TAVSS

Interactive Microservice System for student services

Graduation Project Submitted To Information System Department

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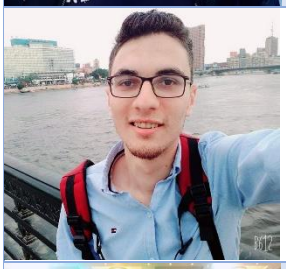

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Acknowledgement

*We want to thank **ALLAH** most of all, because without **ALLAH** we would not be able to do any of this.*

*We want to thank all **our families** that support us from childhood with there care and the patience of them.*

*To our supervisor **Prof.Samir Abd El-Razik** , who take a chance on us to achieve our goals and dreams and make them real, as his patience about his illness to achieve the target of make his students suitable enough to do the impossible things.*

*A very special thanks to **Prof.Haitham Abd Almonem El-Ghareeb** for his advices about enterprise systems and architectures and for teaching us these principles last years, his efforts make us more thankful as he taught us different architectures and design patterns.*

*We would like to give sincere thanks to **Dr.Sara El-Sayed El-Metwally** about giving us the hope to continue, and for supporting our dreams and take us to right place by her good words and advices, these are littles words to thank her, but surely she knows how we appreciate her.*

We would to thank special Drs:

Mohammad Seyam

Mohammad El-Hosseini

Sara Shaker Elhishi

And all our professors and teaching assistants

Edition V 1. 0

Published by:

TAVSS team a division of Mansoura University CIS Faculty team

Using Trading Mark of Microsoft as the technology Provider 1

Using Apple Mark for IOS Apps

Using Amazon Mark as a big organization implement the Microservices

Using Docker Mark as the Backbone of Microservices Systems

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ABSTRACT

The current e-learning systems are legacy to support the changes behind the real domain, as it reflects just the domain of study without collaborations and no external dimensions for entertainment and workspaces, but the microservice system can achieve any type of domains, to integrate the internal and the external environments for student, so the project is a solution to solve the problem of domain-change-per-day problems like to adapt any type of learning methods in just little time, the promise of change can be achieved by the distributed-system environment because the microservices integrate over the processes of the organization and by choosing some critical tactical services like the student can collaborate to the projects of his field and share them with company and can take acclaims by his efforts and find a good place to learn practice and more, the project of TAVSS contains 7 Tactical Services(coarse-grained services) each one contain many microservices implemented by the best practices and can be adapted to a cloud environment.

CHAPTER 1 : INTRODUCTION

E-learning and Career Development discovery are challenges to achieve with the real-time event that the world suffer from Covid-19, so we need speed response and making a solution to go to the next possible . The learning, career development and skills building are the obstacles on the lifecycle in any faculty. Many students suffer so we build our hypothesis on four steps that have been discovered. the lifecycle starts with the student in all faculty years.

1.1 DEFINING SERVICES

The life cycle form of learning by entertainment to interaction learning to skills building to develop the career of the student by supporting the integration of many system services that we tell every student loses these services in faculty, dividing them to internal and external services. Internal services like project, course, schedule, tasks, games and assignment management; external services like communities, teams, companies, training centers, market places and integration by the business using new methods of interaction like evaluation, chatting, blogging and cv development using standards.

1.2 OBJECTIVES

The best goal we need to achieve is by creating channels between student, TAs, doctors and companies by supporting the entire services of communication and career development technique by 4 steps of process integration.

Learning by entertainment is an internal integration process by use gaming, challenges, project challenging, scheduling times, assignments.

- **Interaction learning:** Internal-External integration process by use development communities of faculty, training centers, companies, training courses, project challenging, gaming.
- **Skills Building:** Internal-External integration process by use soft skills building and development skills with communities and Skills Training centers like UCCD and ITI and other training models, with the acclaims of every students.
- **Career Development:** Internal-External Integration, every student here have cv , every cv built by the previous 3 steps and the doctors, companies, training centers achieve the standards of cv making and career development technique.

1.3 SWOT ANALYSIS:

Identifying SWOT very important to identify a problem.

A SWOT analysis is a technique used to determine and define Strengths, Weaknesses, Opportunities, and Threats – SWOT.

SWOT analyses can be applied to an entire company or organization, or individual projects within a single department. Most commonly, SWOT analyses are used at the organizational level to determine how closely a business is aligned with its growth trajectories and success benchmarks, but they can also be used to ascertain how well a particular project – such as an online advertising campaign – is performing according to initial projections.

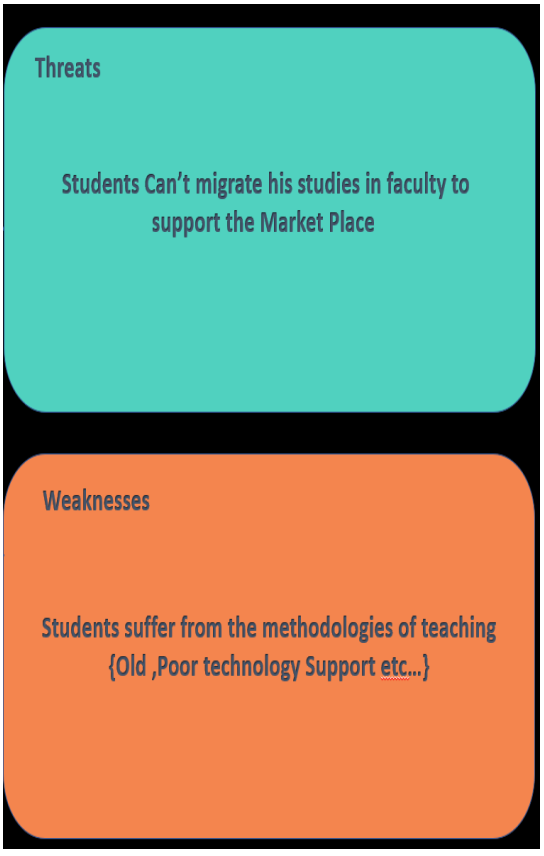


Figure 1.4 the Main Swot Analysis components for decision making

Figure 1.5 Swot Analysis of CIS Faculty

1.4 INTERNAL VS EXTERNAL SERVICES

Solving problem of students needs great effort to build a solution, and the swot analysis get the right action to predict, how to combine the light with dark, the dawn and night, but we can try to define the best solution for them as a system to serve them, defining services is possible some of them are internal and the other are external:

project service: it is a service to manage the projects in the educational organization it provides download and upload projects, enable project evaluation, project documentation and interaction between different student's project, between doctors, student and TAs

communities: provide a high communication with external communities to improve the performance and contribute in the organization in different ways even financial or worker etc…..

Training centers: provide a good relationship and powerful interaction with training centers for making the workers provide a higher performance and improve their skills

market places: Provide a high powerful communication technique to provide a high marketing for the organization so it will attract as much as possible of users

courses: it is a service to manage the courses in the educational organization it provides Module systems, module assignment, virtual classes and topic discussion

schedule management: it is a service to manage the schedule in the educational organization it provides Lecture alarm to notify students, doctors and TAs about lecture times and lecture director to notify them about the place and the lecture specific time

Assignments: it is a service to manage the assignments in the educational organization it provides prizes when success in specific assignment, provides a question and short quizzes which is even open or close and enable evaluation techniques for the assignments

companies: it is a service to manage the interaction between the system and any company that will use the system even for free or companies will buy it

1.5 DIMENSIONS OF SOLUTION

redefining the new system is important to deal with the new Requirements with 3 dimensions:

Business Layer: To get the logic of building and combine multi-business architectures.

"The business logic layer is where the problems are tackled the program was created to solve. In the logic layer, classes decide what information they need in order to solve their

assigned problems, request that information from the accessor layer, manipulate that information as required, and return the ultimate results to the presentation layer for formatting."[2]

Architecture Pattern: What is the best Pattern to recognize the requirements of multiple changing business?

Refers to the fundamental structures of a software system and the discipline of creating such structures and systems. Each structure comprises software elements, relations among them, and properties of both elements and relations. The *architecture* of a software system is a metaphor, analogous to the architecture of a building. It functions as a blueprint for the system and the developing project, laying out the tasks not necessary to be executed by the design teams.[1]

Student Requirements: What is the best conceptual model can observe all these requirements?

1.6 A TRADITIONAL MODEL TO SOLVE PROBLEM

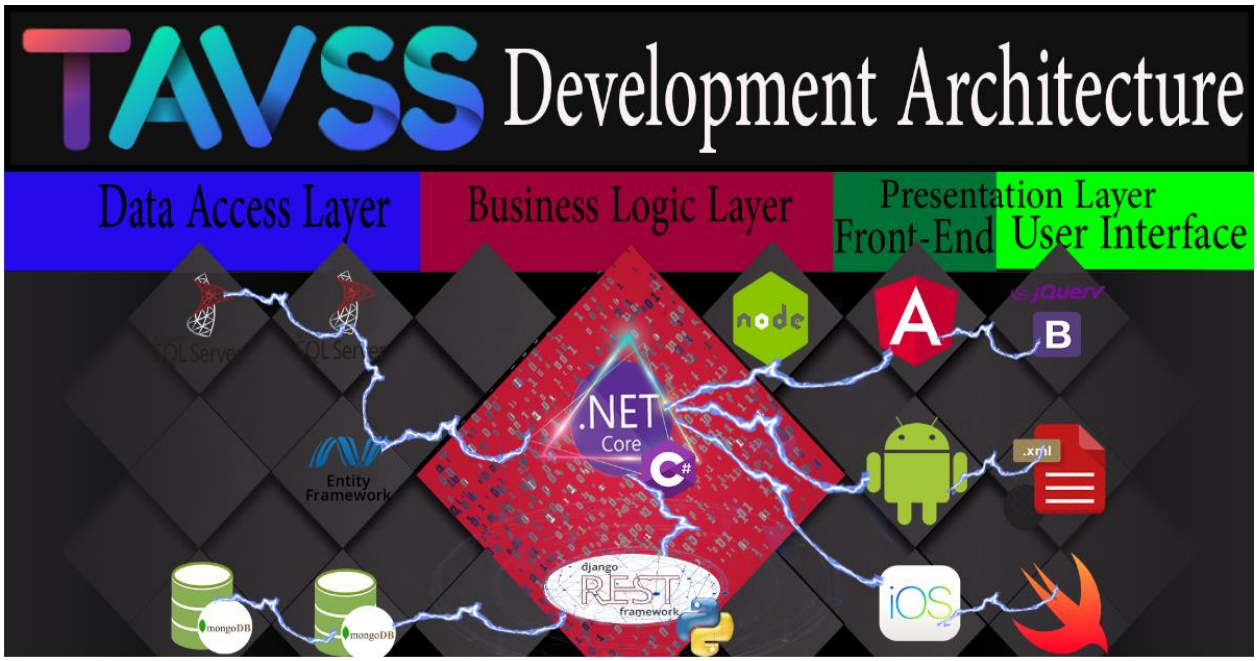


Figure 1.9 The Traditional Distributed System To solve the problem

This traditional Architecture that support student has a greet establishments, but it's not sustainable for long term business, but this is the first architecture on our heads to support as illustrated in figure 1.9.

It’s not a Monolithic architecture, something more, something to higher up our faculty for business.

To Define this architecture, there are 2 phases a Modular one and a Structure one:

- **Modular Architecture:** The Applications are decomposed over the 3-tier architecture:
- **Data Access Layer+ Data Layer:** {SQL Server + NoSQL Mongo + some Middleware for integrations => Entity Framework}.
- **Business Logic Layer: {**Dotnet Core APIS+ djangorestframework API: to control the processing of transmission and the operations of business**}**
- **Presentation Layer: {**Web UIs+ Angular frontend, Android, IOS platforms for mobile user**}**
- **Structure:** Each app has its own design like:
- **Data Centric:** {MVC, MC} patterns
- **NoSQL vs SQL DB: {**Mongo vs SQL Server**}**
- **Http Restful Services: {**Get, Post, Put, Delete**}**
- **Asynchronous Messaging: {**RabbitMQ It will be explained in next Modules**,** SignalR: Chatting services for client server publish subscribe Design Pattern**}**

1.7 THE BIGGEST DEALS OF ARCHITECTURES {MONOLITHIC VS SOA VS MICROSERVICES}

Let us know how to compare the Architectures of Designing a system and decide to take the best alternative of architectures:

1.7.1 MONOLITH**:** is an ancient word referring to a huge single block of stone. Though this term is used broadly today, the image remains the same across fields. In software engineering, a monolithic pattern refers to a single indivisible unit. The concept of monolithic software lies in different components of an application being combined into a single program on a single platform. Usually, a monolithic app consists of a database, client-side user interface, and server-side application. All the software’s parts are unified, and all its functions are managed in one place. Let’s look at the detail.

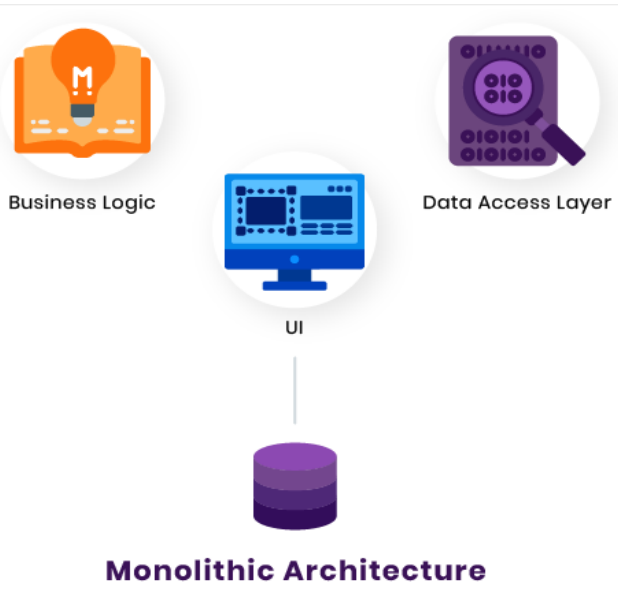


Figure 1.10 The simple Architecture of Monolithic app

1.7.2 A SERVICE-ORIENTED ARCHITECTURE (SOA): is a software architecture style that refers to an application composed of discrete and loosely coupled software agents that perform a required function. SOA has two main roles: a service provider and a service consumer. Both of these roles can be played by a software agent. The concept of SOA lies in the following: an application can be designed and built in a way that its modules are integrated seamlessly and can be easily reused.

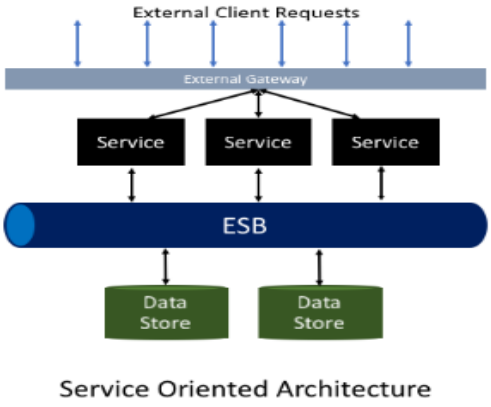


Figure 1.11 Simple Architecture Of SOA

1.7.3 MICROSERVICE: is a type of service-oriented software architecture that focuses on building a series of autonomous components that make up an app. Unlike monolithic apps built as a single indivisible unit, microservice apps consist of multiple independent components that are glued together with APIs.

Figure 1.12 Simple Microservice Architecture

Microservices are important simply because they add unique value in a way of simplification of complexity in systems. By breaking apart your system or application into many smaller parts, you show ways of reducing duplication, increasing cohesion and lowering your coupling between parts, thus making your overall system parts easier to understand, more scalable, and easier to change.

As organizations scale, their monolithic systems become progressively complex and more difficult to manage. [6]

This results in problems such as:

- **Lengthy downtime to undergo updates**: Since each service in a monolithic system is overly reliant with one another, updating one part of the system would require you to update the entire the system. Thus, requiring a significant amount of development time and resources.
- **High costs for expansions**: For scaling, monolithic systems usually require investment into more servers. Again, more cost is involved to acquire more servers.

- **Platform-wide Malfunctions**: This is perhaps the biggest pain point of a monolithic system. If one service within a monolithic system goes down, then this may initiate a chain reaction and could cause the entire system to go down.

1.7.4 TO GO MACRO, GO MICRO

To put it bluntly, there's a reason why some of the biggest players in the software industry to dumping the monolith in favor of the microservice. The former presents significant pains when it comes to scalability, deployment, and agile development — while the latter presents the antidote to those pains.

Investing in microservices may be costlier up front, but with speedier development processes, faster scalability, and the ability to more easily adapt to constantly fluctuating IoT-driven market, that investment makes a whole lot of sense. [6]

Table 1.1 from dzone research as a comparison between SOA and Microservices

SOA	MSA
Follows "**share-as-much-as-possible**" architecture approach	Follows "**share-as-little-as-possible**" architecture approach
Importance is on **business functionality** reuse	Importance is on the concept of "**bounded context**"
They have **common governance** and **standards**	They focus on **people, collaboration** and freedom of other options
Uses **Enterprise Service bus (ESB)** for communication	Simple messaging system
They support **multiple message protocols**	They use **lightweight protocols** such as **HTTP/REST** etc.
Multi-threaded with more overheads to handle I/O	**Single-threaded** usually with the use of Event Loop features for non-locking I/O handling
Maximizes application service reusability	Focuses on **decoupling**
Traditional Relational Databases are more often used	**Modern Relational Databases** are more often used
A systematic change requires modifying the monolith	A systematic change is to create a new service
DevOps / Continuous Delivery is becoming popular, but not yet mainstream	Strong focus on DevOps / Continuous Delivery

1.7.5 PROS AND CONS OF ARCHITECTURES:

Table 1.2 The pros and cons of Many Distributed systems

	Monolithic	SOA	Microservices
• **Pros**	• 1)simple development and deployment • 2)fewer cross-cutting concerns • 3)Better performance	• 1)Reusability of services • 2) Better Maintainability • 3) Higher reliability	• 1)Easy to develop, test, and deploy • 2) Increase Agility • 3)Ability to scale horizontally
• **Cons**	• 1)code base come cumbersome over time • 2)Limited agility • 3)Difficult to adopt new technologies	• 1)Complex management • 2) Extra overload • 3) High investment costs	• 1)Complexity: • 2) Security Concerns • 3)Different programming languages

so After this short definition for each architecture deciding which one of these strategies will be choosen to implement TAVSS microservice strategy will be chosen which will make the system consists of independent components so any update or any attack or problems happens with any service will not affect the other services ,will choose the strategy that will focus on business priorities to improve TAVSS as an educational business ,Microservices are important simply because they add unique value in a way of simplification of complexity in the system. By breaking apart our system into many smaller parts, show ways of reducing duplication, increasing cohesion and lowering your coupling between parts, thus making your overall system parts easier to understand, and easier to change. One of the most important reasons for choosing this strategy because it increases agility which agility is the most powerful development strategies and finally scaling our system will be much easier.

