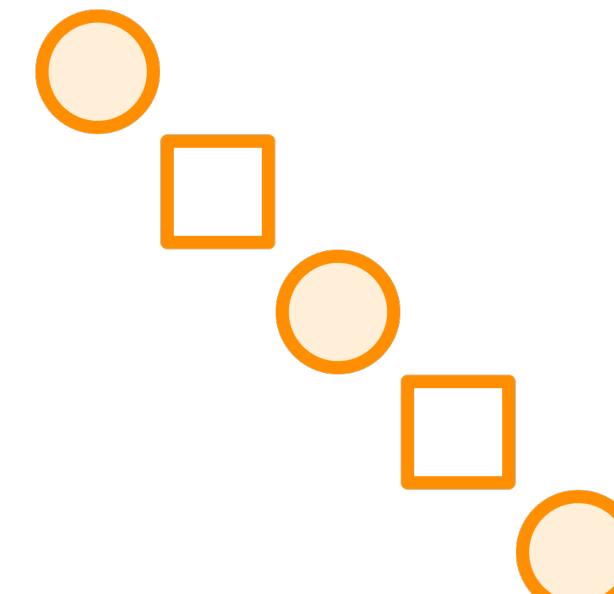
New practices and patterns are gaining popularity
as teams find success using them



Event Storming



Event Modeling



Patterns

Old Technologies

2014 Course
.NET Framework 4
ASP.NET and EF 6

2021 Course
.NET 6
ASP.NET Core 6
and EF Core 6

New Technologies

.NET 8

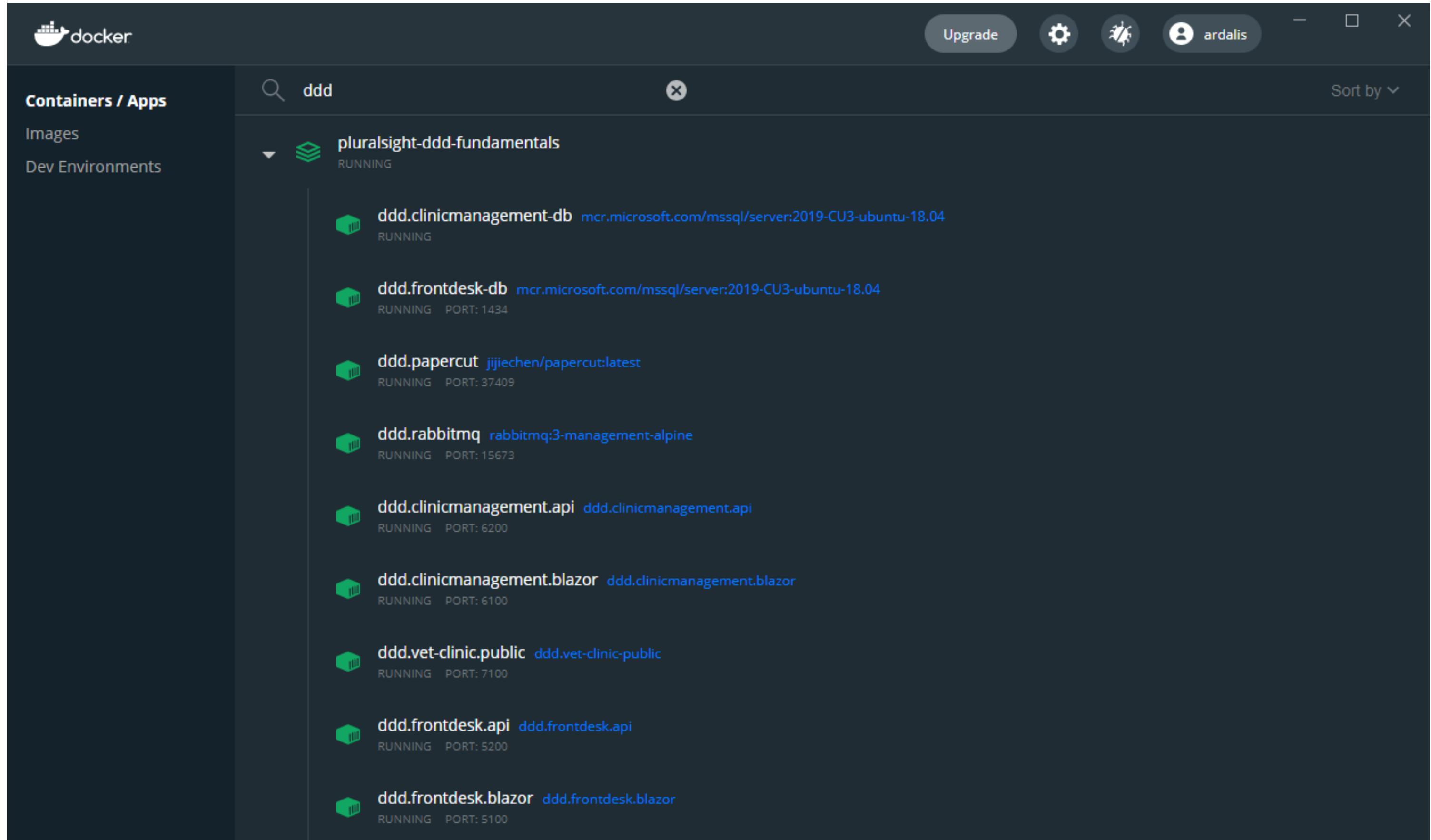
**ASP.NET Core 8
EF Core 8**

Docker

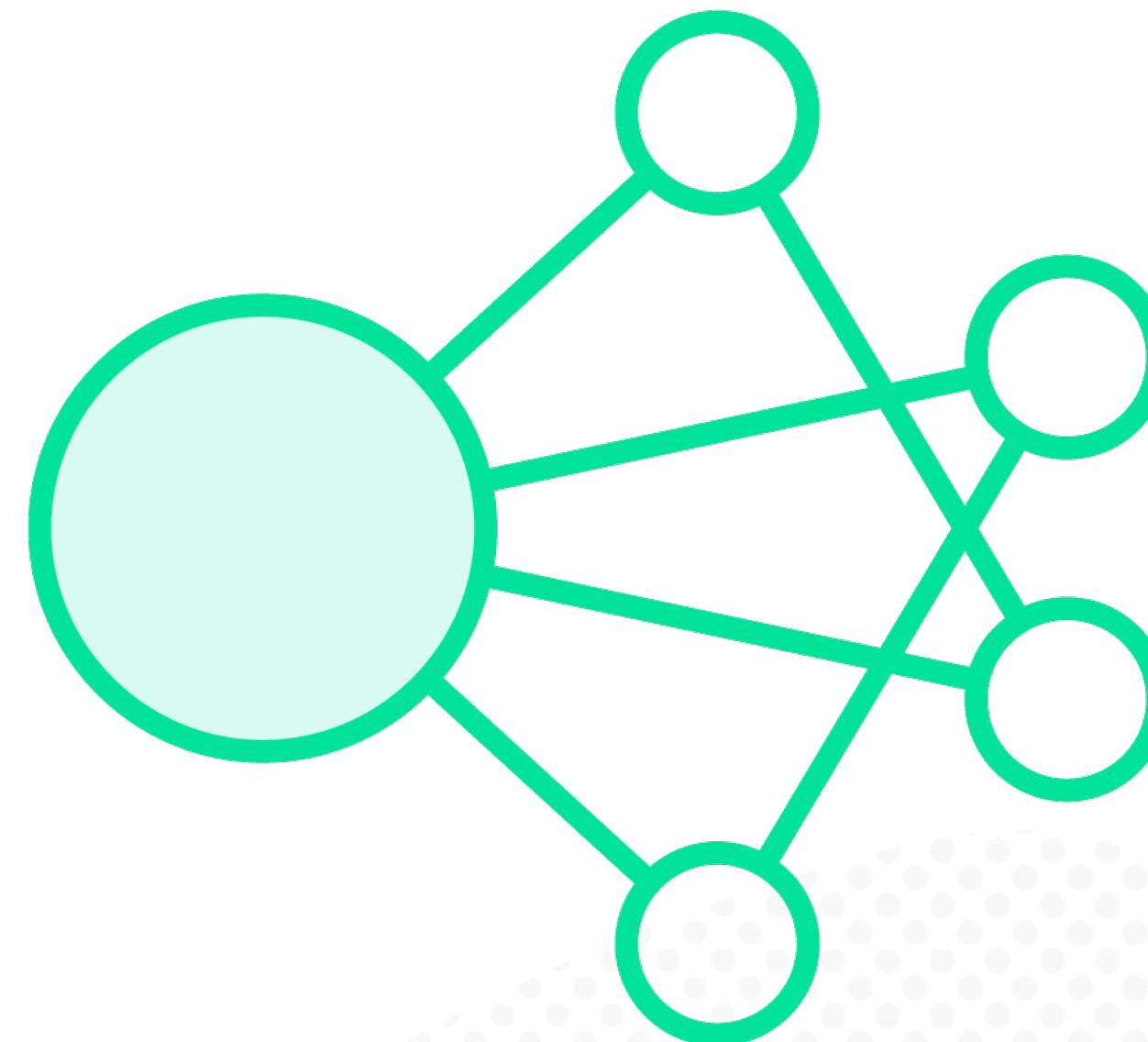
Papercut

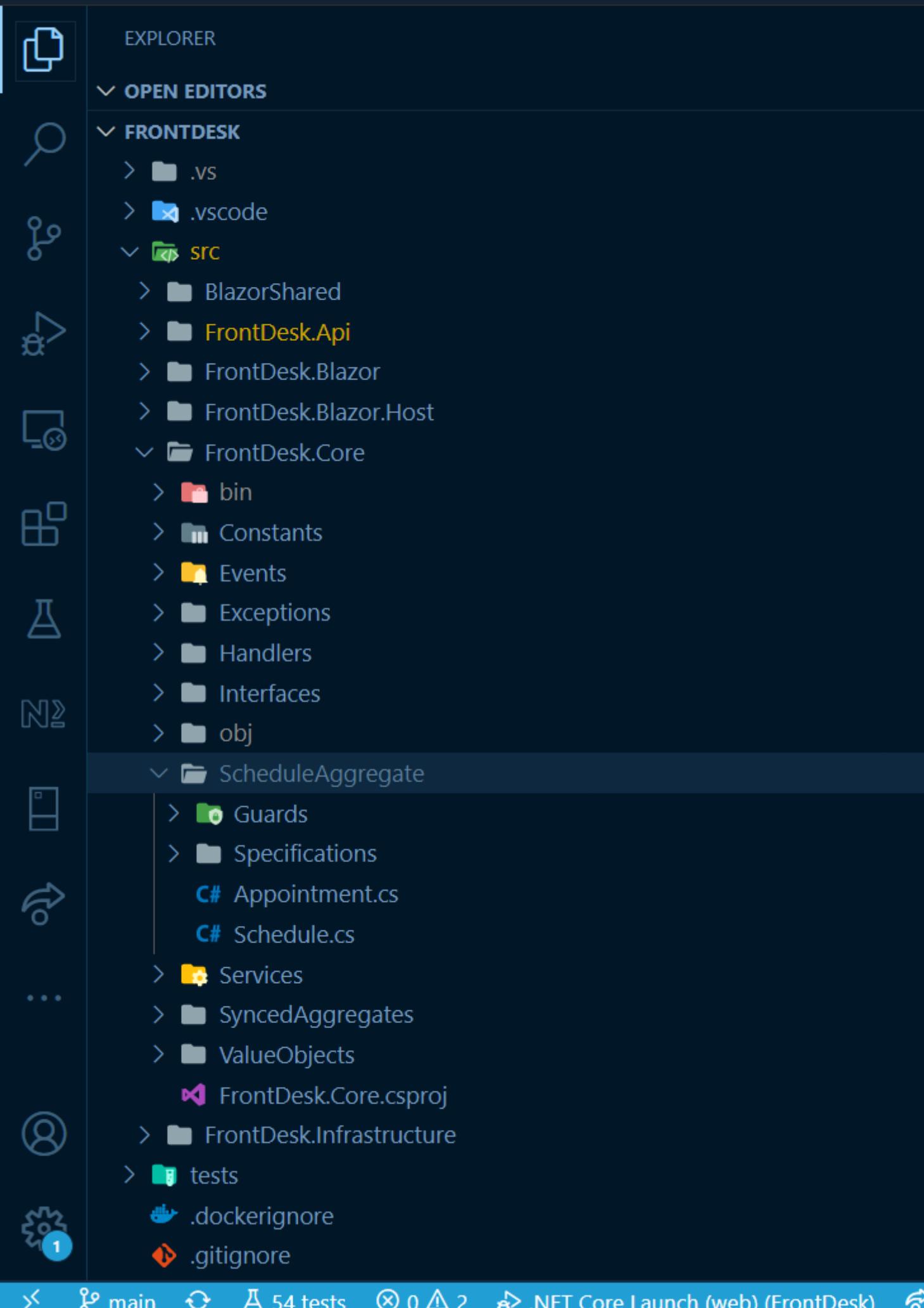
RabbitMQ

Docker Running the Sample Apps



Microservices and DDD