1.8 THE PLAN OF THE MICROSERVICES DEVELOPMENT

the best project management process for the microservices concept is the agile approach, Organizations as large as Amazon, Soundcloud and Netflix have already made successful transitions from monolithic architecture to microservices in recent years. But it is not just the big guns; a Gartner study from 2016 found that approximately 68 percent of organizations were either investigating or developing a microservice architecture.

1.8.1 HOW MICROSERVICES IMPROVE AGILE DEVELOPMENT

Agile Development, which some refer to as 'DevOps', means having a number of small teams working on individual, smaller projects so that those projects are able to get a team's undivided attention. This enables the individual projects to be completed quicker. Microservice architecture fits into this development model perfectly, as each small team can own and focus on one service. A recent study showed that projects managed under agile development tend to be 28 percent more successful than traditional project management techniques.

by assigning a small team of 6-8 people to work on each microservice using the DevOps model, developers can, in theory at least, work more effectively and efficiently. But for DevOps to successfully develop and maintain a microservice architecture, strong project management is essential. Since multiple teams will be working on different elements, there is a possibility that some conflicts between the different teams will arise. For example, one team will feel that a certain task is not associated with their assigned microservice and could come back to management and say, "well, that's not our problem".

With a strong culture of collaboration and project management, DevOps can enable developers to work more effectively than they otherwise would with a monolithic system. This is reflected in the Light bend survey, with by 30 percent of respondents claiming that microservice architecture helped them increase development velocity for new releases.[6]

1.8.2 THE PLAN DECOMPOSITION

Figure 1.13 The decomposition mind map of project processes

1.8.3 DEFINING THE PROCESSES

Explaining every plan execution and delivery at the next tables:

Table 1.2 The planning phase Decomposition

The Planning Phase	
SWOT consulting	Defining organization building blocks of {Strengths, Weaknesses, Opportunities, threats}.
Ideation	Design Thinking process to solve problems and making Automation
Problem Identification	Or problem statement to get the specified problem of an organization
Business Model Canvas	To follow strategic plan without losing the resources and control all our business
Alternative Analysis	Decision Making to get the action of the architecture to make or stop
Milestones	To Finnish the process

Table 1.3 conceptual Design of the models{DDD pattern}

Conceptual Design of the models {DDD pattern}	
Bounded contexts	Breaking down the business to support many layer architecture for business to Microservices.
Modular system	Defining new technologies to support business
Microservice Architecture	Defining the real Architecture and how to connect Microservices
Devops	automates the processes between software development and IT teams, in order that they can build, test, and release software faster and more reliably.
Agile scrum framework	Subset of Agile a framework that helps teamwork together much like a rugby team
Microservice	arranges an application as a collection of loosely coupled services

Table 1.4 Sprint1 {1/10:1/11 2019}

Sprint1 {1/10:1/11 2019}	
Analysis (user story/Req class diagrams)	breaking a complex topic or substance into smaller parts in order to gain a better understanding of it
Identity. API (SQL server + file system)	Design API for identity service as software that intermediary allows identity service to talk to other services.
Course.API (Mongo+FSDB)	Design API for course service as software that intermediary allows course service to talk to other services.
Project.API (Mongo + FSDB)	Design API for project service as software that intermediary allows project service to talk to other services.
SQL server +Mongo DB migration with data access layer	Using sql server and mongo DB as a technique to develop data access layer
Authentication + Authorization	process of verifying the identity of a person or device. + specifying access rights/privileges to resources, which is related to information security and computer security in general and to access control in particular
UI/UX +Angular	Brings a design-centric approach to user interface and user experience and offers a practical skill-based instruction -centered around a visual communication perspective with angular
) Devops CI/CD +Testing +HCI	automates the processes between software development and IT teams, in order that they can build, test, and release software faster and more reliably by (CI/CD +Testing +HCI).
Docker compose deployment	Make it easier to create deploy and run applications by using containers to allow developer to backup an application with all parts it need
{Swaggers + writing} documenting service	

Table 1.5 Sprint3 {1/2:1/6 2020 }

Sprint3 {1/2:1/6 2020 }	
Versioning up+ maintenance	Increasing the project release and fix errors and problems
Finishing up all APIs	Releasing the last versions of all APIs
Integration test	Making test to make sure if all services will satisfy its functions when integrate them together
System testing	Test if the entire system will satisfy it's functions and work well
Finishing up frontend	Releasing the last versions of the frontend
Android finishing	Releasing the last versions of Android mobile application
IOS finishing	Releasing the last versions of IOS mobile application
Devops starting operations	Starting automates the processes between software development and IT teams, in order that they can build, test, and release software faster and more reliably
Documenting system	Writing the documentation for the system to document every step, tool and function in the system
Finishing the project	Releasing TAVSS to the users to use it

Table 1.6 Sprint 2{1/11:1/2 2020}

Sprint 2{1/11:1/2 2020}	
Android +IOS starting	Start developing android and IOS mobile applications
Communities. APIs	Design API for community's service as software that intermediary allows course service to talk to other services
Acclaims. APIs	Design API for Acclaims service as software that intermediary allows course service to talk to other services
SinalR HUB	enables calling methods on connected clients from the server
Rabbit MQ service Bus	open source message brokers. From T-Mobile to Runtastic, RabbitMQ , is lightweight and easy to deploy on premises and in the cloud
CQRS+Ocelot BFF{Mediators+ Aggregators}	(CQRS)every method should either be a command that performs an action, or a query that returns data to the caller, but not both .+ (Ocelot BFF)Ocelot is an Open Source .NET Core based API Gateway especially made for microservices architecture that need unified points of entry into their system
Docker Deployment	Deploy Make it easier to create deploy and run applications by using containers to allow developer to backup an application with all parts it need
Devops(CI/CD+ Testing+HCI)	automates the processes between software development and IT teams, in order that they can build, test, and release software faster and more reliably by (CI/CD +Testing +HCI) .
Documenting	Writing the documentation for the system to document every step ,tool and function in the system
UI/UX Angular	brings a design-centric approach to user interface and user experience design, and offers practical, skill-based instruction centered around a visual communications perspective with angular

1.8.4 SCRUM AS AGILE FRAMEWORK

First, defining the Software Agile Development approaches

The Agile methodologies outlined below share much of the same overarching philosophy, as well as many of the same characteristics and practices. From an implementation standpoint, however, each has its own unique mix of practices, terminology, and tactics.

1.8.4.1 THE MOST WIDELY-USED AGILE METHODOLOGIES INCLUDE:

- **Agile Scrum Methodology**
- **Lean Software Development**
- **Kanban**
- **Extreme Programming (XP)**
- **Crystal**
- **Dynamic Systems Development Method (DSDM)**
- **Feature Driven Development (FDD)**

In 1968, programmer Melvin Conway stated:

> "organizations which design systems … are constrained to produce designs which are copies of the communication structures of these organizations."

Basically, if you have three teams building a compiler, they'll likely build a three-pass compiler, while if you only have two teams, you'll get a two-pass compiler. Your architecture reflects your organizational structure, and if a certain technical architecture has wanted, the organizational structure will need to be realigned.

Since dubbed Conway's Law, it rings especially true with microservices architecture today, which often aggravates communication problems.

Of course, if Whelan's recommendation has taken, while the team's structure may change, "If a company wants to be successful in microservices, since microservices are small, they need to be handled by a single team, as they are in Netflix and Amazon. Then that team needs to be responsible for concept to cash." If the entire team is responsible from start to finish, this would certainly diminish the problem of ownership.

"Microservices will drive team boundaries in a different way because it's going to be hard to have three teams working on the microservices. If you are looking at continuous delivery,

you need a single team, and then Conway's Law kicks in and your team has to mirror your product-slash-microstructure." Of course Whelan admits this is impossible to coordinate across large-scale organizations.

1.8.4.2 BE WARY OF SCRUM IGNORING ANALYSIS AND DESIGN

Scrum can actually do damage to your technical assets. "There has been a steady decline in technical focus with agile transformations. As a really technical agile coach, that disturbs me because I think that organizations need a multifaceted approach to agility. Scrum doesn't provide any guidance on technical practice by design".

"Many organizations that adopt scrum get really good at building technical debt quickly." It's essential to remember that while microservices is all about scaling independently, you can't lose track of broader objectives and how everything connects.

Whelan warns that the popular scrum framework comes with intentional holes that, if not well planned for, leave holes in the microservices architecture.

"If you had a traditional waterfall, if you used to do analysis and design and take care of the technical details, you need to be doing it in another way, but scrum doesn't allow" for that. "If you aren't replacing that with anything else, you're really just having feature after feature after feature," Whelan said, "and, after a while, your technical core will be a huge waste and you'll just have to rewrite and rewrite and rewrite."

team uses a product owner with microservices, but otherwise follows kanban with weekly ceremonies.

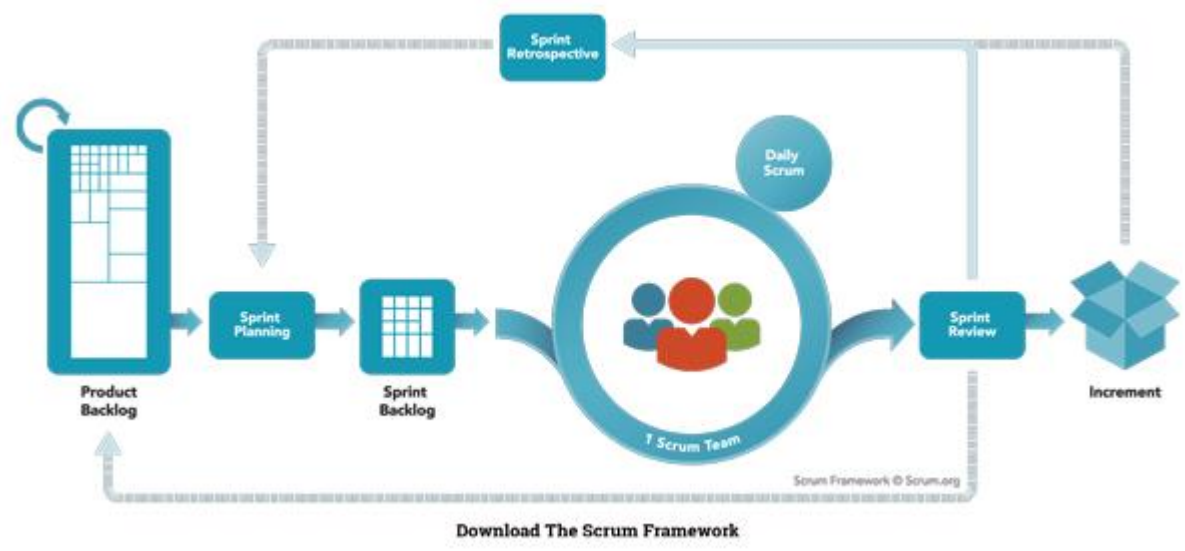


Figure 1.14 The Scrum Product framework

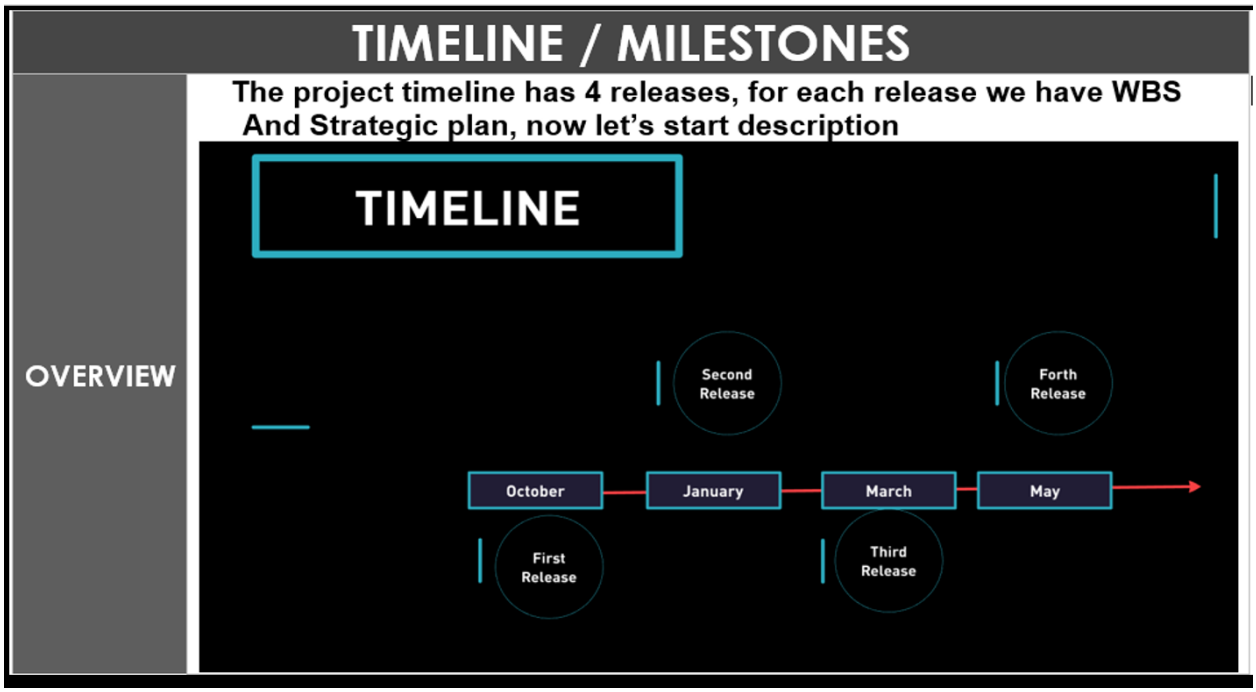


Figure 1.15 The Releasing timeline

1.8.5 THE 4 AGILE SPRINTS:

Using the Microsoft project to build the project time structure and The Work Breakdown structure for the project as collection of sprints for scrum framework shown as figures 1.16, 1.17.

ID	WBS	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	**1**		**Sprint 1**	**26 days**	**Sat 9/28/19**	**Fri 11/1/19**		
2	**1.1**		**Identity Backlog**	**11 days**	**Sat 9/28/19**	**Mon 10/14/19**		
3	1.1.1		Identity Analysis	2 days	Sat 9/28/19	Mon 9/30/19		
4	1.1.2		Identity Developmen	5 days	Tue 10/1/19	Mon 10/7/19	3	
5	1.1.3		Identity Frontend	5 days	Wed 10/2/19	Tue 10/8/19	3	
6	1.1.4		Backlog CI	1 day	Wed 10/9/19	Wed 10/9/19	5	
7	1.1.5		Backlog Health Check	1 day	Thu 10/10/19	Thu 10/10/19	6	
8	1.1.6		Backlog Testing	2 days	Fri 10/11/19	Mon 10/14/19	7	
9	**1.2**		**Project Service Backlog**	**12 days**	**Wed 10/2/19**	**Thu 10/17/19**		
10	1.2.1		Backlog Analysis	2 days	Wed 10/2/19	Thu 10/3/19		
11	1.2.2		Backlog Developmen	5 days	Fri 10/4/19	Thu 10/10/19	10	
12	1.2.3		Backlog Frontend	5 days	Sun 10/6/19	Thu 10/10/19	10	
13	1.2.4		Backlog CI	1 day	Sat 10/12/19	Sat 10/12/19	12	
14	1.2.5		Backlog Health Check	2 days	Mon 10/14/19	Tue 10/15/19	13	
15	1.2.6		Backlog Testing	2 days	Wed 10/16/19	Thu 10/17/19	14	
16	**1.3**		**Courses Service Backlog**	**13 days**	**Sun 10/6/19**	**Wed 10/23/19**		
17	1.3.1		Backlog Analysis	2 days	Sun 10/6/19	Mon 10/7/19		
18	1.3.2		Backlog Developmen	5 days	Thu 10/10/19	Wed 10/16/19	17	
19	1.3.3		Backlog Frontend	5 days	Sat 10/12/19	Thu 10/17/19	17	
20	1.3.4		Backlog CI	1 day	Sat 10/19/19	Sat 10/19/19	19	
21	1.3.5		Backlog Health Check	2 days	Sun 10/20/19	Mon 10/21/19	20	
22	1.3.6		Backlog Testing	2 days	Tue 10/22/19	Wed 10/23/19	21	
23	**1.4**		**Product Documentation**	**7 days**	**Thu 10/24/19**	**Fri 11/1/19**		
24	1.4.1		Building Wikis Devop	7 days	Thu 10/24/19	Fri 11/1/19	22	
25	1.4.2		Doctor Checking	2 days	Wed 10/30/19	Thu 10/31/19	22	
26	**1.5**		**Azure Hosting**	**6 days**	**Thu 10/24/19**	**Thu 10/31/19**		
27	1.5.1		Build Storage	1 day	Thu 10/24/19	Thu 10/24/19	22	
28	1.5.2		Azure Service Fabric	2 days	Fri 10/25/19	Mon 10/28/19	27	
29	1.5.3		Hosting APIS	3 days	Tue 10/29/19	Thu 10/31/19	28	
30	1.5.4		Hosting Angular	3 days	Tue 10/29/19	Thu 10/31/19	28	

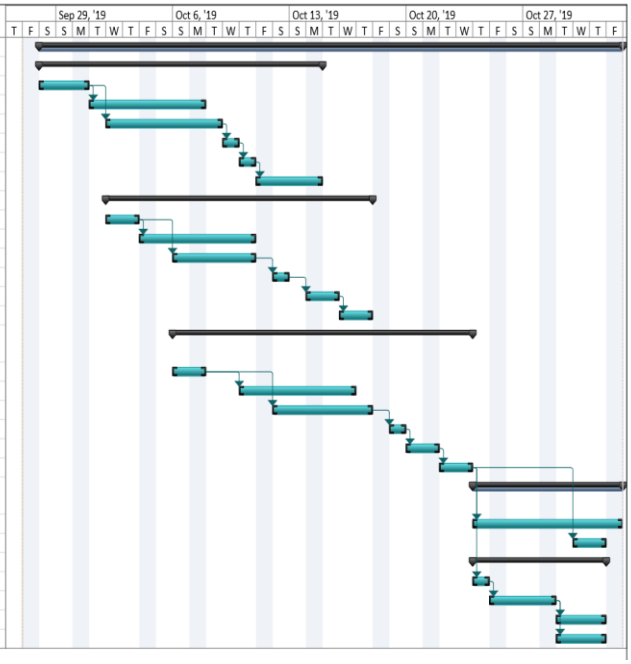
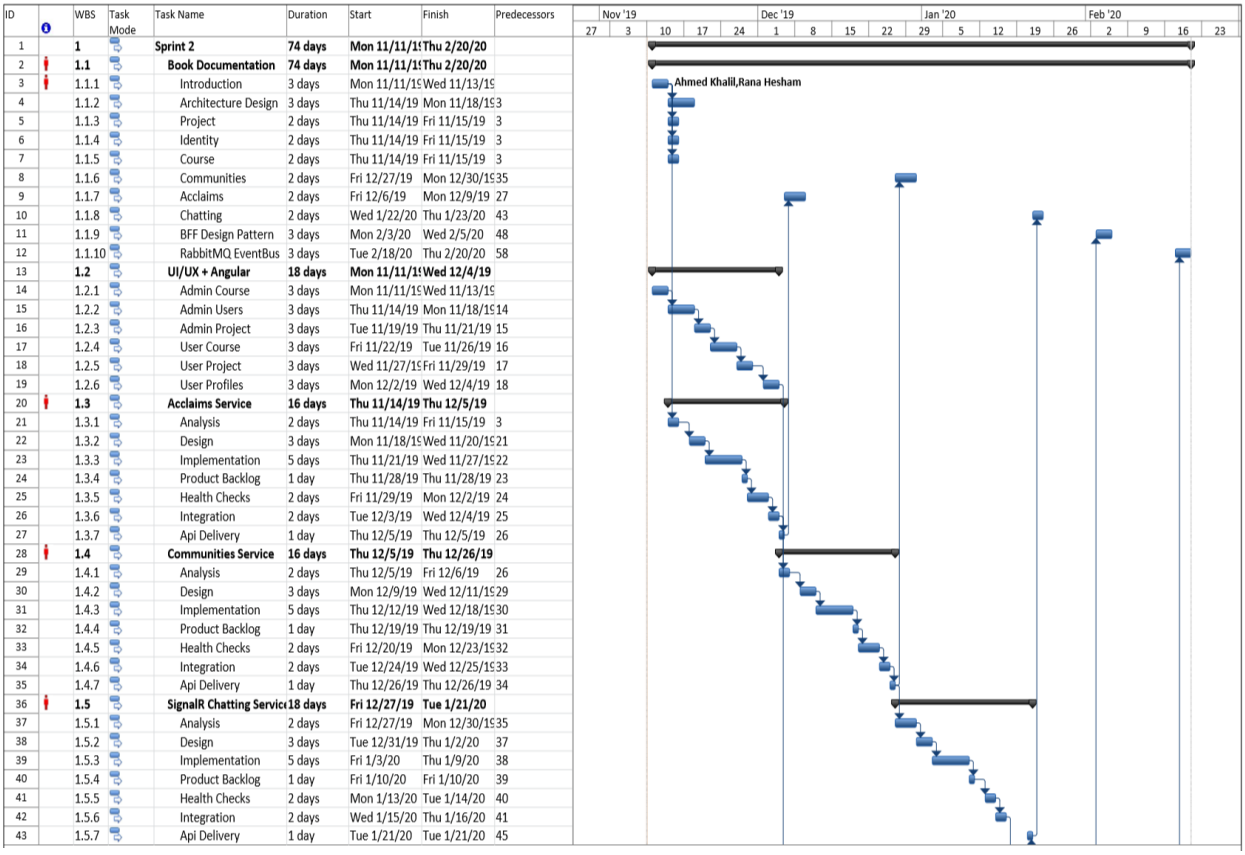
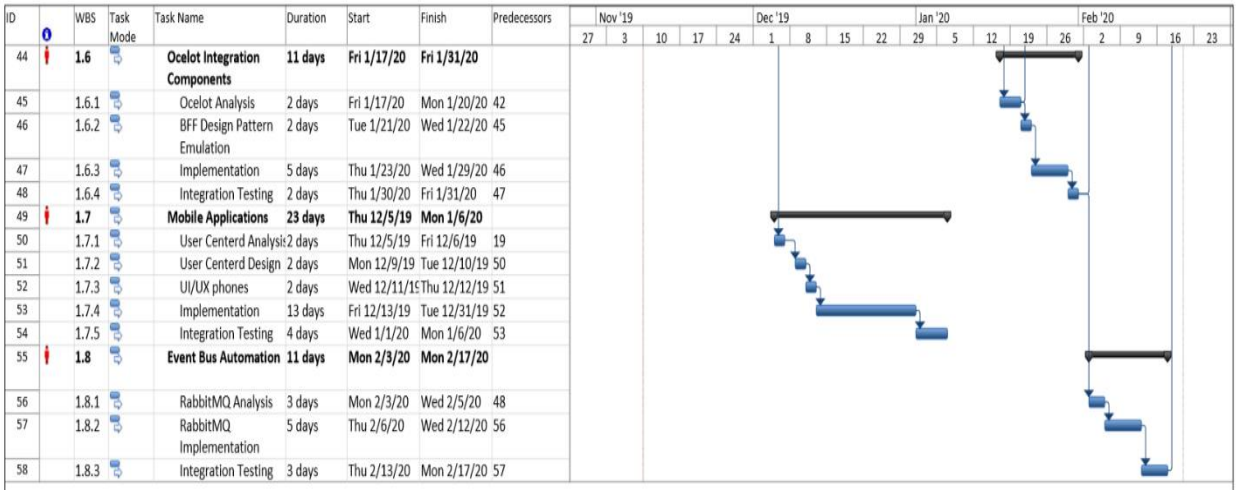


Figure1.16 sprint1



ID	WBS	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1	**1**		**Sprint 2**	**74 days**	**Mon 11/11/19**	**Thu 2/20/20**	
2	**1.1**		**Book Documentation**	**74 days**	**Mon 11/11/19**	**Thu 2/20/20**	
3	1.1.1		Introduction	3 days	Mon 11/11/19	Wed 11/13/19	
4	1.1.2		Architecture Design	3 days	Thu 11/14/19	Mon 11/18/19	3
5	1.1.3		Project	2 days	Thu 11/14/19	Fri 11/15/19	3
6	1.1.4		Identity	2 days	Thu 11/14/19	Fri 11/15/19	3
7	1.1.5		Course	2 days	Thu 11/14/19	Fri 11/15/19	3
8	1.1.6		Communities	2 days	Fri 12/27/19	Mon 12/30/19	35
9	1.1.7		Acclaims	2 days	Fri 12/6/19	Mon 12/9/19	27
10	1.1.8		Chatting	2 days	Wed 1/22/20	Thu 1/23/20	43
11	1.1.9		BFF Design Pattern	3 days	Mon 2/3/20	Wed 2/5/20	48
12	1.1.10		RabbitMQ EventBus	3 days	Tue 2/18/20	Thu 2/20/20	58
13	**1.2**		**UI/UX + Angular**	**18 days**	**Mon 11/11/19**	**Wed 12/4/19**	
14	1.2.1		Admin Course	3 days	Mon 11/11/19	Wed 11/13/19	
15	1.2.2		Admin Users	3 days	Thu 11/14/19	Mon 11/18/19	14
16	1.2.3		Admin Project	3 days	Tue 11/19/19	Thu 11/21/19	15
17	1.2.4		User Course	3 days	Fri 11/22/19	Tue 11/26/19	16
18	1.2.5		User Project	3 days	Wed 11/27/19	Fri 11/29/19	17
19	1.2.6		User Profiles	3 days	Mon 12/2/19	Wed 12/4/19	18
20	**1.3**		**Acclaims Service**	**16 days**	**Thu 11/14/19**	**Thu 12/5/19**	
21	1.3.1		Analysis	2 days	Thu 11/14/19	Fri 11/15/19	3
22	1.3.2		Design	3 days	Mon 11/18/19	Wed 11/20/19	21
23	1.3.3		Implementation	5 days	Thu 11/21/19	Wed 11/27/19	22
24	1.3.4		Product Backlog	1 day	Thu 11/28/19	Thu 11/28/19	23
25	1.3.5		Health Checks	2 days	Fri 11/29/19	Mon 12/2/19	24
26	1.3.6		Integration	2 days	Tue 12/3/19	Wed 12/4/19	25
27	1.3.7		Api Delivery	1 day	Thu 12/5/19	Thu 12/5/19	26
28	**1.4**		**Communities Service**	**16 days**	**Thu 12/5/19**	**Thu 12/26/19**	
29	1.4.1		Analysis	2 days	Thu 12/5/19	Fri 12/6/19	26
30	1.4.2		Design	3 days	Mon 12/9/19	Wed 12/11/19	29
31	1.4.3		Implementation	5 days	Thu 12/12/19	Wed 12/18/19	30
32	1.4.4		Product Backlog	1 day	Thu 12/19/19	Thu 12/19/19	31
33	1.4.5		Health Checks	2 days	Fri 12/20/19	Mon 12/23/19	32
34	1.4.6		Integration	2 days	Tue 12/24/19	Wed 12/25/19	33
35	1.4.7		Api Delivery	1 day	Thu 12/26/19	Thu 12/26/19	34
36	**1.5**		**SignalR Chatting Service**	**18 days**	**Fri 12/27/19**	**Tue 1/21/20**	
37	1.5.1		Analysis	2 days	Fri 12/27/19	Mon 12/30/19	35
38	1.5.2		Design	3 days	Tue 12/31/19	Thu 1/2/20	37
39	1.5.3		Implementation	5 days	Fri 1/3/20	Thu 1/9/20	38
40	1.5.4		Product Backlog	1 day	Fri 1/10/20	Fri 1/10/20	39
41	1.5.5		Health Checks	2 days	Mon 1/13/20	Tue 1/14/20	40
42	1.5.6		Integration	2 days	Wed 1/15/20	Thu 1/16/20	41
43	1.5.7		Api Delivery	1 day	Tue 1/21/20	Tue 1/21/20	45



ID	WBS	Task Mode	Task Name	Duration	Start	Finish	Predecessors
44	**1.6**		**Ocelot Integration Components**	**11 days**	**Fri 1/17/20**	**Fri 1/31/20**	
45	1.6.1		Ocelot Analysis	2 days	Fri 1/17/20	Mon 1/20/20	42
46	1.6.2		BFF Design Pattern Emulation	2 days	Tue 1/21/20	Wed 1/22/20	45
47	1.6.3		Implementation	5 days	Thu 1/23/20	Wed 1/29/20	46
48	1.6.4		Integration Testing	2 days	Thu 1/30/20	Fri 1/31/20	47
49	**1.7**		**Mobile Applications**	**23 days**	**Thu 12/5/19**	**Mon 1/6/20**	
50	1.7.1		User Centerd Analysis	2 days	Thu 12/5/19	Fri 12/6/19	19
51	1.7.2		User Centerd Design	2 days	Mon 12/9/19	Tue 12/10/19	50
52	1.7.3		UI/UX phones	2 days	Wed 12/11/19	Thu 12/12/19	51
53	1.7.4		Implementation	13 days	Fri 12/13/19	Tue 12/31/19	52
54	1.7.5		Integration Testing	4 days	Wed 1/1/20	Mon 1/6/20	53
55	**1.8**		**Event Bus Automation**	**11 days**	**Mon 2/3/20**	**Mon 2/17/20**	
56	1.8.1		RabbitMQ Analysis	3 days	Mon 2/3/20	Wed 2/5/20	48
57	1.8.2		RabbitMQ Implementation	5 days	Thu 2/6/20	Wed 2/12/20	56
58	1.8.3		Integration Testing	3 days	Thu 2/13/20	Mon 2/17/20	57

figure1.17 sprint2

CHAPTER 2: ARCHITECTURE BUILDING

Microservices are smaller segments of an application that run independently of each other and can be deployed in a variety of ways. A serverless microservice is deployed within a serverless architecture.

2.1 INTRODUCTION TO MICROSERVICES

Imagine taking an application, chopping it up into pieces, and running it as a collection of smaller parts instead of one monolithic whole. That's basically what a microservices architecture is. Each piece of the application is called a 'microservice,' and it performs one service only, runs independently of the other parts of the application, operates in its own environment, and stores its own data. Despite the name, microservices do not have to be small. What makes them 'micro' is that they only handle one service and are part of a larger application.[13]

Think of an application constructed of microservices as being like an American football team, in which each player performs a distinct role, but the players together form a team (the whole application) that collectively accomplishes a goal. Or, think of microservices as the different systems in the human body (circulatory, respiratory, etc.), and the application as the entire body.

Figure 2-1 A football team represent the Microservices development

From the user's perspective, an application built with microservices has a single interface and should work just the same as an application designed as one stack. However, behind the scenes each microservice has its own database and runs separately from the rest of the application. In addition, microservices within the same application can be written in different languages and use different libraries.

2.1.1 THE SOA VS MICROSERVICES

SOA Stands for Service Oriented Architecture is a type of distributed systems that can easily fit the organizations needs for software, is essentially a collection of services. These services communicate with each other. The communication can involve either simple data passing or two or more services coordinating some activity. Some means of connecting services to each other is needed.

2.2 MICROSERVICE DESIGN PATTERNS

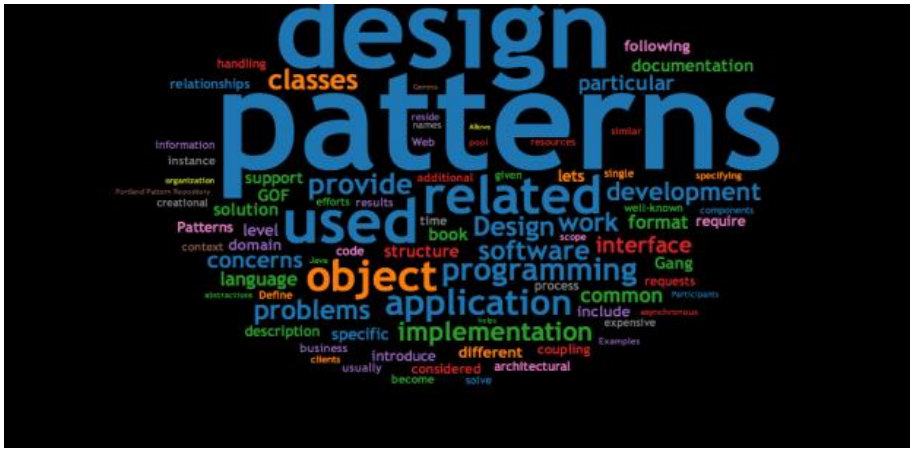


Figure 2.2 The Design Pattern image

Because of the complexity and the large scale of Microservices architecture we need to define how can solve the complexity and using many patterns that can help the project to be more valuable, so if there a need to get more accurate architecture, must follow greet patterns:

2.2.2 DOMAIN DRIVEN DESIGN

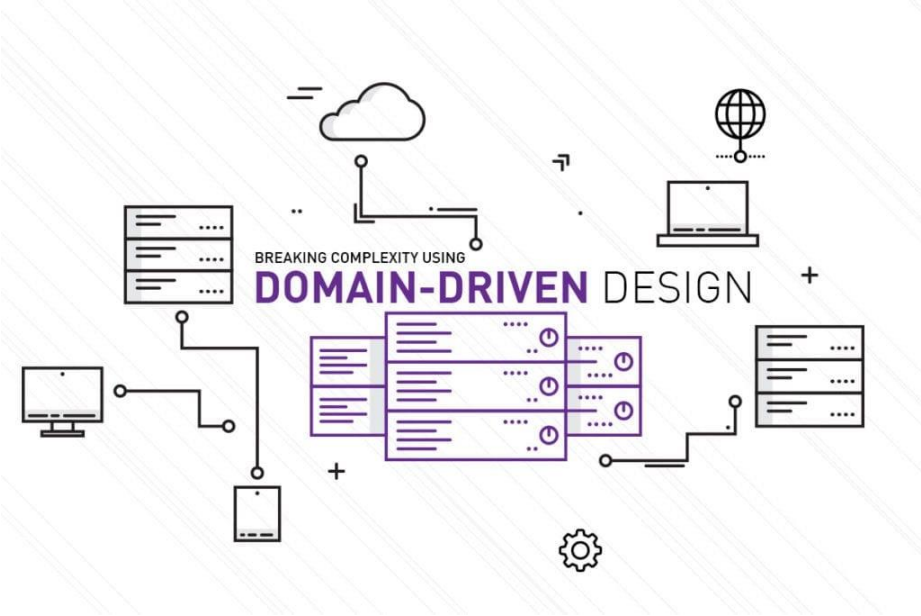


Figure 2.3 The Domain Driven Design

Domain-Driven Design is a set of tools or patterns that are used in designing and implementing the software that delivers high value, both strategically and tactically. By using DDD strategic development tools, you and your team will be able to create the competitively best software design choices and integration decisions for your business.

In order to design a useful software, which accurately models the unique operations of the business, DDD can be used ,DDD is tactical development tools to assist developer and his team.

DDD is the most effective software design and implementation needed to succeed in today's competitive business landscape. Complicated? Not Necessarily. However, it does involve a set of advanced techniques to be used on complex software projects. Domain-Driven Design will bring domain experts and software developers together to create a software solution that reflects the mental model of business experts. It is essential to have the same understanding of the business and provide a solution to help business processes.

Therefore, the DDD method will need to invest in resources.
Within the team, we have domain experts using the DDD. This way, the team will not only deliver the application but the true business value application. [2]

Domain-driven design (DDD), a software development technique first proposed by Eric Evans, includes strategic, philosophical, tactical, and technical elements, and is related to many specific practices.