Real World Code

**DDD is a big topic, and
we're all learning new ways
to build better software**



Review and Resources

**Planning and implementing
with DDD guidance made
extending the application
painless.**

Message Queue

A tool for storing and retrieving messages, often used by applications to communicate with one another in a disconnected fashion

Service Bus

Software responsible for managing how messages are routed between numerous applications and services

Key Takeaways



Previous design set us up for easily adding features

Used a message queue (RabbitMQ) to communicate between apps

Leveraged 3rd party products for generic domains

Debugged through code to see how the data and events flowed

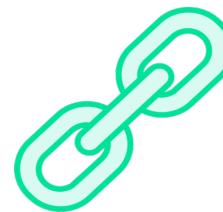
Highlighted modeling tools and practices and new ideas emerging from DDD community

Shared lessons learned since first iteration of this course!

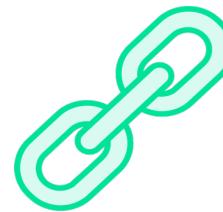


**Thanks to Eric Evans for
his great advice and
insights**

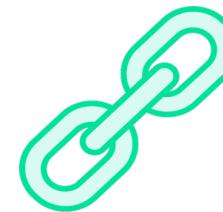
Resources Referenced in This Module



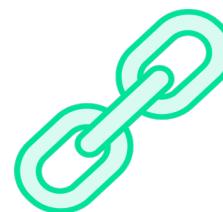
Bus or Queue (Blog post):
ardalis.com/bus-or-queue



RabbitMQ.com



Miro.com



eventstorming.com



eventmodeling.org



DomainStorytelling.org



Domain Storytelling Modeler
wps.de/modeler



Bounded Context Canvas
github.com/ddd-crew/bounded-context-canvas

More Resources Referenced in This Module

Developing Core Business Applications with Domain-Driven Design (DDD) and Microsoft .NET

Jimmy Nilsson, TechEd bit.ly/NilssonDDDTechEd2013

Papercut github.com/ChangemakerStudios/Papercut-SMTP

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