DDD STRATEGY AND PHILOSOPHY

probably it will be known that DDD has strategic value; that's why so many companies with extremely complex domains rely on it to produce software that can rapidly evolve with the business. But did you know that DDD also has a philosophical theme? You might have heard the term "ubiquitous language," which is a mouthful when you're speaking about it, but it's a shorthand way of emphasizing the fundamental principle of DDD: Use domain terminology everywhere; make it ubiquitous. When practicing DDD, this basic philosophy of the primacy of domain terminology can be distributed across three guiding principles:

1. CAPTURE THE DOMAIN MODEL, IN DOMAIN TERMS, THROUGH INTERACTIONS WITH DOMAIN EXPERTS.
   In other words, talking to the people in the businesses where problems are solving and understanding from their point of view first and foremost. This is how the ubiquitous language is formed of the domain and set the foundation for harmonious models.
2. EMBED THE DOMAIN TERMINOLOGY IN THE CODE.
   This means naming things the way the domain expert would name them, including classes, methods, commands, and especially domain events. This is how the domain model is reflected in the code.
3. PROTECT THE DOMAIN KNOWLEDGE FROM CORRUPTION BY OTHER DOMAINS, TECHNICAL SUBDOMAINS, ETC.
   If the code is talking about two different things—e.g., the domain solution and the technical implementation—separate those components to keep the subdomains apart. This strategy tends to result in classes with single responsibilities and a terse, focused vocabulary. Put "translators" at the boundaries between subdomains to keep them from depending on each other's structures unnecessarily, and also to prevent blurring of the meaning of domain terms.

These three principles guide and inform DDD. Knowing and using them provides benefits, even without the rest of the DDD practices and patterns. Let's look at how some benefits are reaped from just using this information in the software development projects.

2.2.3 COMMUNICATION IN A MICROSERVICE ARCHITECTUR

In a monolithic application running on a single process, components invoke one another using language-level method or function calls. These can be strongly coupled if objects with code were created (for example, new ClassName()), or can be invoked in a decoupled way if Dependency Injection has been used by referencing abstractions rather than concrete object instances. Either way, the objects are running within the same process. The biggest challenge when changing from a monolithic application to a microservices-based application lies in changing the communication mechanism. A direct conversion from in-process method calls into RPC calls to services will cause a chatty and not efficient communication that won't perform well in distributed environments. The challenges of designing distributed system properly are well enough known that there's even a canon known as the Fallacies of distributed computing that lists assumptions that developers often make when moving from monolithic to distributed designs.

There isn't one solution, but several. One solution involves isolating the business microservices as much as possible. asynchronous communication then used between the internal microservices and replace fine-grained communication that's typical in intra-process communication between objects with coarser-grained communication. This can be done by grouping calls, and by returning data that aggregates the results of multiple internal calls, to the client.

A microservices-based application is a distributed system running on multiple processes or services, usually even across multiple servers or hosts. Each service instance is typically a process. Therefore, services must interact using an inter-process communication protocol such as **HTTP, AMQP**, or a binary protocol like TCP, depending on the nature of each service.

The microservice community promotes the philosophy of "smart endpoints and dumb pipes" This slogan encourages a design that's as decoupled as possible between microservices, and as cohesive as possible within a single microservice. As explained earlier, each microservice owns its own data and its own domain logic. But the microservices composing an end-to-end application are usually simply choreographed by using REST communications rather than complex protocols such as WS-* and flexible event-driven communications instead of centralized business-process-orchestrators.

The two commonly used protocols are HTTP request/response with resource APIs (when querying most of all), and lightweight asynchronous messaging when communicating updates across multiple microservices.

COMMUNICATION TYPES

Client and services can communicate through many different types of communication, each one targeting a different scenario and goals. Initially, those types of communications can be classified in two axes.

THE FIRST AXIS DEFINES IF THE PROTOCOL IS SYNCHRONOUS OR ASYNCHRONOUS:

- **Synchronous protocol.** HTTP is a synchronous protocol. The client sends a request and waits for a response from the service. That's independent of the client code execution that could be synchronous (thread is blocked) or asynchronous (thread isn't blocked, and the response will reach a callback eventually). The important point here is that the protocol (HTTP/HTTPS) is synchronous and the client code can only continue its task when it receives the HTTP server response. [4]

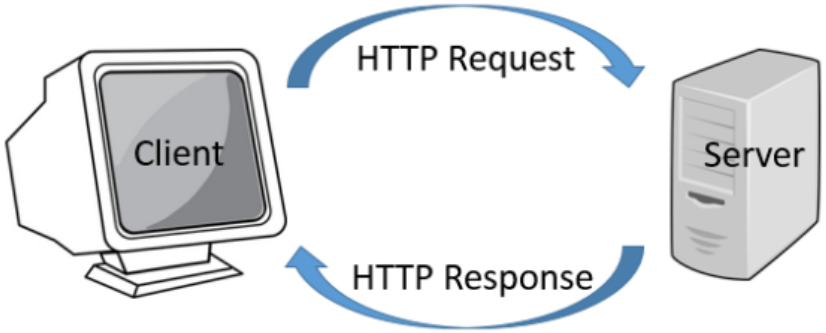


Figure 2.4The Request Response synchronous transmission

- **Asynchronous protocol**. Other protocols like AMQP (a protocol supported by many operating systems and cloud environments) use asynchronous messages. The client code or message sender usually doesn't wait for a response. It just sends the message as when sending a message to a RabbitMQ queue or any other message broker. [4]

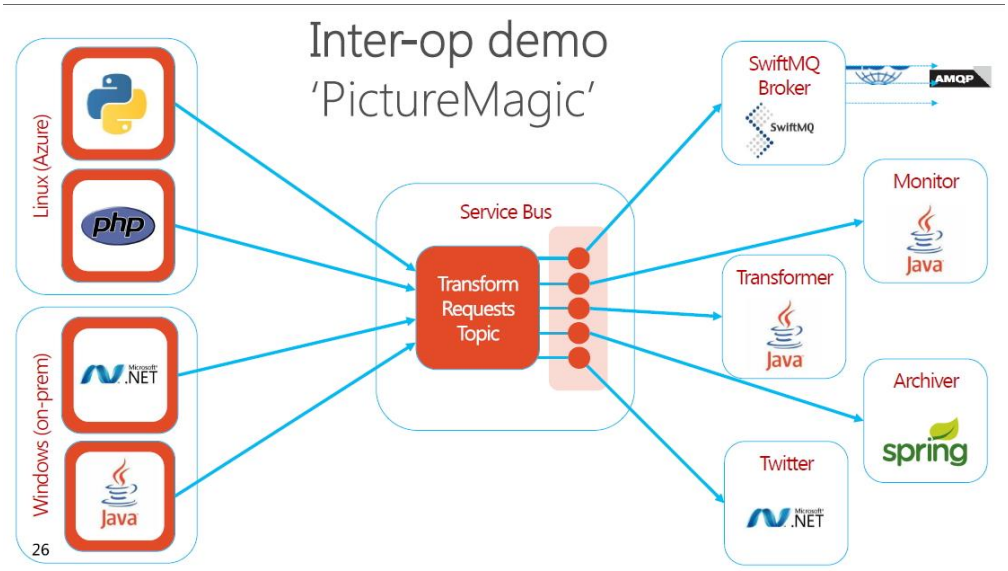


Figure 2.5The Magic about Asynchronous transmission is to develop multi-programming language application

THE SECOND AXIS DEFINES IF THE COMMUNICATION HAS A SINGLE RECEIVER OR MULTIPLE RECEIVERS:

- **Single receiver**. Each request must be processed by exactly one receiver or service. An example of this communication is the Command pattern.
- **Multiple receivers**. Each request can be processed by zero to multiple receivers. This type of communication must be asynchronous. An example is the publish/subscribe mechanism used in patterns like Event-driven architecture. This is based on an event-bus interface or message broker when propagating data updates between multiple microservices through events; it's usually implemented through a service bus or similar artifact like Azure Service Bus by using topics and subscriptions.

A microservice-based application will often use a combination of these communication styles. The most common type is single-receiver communication with a synchronous protocol like HTTP/HTTPS when invoking a regular Web API HTTP service. Microservices also typically use messaging protocols for asynchronous communication between microservices.

These axes are good to know so you have clarity on the possible communication mechanisms, but they're not the important concerns when building microservices. Neither the asynchronous nature of client thread execution nor the asynchronous nature of the selected protocol is the important points when integrating microservices.

What is important is being able to integrate your microservices asynchronously while maintaining the independence of microservices.

2.2.4 ASYNCHRONOUS MICROSERVICE INTEGRATION ENFORCES MICROSERVICE'S AUTONOMY

As mentioned, the important point when building a microservices-based application is the way that microservices are integrated. Ideally, you should try to minimize the communication between the internal microservices. The fewer communications between microservices will need to be integrated, the better. But in many cases, microservices. When that need to be done, the critical rule here is that the communication between the microservices should be asynchronous. That doesn't mean that a specific protocol must be used(for example, asynchronous messaging versus synchronous HTTP). It just means that the communication between microservices should be done only by propagating data asynchronously but try not to depend on other internal microservices as part of the initial service's HTTP request/response operation. [4]

If possible, never depend on synchronous communication (request/response) between multiple microservices, not even for queries. The goal of each microservice is to be autonomous and available to the client consumer, even if the other services that are part of the end-to-end application are down or unhealthy. If making a call from one microservice to other microservices was needed (like performing an HTTP request for a data query) to be able to provide a response to a client application, having architecture that won't be resilient when some microservices fail as illustrated In figure 2.6.

Moreover, having HTTP dependencies between microservices, like when creating long request/response cycles with HTTP request chains, as shown in the first part of the Figure 2.7, not only makes your microservices not autonomous but also their performance is impacted as soon as one of the services in that chain isn't performing well.

The more you add synchronous dependencies between microservices, such as query requests, the worse the overall response time gets for the client apps.

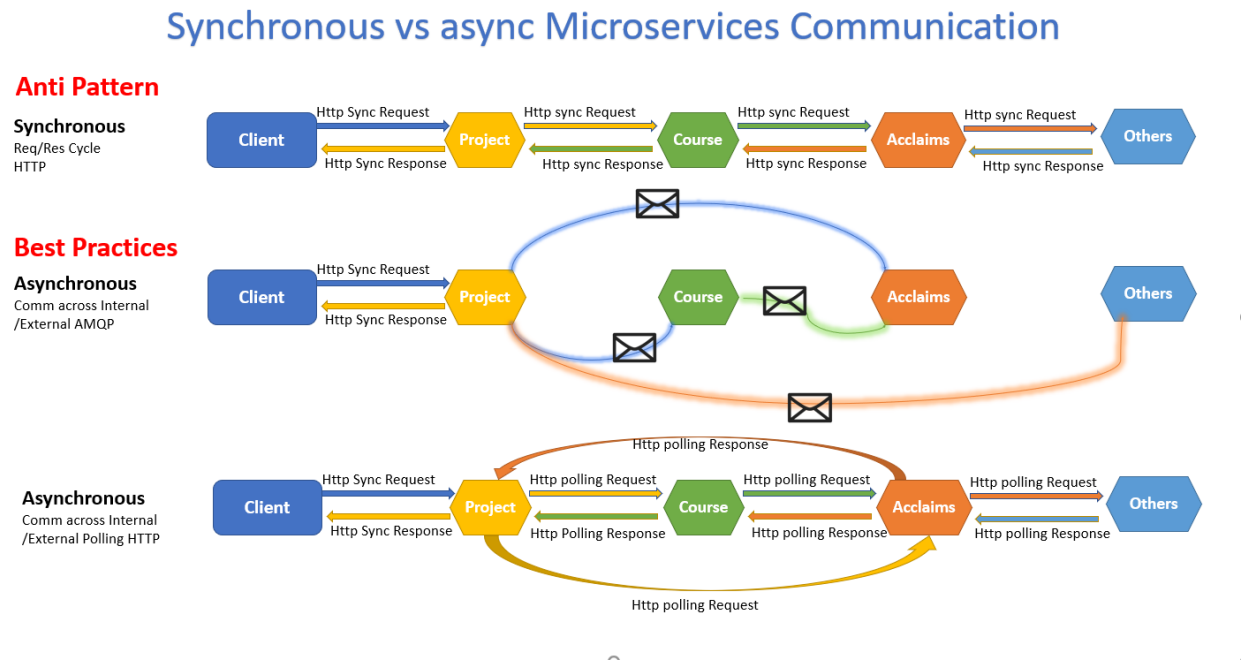


Figure 2.6 The 3 ways of Microservices communication

If a microservice needs to raise an additional action in another microservice, if possible, do not perform that action synchronously and as part of the original microservice request and reply operation. Instead, do it asynchronously (using asynchronous messaging or integration events, queues, etc.). But, as much as possible, do not invoke the action synchronously as part of the original synchronous request and reply operation.

And finally (and this is where most of the issues arise when building microservices), if the initial microservice needs data that is originally owned by other microservices, do not rely on making synchronous requests for that data. Instead, that data are replicated or propagated(only the attributes you need) into the initial service's database by using eventual consistency (typically by using integration events, as explained in upcoming sections).

As noted earlier in the section Identifying domain-model boundaries for each microservice, duplicating some data across several microservices isn't an incorrect design—on the contrary, when doing that translating the data into the specific language or terms of that additional domain or Bounded Context can be done. For instance, in the Tavss application you have a microservice named identity.api that's in charge of most of the user's data with an entity named User. However, when storing data about the user within the Project microservice is needed, you store it as a different entity named Acclaim. The Acclaim entity shares the same identity with the original User entity, but it might have only the few attributes needed by the Acclaim domain, and not the whole user profile.

any protocol can be used to communicate and propagate data asynchronously across microservices to have eventual consistency. As mentioned, integration events can be

used using an event bus or message broker or could even use HTTP by polling the other services instead.

It does not matter. The important rule is to not create synchronous dependencies between your microservices.

The following sections explain the multiple communication styles you can consider using in a microservice-based application.

2.2 WHAT IS DOCKER?

2.2.1 INTRODUCTION TO DOCKER

Docker is an open-source project for automating the deployment of applications as portable, self sufficient containers that can run on the cloud or on-premises. Docker is also a company that promotes and evolves this technology, working in collaboration with cloud, Linux, and Windows vendors, including Microsoft.[3]

Figure 2.7Docker Logo

Docker image containers can run natively on Linux and Windows. However, Windows images can run only on Windows hosts and Linux images can run on Linux hosts and Windows hosts (using a Hyper-V Linux VM, so far), where host means a

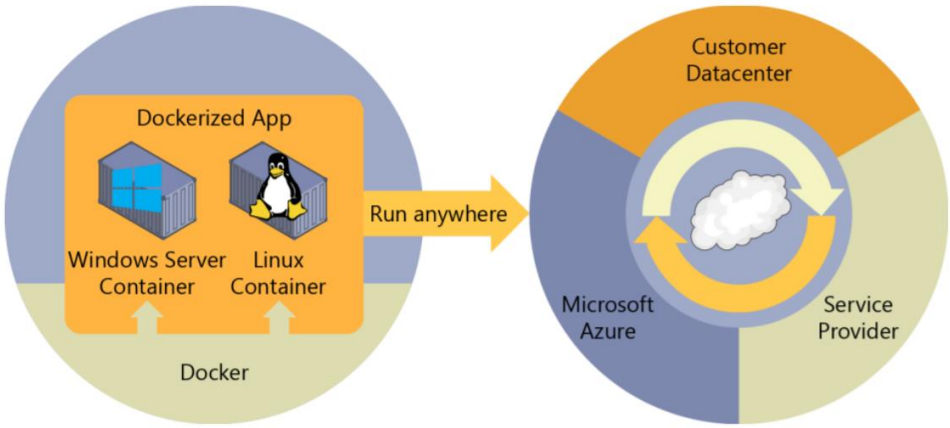


Figure 2.8 Docker deploys containers at all layers of the hybrid cloud

server or a VM. Developers can use development environments on Windows, Linux, or macOS as shown as figure 2.8

On the development computer, the developer runs a Docker host where Docker images are deployed, including the app and its dependencies. Developers who work on Linux or on the Mac, use a Docker host that's Linux based, and they can only create images for Linux containers. (Developers working on the Mac can edit code or run the Docker command-line interface (CLI) from macOS, but as of this writing, containers don't run directly on macOS.)

Developers who work on Windows can create images for either Linux or Windows Containers. To host containers in development environments and provide additional developer tools, Docker ships Docker Community Edition (CE) for Windows or for macOS.

These products install the necessary VM (the Docker host) to host the containers. [4]

Docker also makes available Docker Enterprise Edition (EE), which is designed for enterprise development and is used by IT teams who build, ship, and run large business-critical applications in production. To run Windows Containers, there are two types of runtimes:

- **Windows Server Containers** provide application isolation through process and namespace isolation technology. A Windows Server Container shares a kernel with the container host and with all containers running on the host. 3 Introduction to containers and Docker.

- **Hyper-V Containers** expand on the isolation provided by Windows Server Containers by running each container in a highly optimized virtual machine. In this configuration, the kernel of the container host isn't shared with the Hyper-V Containers, providing better isolation. The images for these containers are created and work just the same way. The difference is in how the container is created from the image—running a Hyper-V Container requires an extra parameter. For details, see Hyper-V Containers.

2.2.2 WHY DOCKER

"Docker allows applications to be isolated into containers with instructions for exactly what they need to survive that can be easily ported from machine to machine. Virtual machines also allow the exact same thing, and numerous other tools like Chef and Puppet already exist to make rebuilding these configurations portable and reproducible."

"While Docker has a more simplified structure compared to both of these, the real area where it causes disruption is resource efficiency."

2.2.3 DOCKER TERMINOLOGY

This section lists terms and definitions you should be familiar with before getting deeper into Docker. For further definitions, see the extensive glossary provided by Docker.

- **Container image**: A package with all the dependencies and information needed to create a container. An image includes all the dependencies (such as frameworks) plus deployment and execution configuration to be used by a container runtime. Usually, an image derives from multiple base images that are layers stacked on top of each other to form the container's filesystem. An image is immutable once it has been created.

- **Dockerfile**: A text file that contains instructions for how to build a Docker image. It's like a batch script, the first line states the base image to begin with and then follow the instructions to install required programs, copy files and so on, until you get the working environment you need.

- **Build**: The action of building a container image based on the information and context provided by its Dockerfile, plus additional files in the folder where the image is built. Images can be built with the Docker docker build command.

- **Container**: An instance of a Docker image. A container represents the execution of a single application, process, or service. It consists of the contents of a Docker image, an execution environment, and a standard set of instructions. When scaling a service, multiple instances of a container are created from the same image. Or a batch job can create multiple containers from the same image, passing different parameters to each instance.

- **Volumes**: Offer a writable filesystem that the container can use. Since images are read-only but most programs need to write to the filesystem, volumes add a writable layer, on top of the container image, so the programs have access to a writable filesystem. The program doesn't know it is accessing a layered filesystem, it is just the filesystem as usual. Volumes live in the host system and are managed by Docker.

- **Tag**: A mark or label you can apply to images so that different images or versions of the same image (depending on the version number or the target environment) can be identified.

- **Multi-stage Build**: Is a feature, since Docker 17.05 or higher, that helps to reduce the size of the final images. In a few sentences, with multi-stage build can be used, for example, a large base image, containing the SDK, for compiling and publishing the application and then using the publishing folder with a small runtime-only base image, to produce a much smaller final image

- **Repository** (repo): A collection of related Docker images, labeled with a tag that indicates the image version. Some repos contain multiple variants of a specific image, such as an image containing SDKs (heavier), an image containing only runtimes (lighter), etc. Those variants can be marked with tags. A single repo can contain platform variants, such as a Linux image and a Windows image.

- **Registry:** A service that provides access to repositories. The default registry for most public images is Docker Hub (owned by Docker as an organization). A registry usually contains repositories from multiple teams. Companies often have private registries to store and manage images they've created. Azure Container Registry is another example.

- **Multi-arch image**: For multi-architecture, is a feature that simplifies the selection of the appropriate image, according to the platform where Docker is running, e.g. when a Dockerfile requests a base image FROM mcr.microsoft.com/dotnet/core/sdk:2.2 from the registry it actually gets 2.2-sdknanoserver-1709, 2.2-sdk-nanoserver-1803, 2.2-sdk-nanoserver-1809 or 2.2-sdk-stretch, depending on the operating system and version where Docker is running.

- **Docker Hub:** A public registry to upload images and work with them. Docker Hub provides Docker image hosting, public or private registries, build triggers and web hooks, and integration with GitHub and Bitbucket.

- **Azure Container Registry:** A public resource for working with Docker images and its components in Azure. This provides a registry that is close to deployments in Azure and that gives you control over access, making it possible to use Azure Active Directory groups and permissions.

- **Docker Trusted Registry (DTR):** A Docker registry service (from Docker) that can be installed onpremises so it lives within the organization's datacenter and network. It is convenient for private images that should be managed within the enterprise.

Docker Trusted Registry is included as part of the Docker Datacenter product. For more information, see Docker Trusted Registry (DTR).

- **Docker Community Edition (CE):** Development tools for Windows and macOS for building, running, and testing containers locally. Docker CE for Windows provides development environments for both Linux and Windows Containers. The Linux Docker host on Windows is based on a Hyper-V virtual machine. The host for Windows Containers is directly based on Windows. Docker CE for Mac is based on the Apple Hypervisor framework and the xhyve hypervisor, which provides a Linux Docker host virtual machine on Mac OS X. Docker CE for Windows and for Mac replaces Docker Toolbox, which was based on Oracle VirtualBox.
- **Docker Enterprise Edition (EE):** An enterprise-scale version of Docker tools for Linux and Windows development.

- **Compose:** A command-line tool and YAML file format with metadata for defining and running multi container applications. defining a single application based on multiple images with one or more .yml files that can override values depending on the environment. After have been created the definitions, the whole multi-container application can be deployed with a single command (dockercompose up) that creates a container per image on the Docker host.

- **Cluster:** A collection of Docker hosts exposed as if it were a single virtual Docker host, so that the application can scale to multiple instances of the services spread across multiple hosts within the cluster. Docker clusters can be created with Kubernetes, Azure Service Fabric, Docker Swarm and Mesosphere DC/OS.

- **Orchestrator**: A tool that simplifies management of clusters and Docker hosts. Orchestrators enable user to manage their images, containers, and hosts through a command line interface (CLI) or a graphical UI. You can manage container networking, configurations, load balancing, service discovery, high availability, Docker host configuration, and more. An orchestrator is responsible for running, distributing, scaling, and healing workloads across a collection of nodes. Typically, orchestrator products are the same products that provide cluster infrastructure, like Kubernetes and Azure Service Fabric, among other offerings in the market

2.2.4 DOCKER ORCHESTRATION

"The portability and reproducibility of a containerized process mean we have an opportunity to move and scale our containerized applications across clouds and datacenters.

Containers effectively guarantee that those applications run the same way anywhere, allowing us to quickly and easily take advantage of all these environments. Furthermore, as we scale our applications up, we'll want some tooling to help automate the maintenance of those applications, able to replace failed containers automatically, and manage the rollout of updates and reconfigurations of those containers during their lifecycle."

"Tools to manage, scale, and maintain containerized applications are called *orchestrators*, and the most common examples of these are *Kubernetes* and *Docker Swarm*. Development environment deployments of both of these orchestrators are provided by Docker Desktop, which we'll use throughout this guide to create our first orchestrated, containerized application."

2.2.5 CLUSTERING

Docker Cluster is a tool for lifecycle management of Docker clusters. With Cluster, using a YAML file to configure your provider's resources. Then, with a single command, then provision and install all the resources from your configuration.

2.3 BUILDING BLOCKS

The Essential Building Blocks of Microservices

2.3.1 GUIDELINES AND GOVERNANCE

When many teams start implementing Microservices independently, there is a good chance that teams will adopt multiple approaches to similar problems. Inconsistencies in end point definitions, documentation, terminologies, and duplication of functionality are common problems that can be resulted in the absence of having proper guidelines and governance. Governance helps to ensure that the teams adhere to the guidelines set forth, ensuring consistency across Microservices. It's important that the guidelines and governance model does not make the teams under productive. Their purpose is to increase their own efficiency so that there is a natural adoption to follow the guidelines.

2.3.2 API GATEWAY

There are many well-known functionalities required in APIs such as Security, Authentication, Authorization, Caching, Logging, Transformation, Proxying, etc. Having an API gateway becomes essential to minimize the rework and to improve efficiency in implementing these well-known requirements.

2.3.3 MICRO SERVICE DOCUMENTATION

Proper and consistent documentation of the APIs is important as all of applications will be designed around them. Without documentation, the services would be useless. Documentation should be precise, concise, and consistent across multiple APIs while using agreed upon terminology based on domain, so that clients can easily interpret the functionality of the service. It is important to make the API documentations available in a single location so that clients can discover the documentations easily and visualize the relationship of each API in a holistic manner.

2.3.4 CONFIGURATION MANAGEMENT

Since Microservices can be deployed in many environments or in auto scaling infrastructure, the service configurations cannot be stored statically. Instead, configurations should be loaded dynamically based on the environment it runs as and when the services are spawned. It is recommended not to store configurations in the source code or in locally available file locations as it makes it impossible to deploy the API in an auto-scaling infrastructure. The Microservice should be designed in a way that the same build can run in multiple configurations without having to be rebuilt.

2.3.5 NETWORKING INFRASTRUCTURE

With Microservices architecture, there will be many more APIs being developed/deployed by independent teams. The networking infrastructure/architecture should provide sufficient security, performance, and reliability to deploy, operate, and monitor services.

2.3.6 DEPLOYMENT STRATEGY

Deployment strategy plays a vital role in Microservices architecture as having a smooth and consistent deployment strategy makes it possible for teams to iterate over multiple services at a much faster pace with a higher level of confidence.

The services should not assume any dependencies to be available, instead all the dependencies should be explicitly provided upfront. Containerization is a great way to ensure the services have everything it needs when running. Containerization also helps to deploy solutions in a variety of Container Services such as Docker, AWS BeanStalk, Google`s Kubenetes, etc.

2.3.7 RELEASE MANAGEMENT

Releases should be organized in such a way that the gaps between production and pre-production is minimal, making it a breeze to take releases to production. Minimize the gap between (human, time, or runtime) production and pre-production.

Reduce the Human Gap by letting teams manage the entire lifecycle of the services such as development, deployment, monitoring, and evolving. Having end-to-end visibility of the Microservices helps teams architect the solution better and have minimum operational overheads.

The Time Gap between pre-production and production should also be minimized such that changes could be rolled out more frequently. Attributes of Microservices such as focused functionality, small code base, etc. are complementary to moving the developed code into production with the lowest time gap.

Having a similar runtime environment in any environment that the service is deployed helps reduce the Runtime Gap. Containerization helps ensure that the services have everything it needs to run.

2.3.8 TEAMS

With Microservices, it`s desirable to let teams manage the services throughout its lifespan instead of having different teams for testing, deployment, monitoring, etc. Such a model also helps the team to fix any operational or non-functional pain point comparatively faster. Attributes of Microservices are complementary to adopt an effective dev-ops model without burdening the team.

As teams undertake the ownership of the Microservices end to end, they need more autonomy in terms of deployment, configurations, and the monitoring of production deploys. Teams need to extend their full stack capabilities beyond the mere development of services to providing support for entire the lifecycle of the service as well.

Since teams will have to own multiple services, and continuous changes to the existing API are expected, having consistency in how the team develops Microservices greatly helps reduce the learning curve and increase productivity over time. Therefore,

adopting a uniform technology stack and well-standardized frameworks makes a lots of sense.

2.3.9 OPERATIONS

Operational support is the responsibility of the team who owns the Microservice. Automated monitoring of application and infrastructure health is a must to relieve the additional burden on the team.

Log aggregation becomes mandatory as the Microservices are spawned in unknown instances in an auto scaling setup, leaving no immediate trace where to look for logs. There could be an agent pushing the logs to a centrally managed aggregation service that provides up to date log data in a more organized way.

2.4 DOMAIN DRIVEN DESIGN PATTERN

"This is a quick reference for the key concepts, techniques and patterns described in detail in Eric Evans's book Domain-Driven Design: Tackling Complexity in the Heart of Software and Jimmy Nilsson's book Applying Domain-Driven Design and Patterns with Examples in C# .NET. In some cases, it has made sense to use the wording from these books directly, and I thank Eric Evans and Jimmy Nilsson for giving permission for such usage."

"While it is useful to present the patterns themselves, many subtleties of DDD are lost in just the description of the patterns. These patterns are your tools, and not the rules. They are a language for design and useful for communicating ideas and models amongst the team. More importantly, remember that DDD is about making pragmatic decisions. Try not to 'force' a pattern into the model, and, if you do 'break' a pattern, be sure to understand the reasons and communicate that reasoning too."

"Often, it is said that DDD is object orientation done right but DDD is a lot more than just object orientation. DDD also deals with the challenges of understanding a problem space and the even bigger "

"Importantly, DDD also encourages the inclusion of other areas such as Test-Driven Development (TDD), usage of patterns, and continuous refactoring."

2.5 BOUNDED CONTEXTS

"Bounded Context is a central pattern in Domain-Driven Design. It is the focus of DDD's strategic design section which is all about dealing with large models and teams. DDD deals with large models by dividing them into different Bounded Contexts and being explicit about their interrelationships." It can be presented in figure 2.9

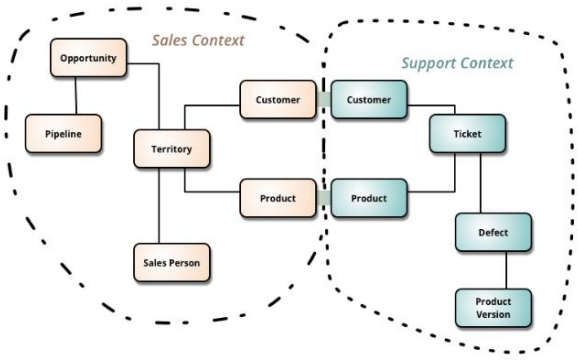


Figure 2.9

"DDD is about designing software based on models of the underlying domain. A model acts as a UbiquitousLanguage to help communication between software developers and domain experts. It also acts as the conceptual foundation for the design of the software itself - how it's broken down into objects or functions. To be effective, a model needs to be unified - that is to be internally consistent so that there are no contradictions within it."

For more information read here "https://martinfowler.com/bliki/BoundedContext.html"

2.6 CONCEPTUAL DESIGN MODEL

"A conceptual model is the mental model that people carry of how something should be done. Conceptual modelling can be carried out at a very early point in the design cycle so that there is a basic understanding of how users conceive tasks and this can then be brought to bear on UI design. The ability to sketch conceptual models quickly and easily can save large amounts of time in UI design and help deliver more intuitive applications.We build mental models of concepts without thinking about it; it helps us categorize things in our lives easily and simply. So for example, when we think about appointment setting our mental model is probably a diary or a calendar – not a piece of software."

For more information read here" https://www.interaction-design.org/literature/article/we-think-therefore-it-is-conceptual-modelling-for-mobile-applications "

2.7 ARCHITECTURE BUILDING

In cloud and architecture development, the cloud has changed the way organizations solve their business challenges, and how applications and systems are designed. The role of a solution architect is not only to deliver business value through the functional requirements of the application, but to ensure the solution is designed in ways that are scalable, resilient, efficient and secure. Solution architecture is concerned with the planning, design, implementation, and ongoing improvement of a technology system. The architecture of a system must balance and align the business requirements with the technical capabilities needed to execute those requirements. It includes an evaluation of risk, cost, and capability throughout the system and its components.

While there is **no one-size-fits-all approach** to designing an architecture, there are some universal concepts that will apply regardless of the architecture, technology, or cloud provider. While these are not all-inclusive, focusing on these concepts will help to build a reliable, secure, and flexible foundation for the application.[12]

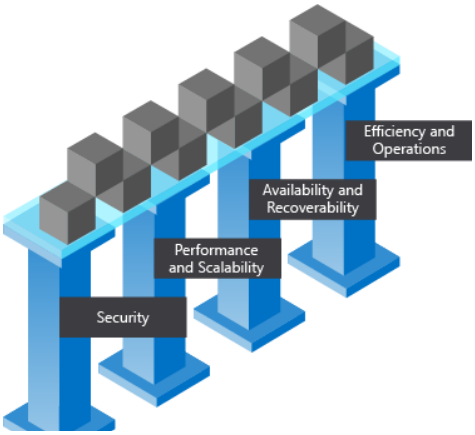


Figure 2-10The Software Architecture pillars

A great architecture starts with a solid foundation built on four pillars illustrated in figure 2-10:

- Security
- Performance and scalability
- Availability and recoverability
- Efficiency and operations

2.8 THE SOFTWARE/NETWORK ARCHITECTURE

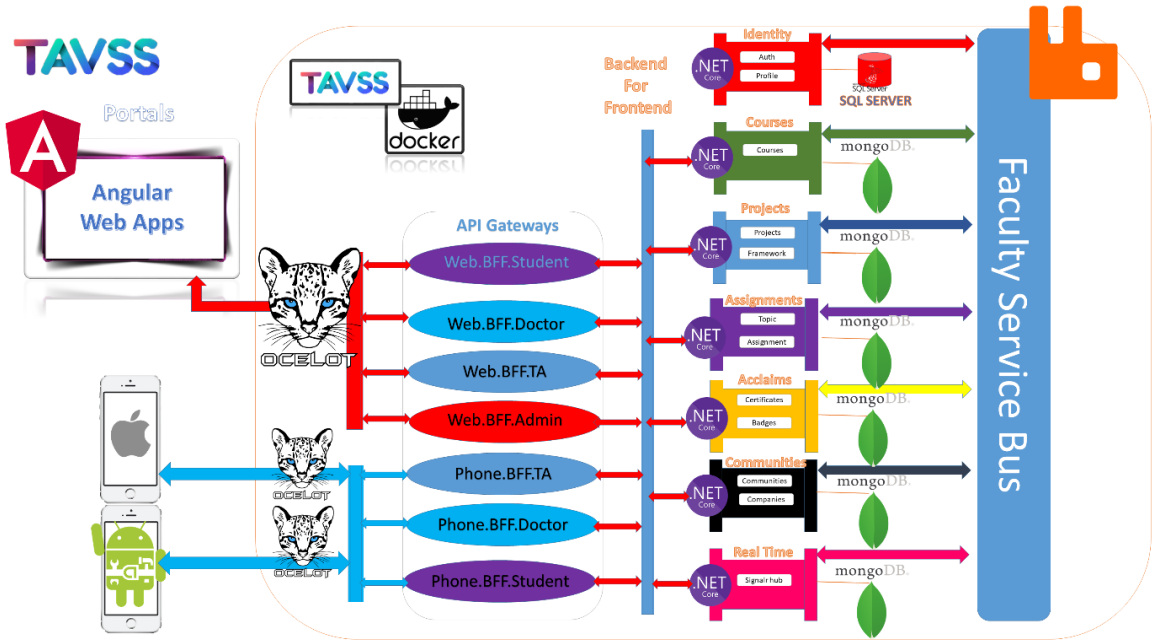


Figure 2.11 The TAVSS Distributed Architecture based on Microservices

The figure 2.11 shows normal flow of our architecture starts from the user who deliver the content over a req/res design pattern using HTTPs protocol or other delivery protocols (Fttps, POP3,…) using frontend applications like:

- Angular version 9 for websites (Typescript and Javascript) structure
- Blazor Dotnet core 3.1 websites (C# web assembly , Javascript) structure
- IOS Native Swift
- Android Native JAVA

Then implementing Ocelot .Net Core are layers for consuming APIs is called the **API Gateways** for cloud people and developers it is responsible as:

- An Aggregation layer for the APIs, Curing the Round Trips Problems
- A Reverse Proxy for many API
- Implement the Cross-cutting concerns

The Microservices are implemented recently on .Net Core, each one in the figure 2.11 is a Tactical level as a conceptual for the implementation as can take a sample of one of

the is a real time abstraction of what comes in its implementation in figure 2.1

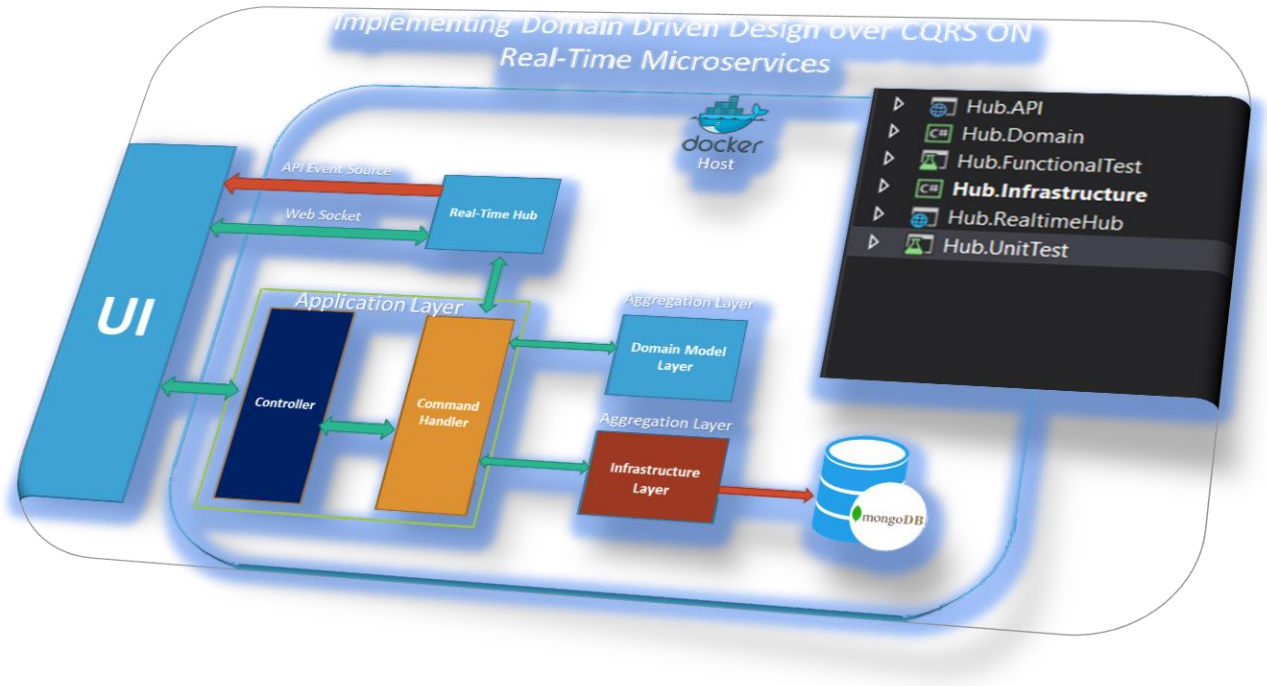


Figure 2.12 The Internal Design of Realtime Microservices

The Database Layers is consisting of many DBs which every Stateful Microservice implement the Single Database Per Service Design Pattern and they are vary because of implementation concerns and Performance for every service.

CHAPTER 3: MICROSERVICES ANALYSIS

3.1 THE CONCEPTUAL DESIGN

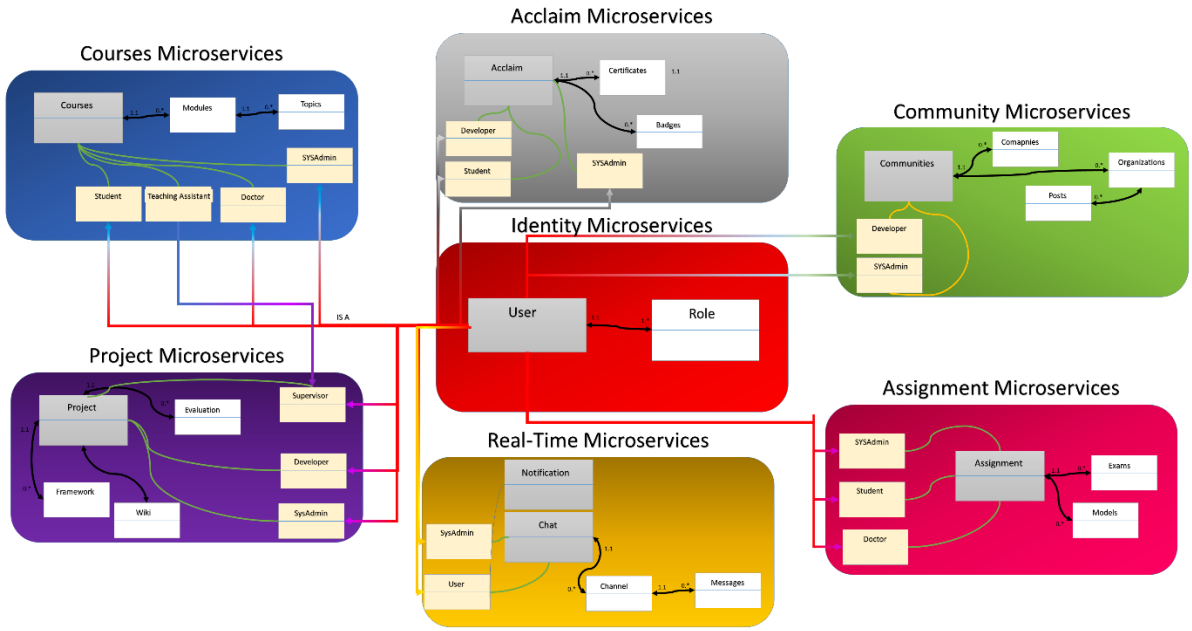


Figure 3.1 conceptual design

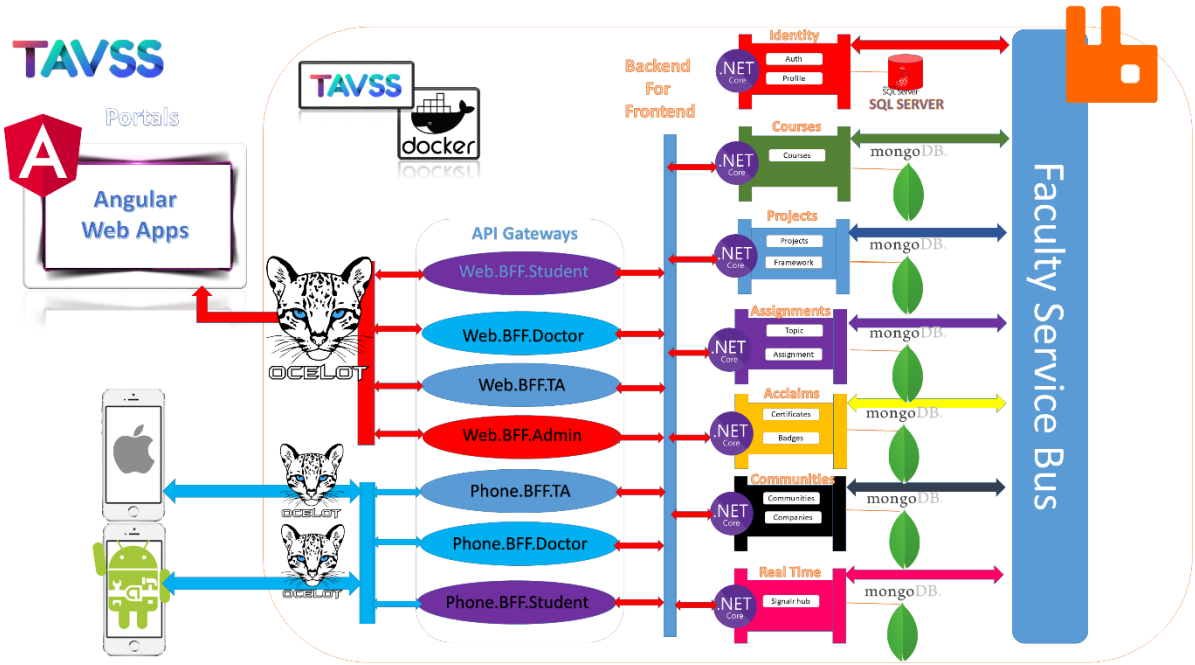


Figure 3.2 system architecture

3.2 IDENTITY MICROSERVICES

Identity micro service is one of the most important micro services in TAVSS. Identity will provide lots of features that it is responsible for determining who is the current user in the system, who is the suitable and the permissioned user to every micro service ex: is he a doctor or student? responsible to notify the admin of the system who is the current user login to the system ?? who tried to log the service?? The result of this service allows the Admin to grant or revoke the user access depending on his permissions. It is a very important service for protecting against hacking and it can find and detect if the user was an authorized user or unauthorized.

3.3 PROJECT MICROSERVICES

Students always need to make project ,need to manage their projects ,need to be followed up by their doctors and TAs and after finishing the project evaluating and ranking will be the next needed step and marketing is the most important for a powerful startup for a project and contact with the external companies , so, One of the most important micro services in TAVSS is Project micro service , Project micro service will provide lots of features that users as students, teams, doctors and teacher assistants can attain and acquire these features and interact with them.

Project micro service provide to the user Download and Upload features for students or teams to download their projects to modify them or to share it and upload their projects on TAVSS so TAs ,Doctors or other teams and students can perusal them. After uploading the project Another feature in project micro service will be important which is a documentation feature which is allow students to document their projects and explain all the project sides and how it implemented so, it can be more clear and understandable to

everyone . After uploading and documenting the project doctors and TAs will Evaluate the project which is another feature in project service that after evaluation project ranking will be applied depending on ranking there will be an acclaims which is another micro service ,will be explained in another section .when applying these three features it will be inevitable to have interaction which is another feature in project micro service ,this interaction will be between doctors, TAs and students.

3.3.1 PROJECT MICROSERVICE USE CASE

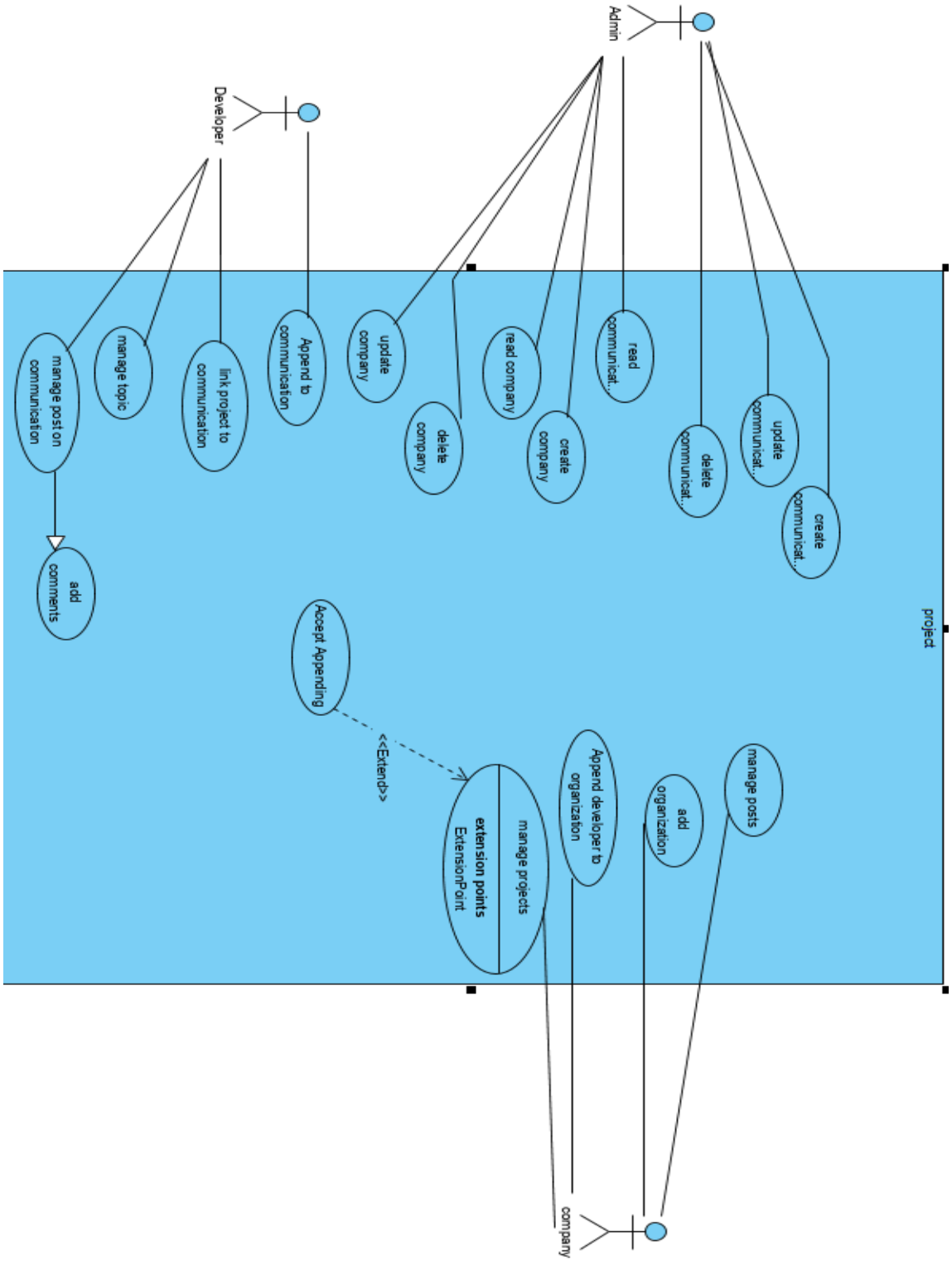


Figure 3.3project micro service use case diagram

Project micro service use case there will have three actors: Admin to manage the authentication and authorization in project service with doctors, students(developers) and TAs , Company actor will have a very important role because they will be the startup for every project and the way to have a marketing for the project , Developer actor is important actor because he will work on the project .each one of these three actors will have a use cases (functions) explains his mission in the system.

developers as students(teams) or TAs and companies need to share experience or share their projects with companies to market for them or to make a startup for the project Admin will create a communication between them that will be by allow developers to make a communication with companies so TAs will follow up team progress in the project by communication between the developers , instruct teams about their projects and evaluate the final project or the project prototypes all of this will be Supervised by the Admin . sometimes user needs to update communication by make changes in the communication between developers and companies, changing the company for the developers, changing the peers of the communication, for example if the TAs for the team has been changed so the peers of the communication will need to have a changes by the admin, changing the TAs instructions for the team adding new instructions or changing the evaluation of the project team need to be supervised by the admin. Also, admin will have the permission to give the availability for reading or not reading any communication between any two peers. But if ending the communication between them even company or a developer needed to be done so the admin will be responsible for deleting this communication after taking the agree from them. one of the admin functions is creating a company which allows the project to be supported by external company admin also can allow changing the company that will be supporter for the project or allow any developer to read about the supporter company of the project or deleting this company so it will not be a supporter for the project.

Developer needs append to a communication with a company to share its experience or to share his visions with the company as a team or individual. When user accept the appending, he can link his project to the communication between him and the company. Also, developer will be responsible for managing kinds of topics that will be shared with a company and filtering what he could share with him and what he could not. He will be managing the posts on communication by generate posts on the communication channel between them. The developer and the company can add comments in the posts to discuss the post.

Every company need to manage the kind of posts and the content of these posts ,need to filtering the kind of the organization will be added to the company and managing the project that will be shared from developers by send an appending request for the developers who the company need to contact with them in the first of all so use case diagram contained the company actor who will solve all these problems.

3.4 COURSE MICROSERVICES

Another important micro services in TAVSS is course microservice , course micro service will provide lots of features that users as students ,teams ,doctors and teacher assistants can attain and acquire these features and interact with them.

Doctors always need to insert and assign their courses in the system also students always need to be assigned in their courses and know their doctors and TAs in every course so, they will have a module system feature in course micro service in TAVSS which will solve this problem .After the doctor assigning his course and lectures he can give his student an assignment using Assignment module feature. Another advanced way for doctors for teaching their students which is Virtual classes which allow doctors to make online courses on TAVSS which will be easier more effective and will be a good solution for students who cannot go to a university. Finally if students need a discussion between Professors, course micro service will allow discussion between doctors and their student about the course lectures .

3.4.1 COURSE MICROSERVICE USE CASE

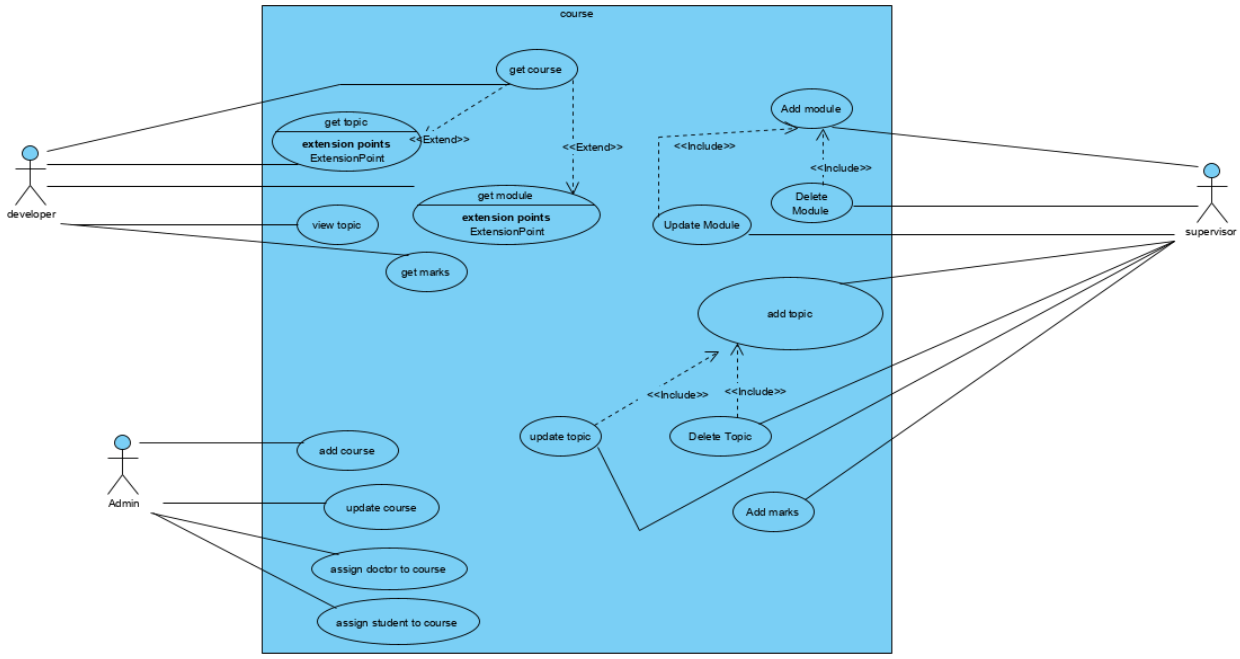


Figure 3.4course micro service use case diagram

if the doctor or instructor want to assign a course on TAVSS he must take a permission to make sure that the course not teaching by another doctor so, Course micro service will have Admin actor who will have a permission that allow him to add courses to TAVSS , if a

doctor wants to update a course a doctor will insert his updates but the admin will be responsible for applying these updates , also admin will have a permission to assign the suitable doctor to his suitable course depends on the college instructions ,admin also will have all permissions that allow him to assign student in his suitable course depending on doctor instructions and finally getting all the courses on TAVSS and getting their topics and modules .

every student need to get a course and as a result he can get the topic which is the general titles in the course and modules which is the content of the of the course ,view topic and get marks . Developer actor will have a permission for getting all the courses on TAVSS and getting their topics and modules also he has a permission to get just a view of the topic of the course not the original version of the topic , finally, he has a permission to get his marks in the course .

Supervisor actor will be a more specific for the courses than admin he has a permission to add a module in a course which is the content of the course so he can update or delete this module also he can add topic to a course which is the general titles in the course and delete or update these titles and he will add the student marks in every course in the system.

3.4.2 COURSE CLASS DIAGRAM

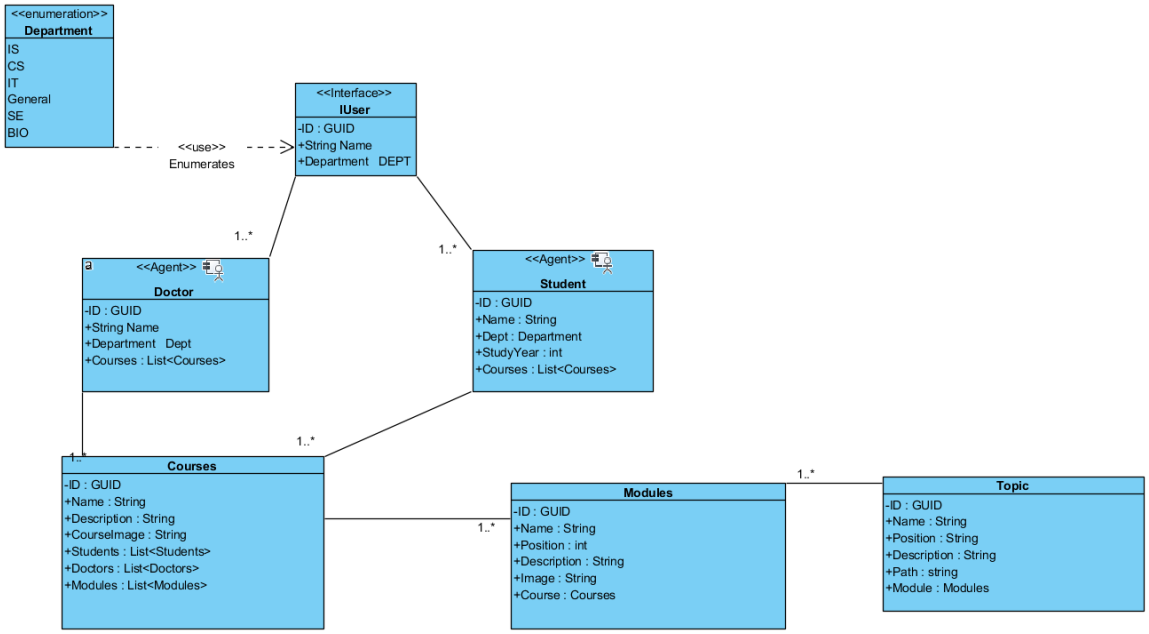


Figure 3.5course micro service class diagram

Every user in any system need to have an information, so in TAVSS every user doctor or student will have an information. Class diagram will contain Iuser interface parent class containing all information can user have even he was a doctor or student (child classes). As we know every student and doctor belong to a specific department so Department enumeration class will contain a static values for the departments every user even doctor or student need to have one value of Department class. Also doctor will teach a course and student will learn that course so course class important will be very important to contain information for every course and who is the doctors will teach and students will learn that course. Every course contains topics and modules which will be in module class and topic classes , these two classes will contain all information needed for each one of them and which course they belong to.

3.4.3 COURSE CLASS DIAGRAM

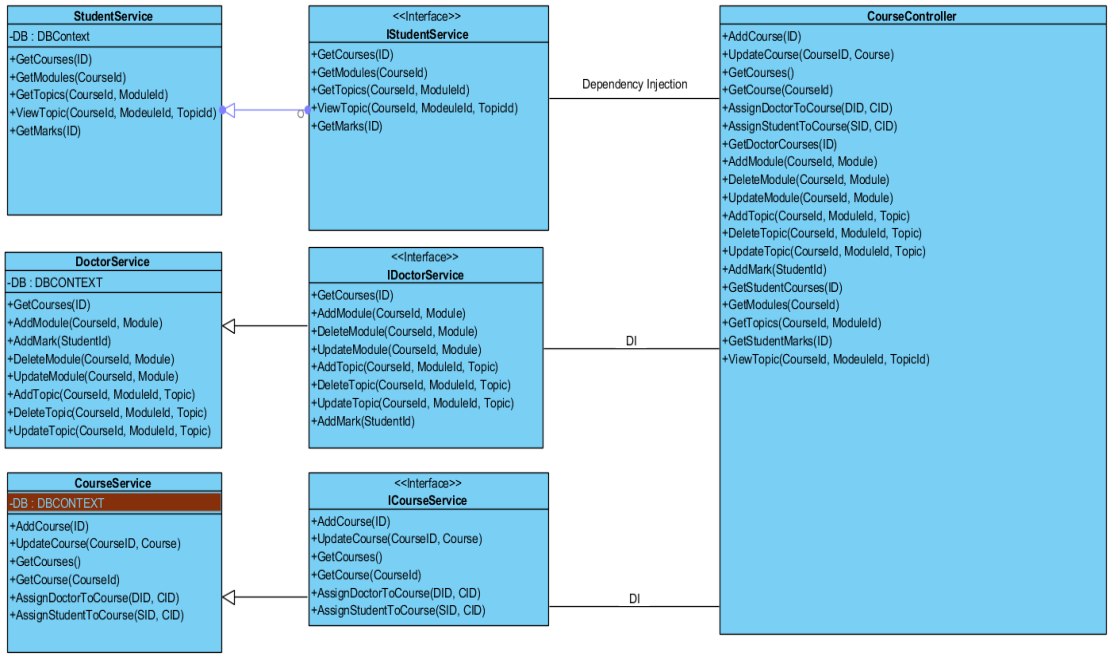


Figure 3.6ourse micro service class diagram

In course service using MVC modeling will be very perfect to improve the service performance ,first of all Modeling . Every doctor need a part in database to save his

information ,so as students need a database for saving information and courses need also database for saving any information about courses in the system , as a result student service class , doctor service class and doctor service class was important to be excited

Second doctor , students need a an interface to connect the user to the database of the system in the system so as a result Istudent service and Idoctor service class important which will be like a view in MVC . courses need an interface to connect course database with the users in a view so, Icourse service class which will be like the view in MVC.

Finally doctor and students need to perform functions and interact with courses in the system so , course controller will be responsible for handling ,controlling and performing all the functions in the system , to assign results and changes in the model

3.5 ACCLAIM MICROSERVICES

Another important micro services in TAVSS is Acclaim Microservices , Acclaim Microservices will provide lots of features that users as students ,teams ,doctors and teacher assistants can attain and acquire these features and interact with them .Acclaim Microservices will give each student a specific rank on TAVSS depending on contributions, winning a competition with his project, as a result of this rank he can take number of xp points,also he can take Badges after finishing model in every course ,finally he can get a Certificates after finishing the entire course.

3.5.1 ACCLAIM MICROSERVICES SEQUENCE DIAGRAM

Sequence diagrams in UML show how objects interact with each other and the order those interactions occur. It’s important to note that they show the interactions for a particular scenario. The processes are represented vertically and interactions are shown as arrows

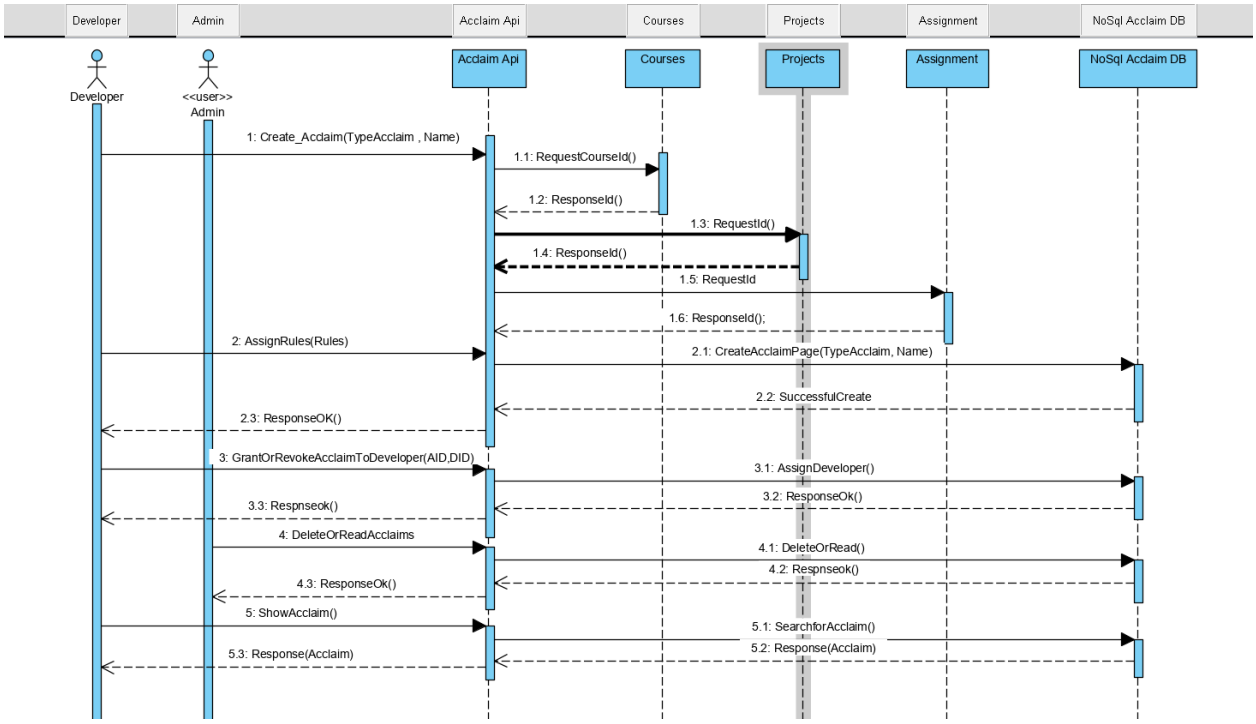


Figure 3.7Acclaim micro service sequence diagram

Acclaim sequence diagram two important actors will interact in the system: Developer and Admin.

Sometimes user need to get an acclaim so he send a message per acclaim API to ask for an acclaim, depending on acclaim type the system will send a message to the right sub system either it was project, course or assignment acclaim and waiting for a response from the system.

Also if developers need to get an acclaim badge so, they send a message per acclaim API to ask for an acclaim badge and waiting for system results .

When developer request an acclaim he need a granting or revoking from the system which is the Admin role to interact with acclaim DB in the system, also deleting an acclaim from the system is Admin role by deleting from acclaim DB . Finally if developer needs to show all acclaims he has got he can sending a request to the acclaims api which will search in acclaimDB for all acclaims for the requested developer.

"All of these functions can be applied by interacting through Acclaim API".

3.6 COMMUNITIES MICROSERVICES

Communities micro service will be responsible for any communication even it was broadcast, multi cast ,peer to peer, unicast between doctors, students, developers, TAs, companies or organization there will be a strong connection between the connector , high

security and have a good manage .This communication can be done even by chatting ,posts and comments on these posts, surveys and reacting by emojies.

3.6.1 COMMUNITIES USECASE DIAGRAM

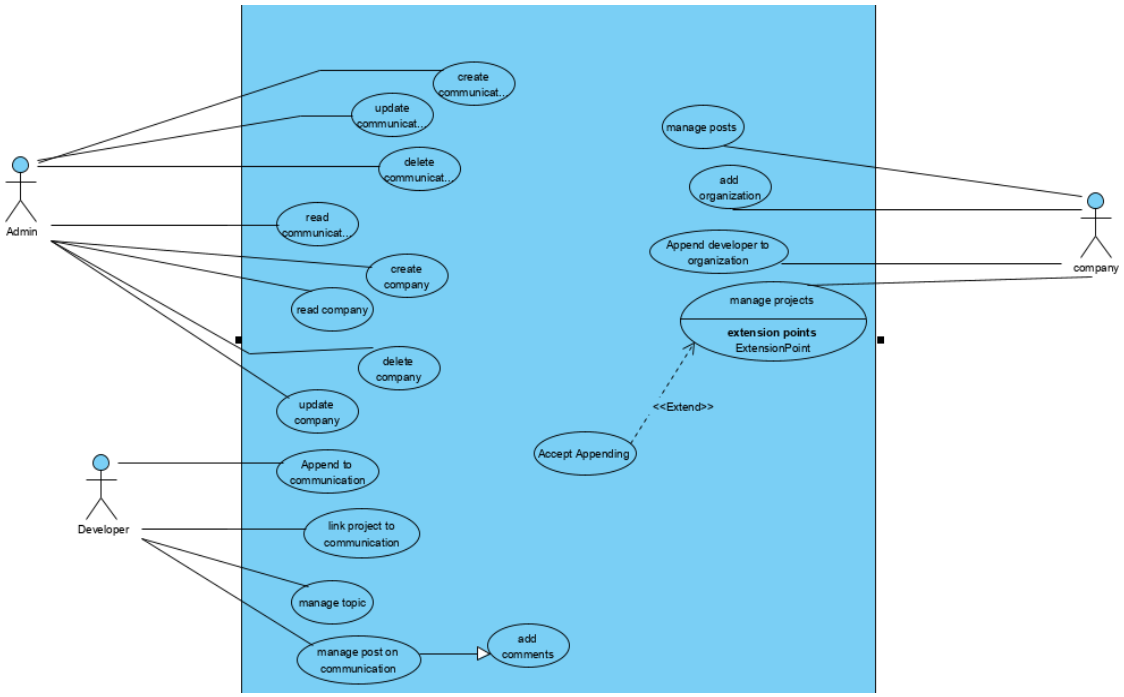


Figure 3.8communities micro service use case diagram

communities micro service use case there will have three actors: Admin to manage the authentication and authorization in community service with doctors, students(developers) and TAs , Company actor will have a very important role because they will be the startup for every project and the way to have a marketing for the project , Developer actor is important actor because he will work on the project .each one of these three actors will have a use cases (functions) explains his mission in the system.

developers as students(teams) or TAs and companies need to share experience or share their projects with companies to market for them or to make a startup for the project Admin will create a communication between them that will be by allow developers to make a communication with companies so also TAs will follow up team progress in the project by communication between the developers , instruct teams about their projects and evaluate the final project or the project prototypes all of this will be Supervised by the Admin . sometimes user needs to update communication by make changes in the communication between developers and companies, changing the company for the developers , changing the peers of the communication, for example if the TAs for the team has been changed so the peers of the communication will need to have a changes by the

admin, changing the TAs instructions for the team adding new instructions or changing the evaluation of the project team need to be supervised by the admin. Also, admin will have the permission to give the availability for reading or not reading any communication between any two peers. But if ending the communication between them even company or a developer needed to be done so the admin will be responsible for deleting this communication after taking the agree from them . one of the admin functions is creating a company which allows the project to be supported by external company admin also can allow changing the company that will be supporter for the project or allow any developer to read about the supporter company of the project or deleting this company so it will not be a supporter for the project.

Developer needs append to a communication with a company to share its experience or to share his visions with the company as a team or individual. When user accept the appending he can link his project to the communication between him and the company. Also developer will be responsible for managing kinds of topics that will be shared with a company and filtering what he could share with him and what he could not. He will managing the posts on communication by generate posts on the communication channel between them. The developer and the company can add comments in the posts to have a discussion about the post.

Every company need to manage the kind of posts and the content of these posts ,need to filtering the kind of the organization will be added to the company and managing the project that will be shared from developers by send an appending request for the developers who the company need to contact with them in the first of all so use case diagram contained the company actor who will solve all these problems.

3.6.2 COMMUNITIES SEQUENCE DIAGRAM

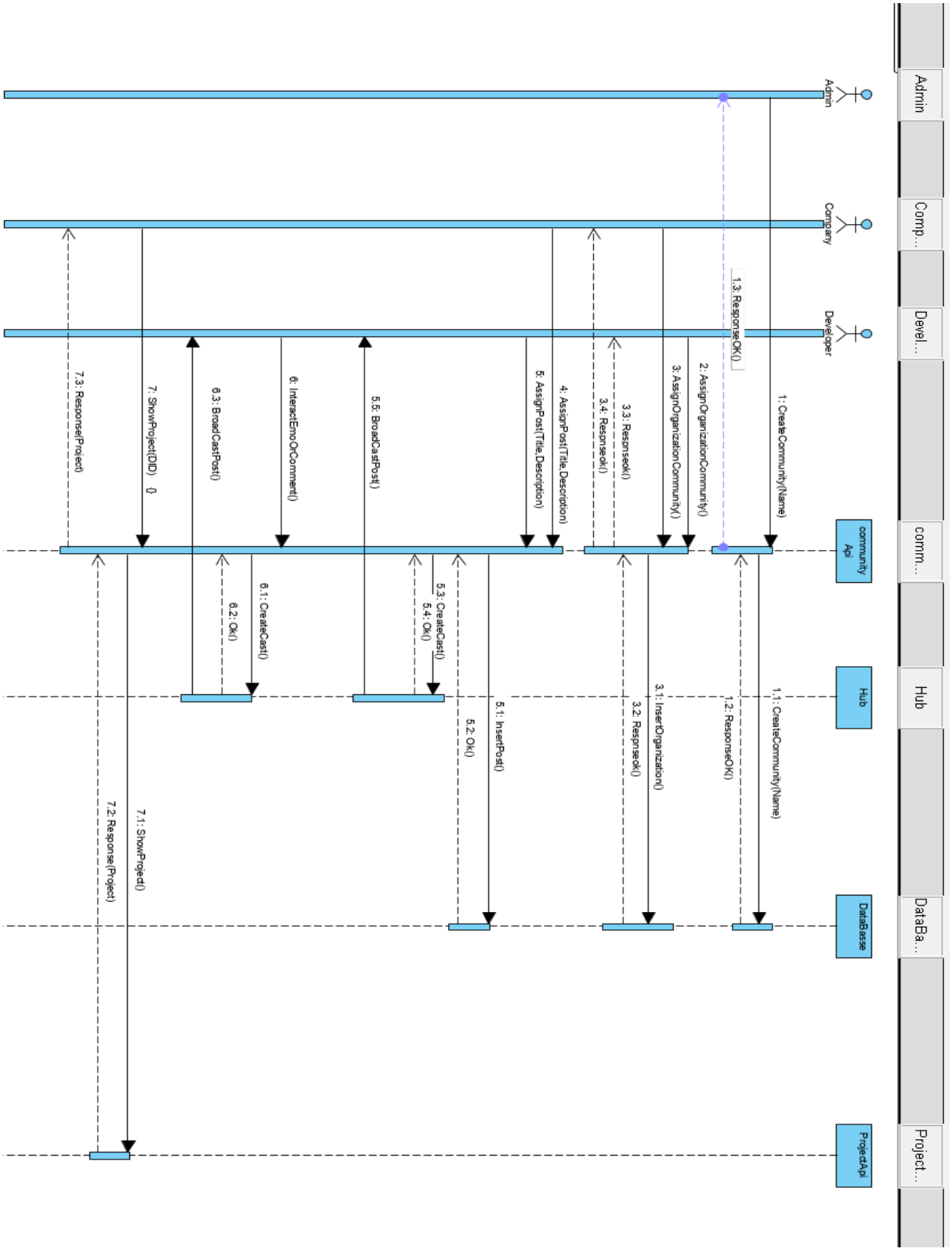


Figure 3.9communities micro service sequence diagram

Having an idea about the operations available for each user and the relations between them in usecase diagram ,we are going to dig deeper and see how they are done,

communities sequence diagram has three important actors will interact in the system: Developer, company and Admin.

If any community needed to be establish it must be initiated by Admin by assigning this community in the DB of the system, developer and company who will responsible for assigning organizations to that community by inserting organization to the community in the DB of the system, also both of them can generate posts in the same way , after post generating this post need to be broadcasted to the developers , finally if the company need show all the project it will send a request to the DB to return all projects to the company.

"All of these functions can be applied by interacting through community API".

3.6.3 COMMUNITY CLASS DIAGRAM

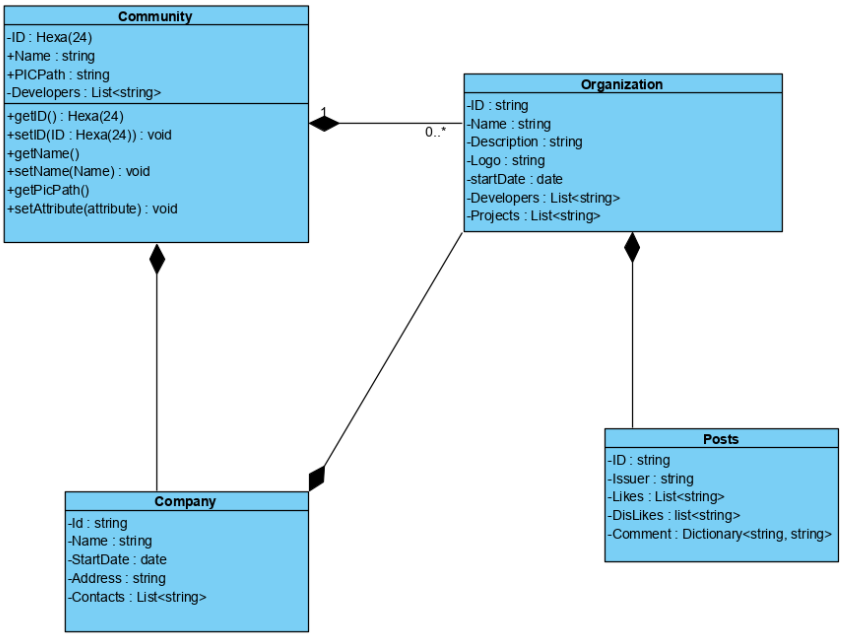


Figure 3.10communities micro service class diagram

To make a connection with any company must be there an information about that company so class company will be very important to contains any information about companies , every company has organizations belong to it which every company and its organizations create a powerful community and exciting this community depending on them , to make an interaction between them posts are important which organizations will be the post generator ,and establishing posts depending on an organizations.

3.7 REALTIME MICROSERVICES

User in the system need to be notified with any incomings in the system he needs to be on line with his doctors notifies, his TAs instructions, the important events even internal or external events.

Any change in courses schedule students and doctors needed to be notified with it or changing in the courses locations , if doctors has been changed their courses every student need to be notifies , internal event in the college or external events from companies, posts from companies and advertisements all of those need to be in the system notifications. Also, number of page visitors or users, number of appending and changes in the highest-ranking need to be in system notifications. It will be visualized with charts.

3.8 ASSIGNMENTS MICROSERVICES

Assignment micro service will be responsible for give student a different kinds of questions in different ways in different courses to help doctors and TAs to evaluate their students and help students to know their levels, like exams system , assignment for a lecture or course every assignment will have ,type of questions can be open questions like how ,what ,why or close questions like MCQ. Depending on questions answering it will be evaluated to be ranked and it will make a Trophy for the higher ranking.

3.8.1 ASSIGNMENT USE CASE DIAGRAM

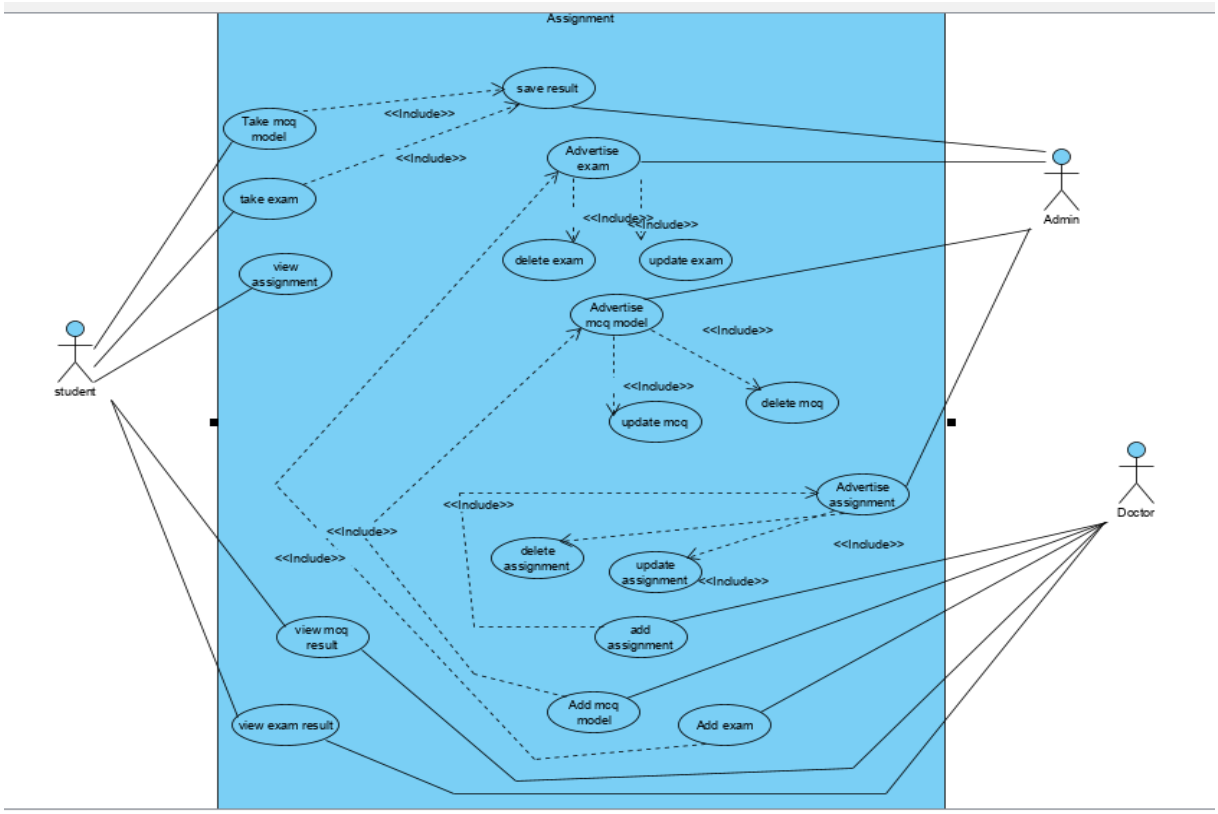


Figure 3.11Assignment microservice usecase diagram

Student wants to take MCQ model to solve it and save his mark in the system or take an exam to solve it and as a result his marks will be saved in the system so, he will have all permissions to do these, also it has a permission to view his assignments in every course ,after solving an MCQ or exam he view his results in both of them.

After student takes MCQ or exam saving the students results is desirable, Admin actor will take all these permissions, he has the ability to advertise exams, MCQ models and assignments in the system for all students as a result he can update or delete them also.

Doctor actor has permissions that allow him to add assignment, add MCQ model or add exam as a result they will be advertised by the Admin actor as mentioned before. Also, he has a permission to view exam results or view MCQ results.

3.8.2 ASSIGNMENT SEQUENCE DIAGRAM

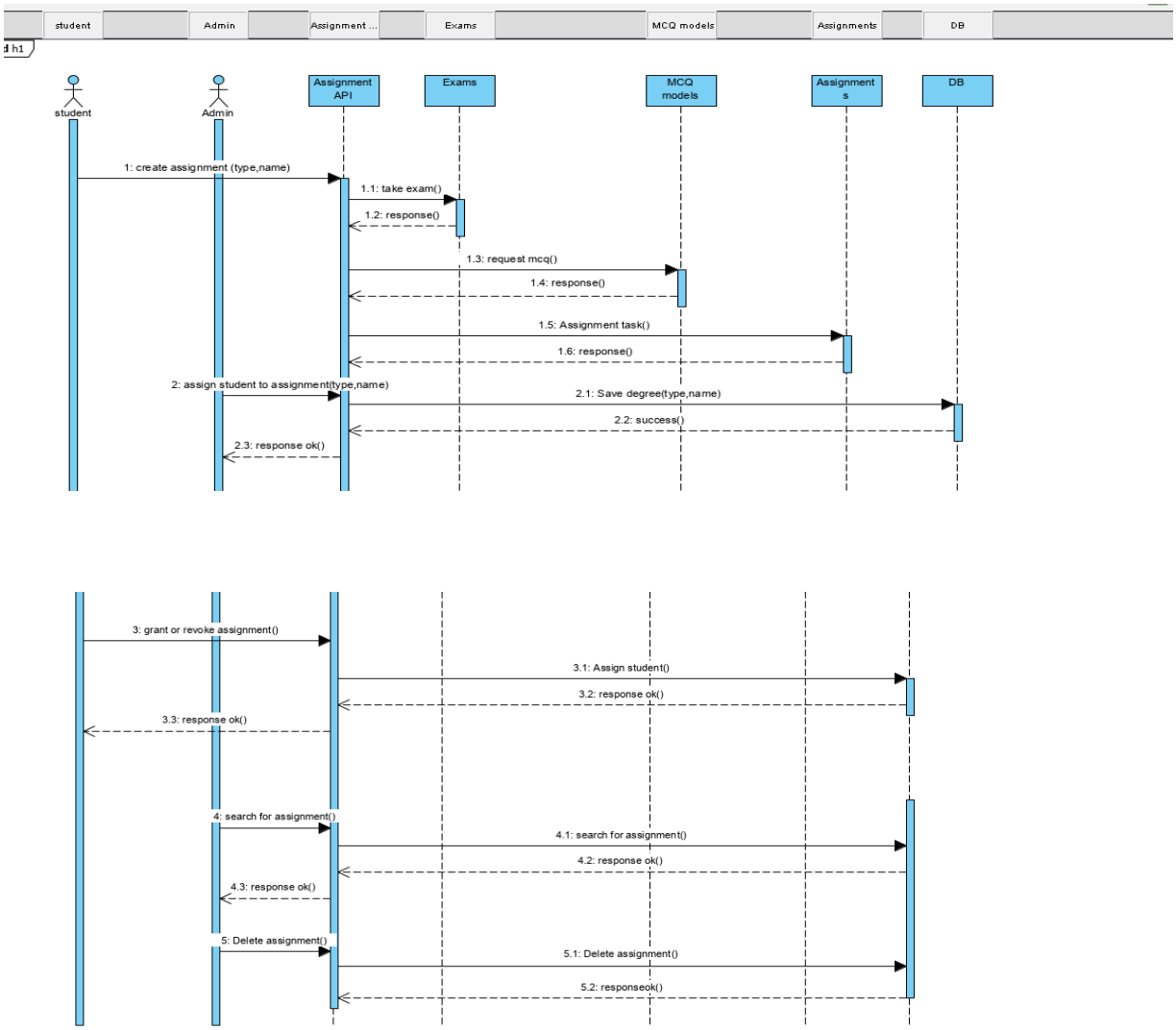


Figure 3.12Assignment micro service sequence diagram

This sequence will contain two actors: student, Admin. Having an idea about the operations available for each user and the relations between them in use case diagram ,we are going to dig deeper and see how they are done, If students want to take an assignment they send an assignment message exciting the assignment type , depending on that type assignment can be either MCQ model , exam or assignment. After the student taking his assignment, he needs to be assigned that he takes that assignment this will be done by the admin and saving his degree in DB. If student grant his assignment, Admin will assign the student in the DB for the assignment, Admin will be responsible for searching and deleting the assignment from the DB.

“All of these functions can be applied by interacting through Assignment API”.

CHAPTER 4: IMPLEMENTATION

Focusing on how the difficulty of creating the APIs to be stable enough, So Why to use Dotnet Core as a main framework?

4.1 WHY TO USE .NET CORE AS A MAIN FRAMEWORK FOR APIS DEVELOPMENT?

The **modularity** and **lightweight** nature of **.NET Core** makes it perfect for containers. When deploying and starting a container, its image is far smaller with .NET Core than with .NET Framework. In contrast, to use .NET Framework for a container, the image must be based on the Windows Server Core image, which is **a lot heavier** than the **Windows Nano Server** or **Linux images** that used for .NET Core. [4]

Additionally, .NET Core is cross-platform, so server can deploy apps with Linux or Windows container images. However, if the traditional .NET Framework used, images can be deployed based on Windows Server Core.

The following is a more detailed explanation of why to choose .NET Core.

4.1.1 DEVELOPING AND DEPLOYING CROSS PLATFORM

Clearly, if having an application is the goal (web app or service) that can run on multiple platforms supported by Docker (Linux and Windows), the right choice is **.NET Core**, because .NET Framework only supports Windows.

See the Differences on Figure 4-1.

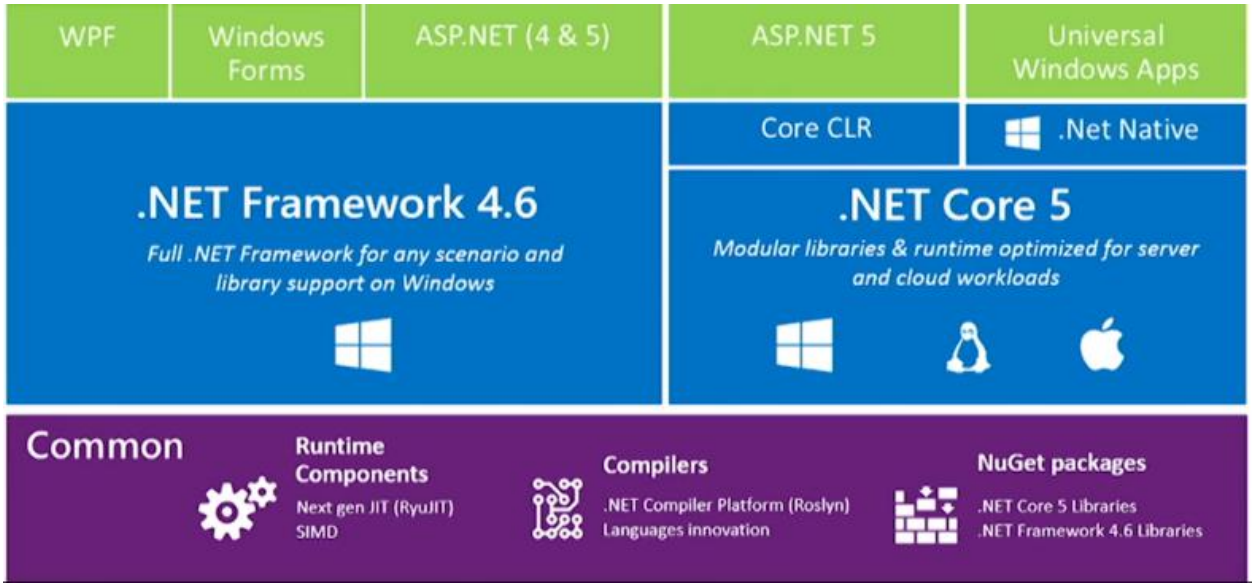


Figure 4-1 .Net Framework Vs .Net Core

.NET Core also supports **macOS** as a development platform. However, when deploying containers to a **Docker host**, that host must (currently) be based on Linux or Windows. For example, in a development environment, a Linux VM running on a Mac could be used. It's still a viable choice see this Article [(5 REASONS WHY MICROSOFT STACK IS STILL A VIABLE CHOICE)]

THE IDES

Visual Studio provides an integrated development environment (IDE) for Windows and supports Docker development.

Visual Studio for Mac is an IDE, evolution of **Xamarin Studio**, that runs on **macOS** and supports Docker-based application development. This should be the preferred choice for developers working in Mac machines who also want to **use a powerful IDE.**

You can also use **Visual Studio Code (VS Code)** on **macOS**, **Linux**, and **Windows**. VS Code fully supports .NET Core, including IntelliSense and debugging. Because VS Code is a lightweight editor, it can be used to develop containerized apps on the Mac in conjunction with the Docker CLI and the .NET Core command-line interface (CLI). also targeting .NET Core with most third-party editors is possible.

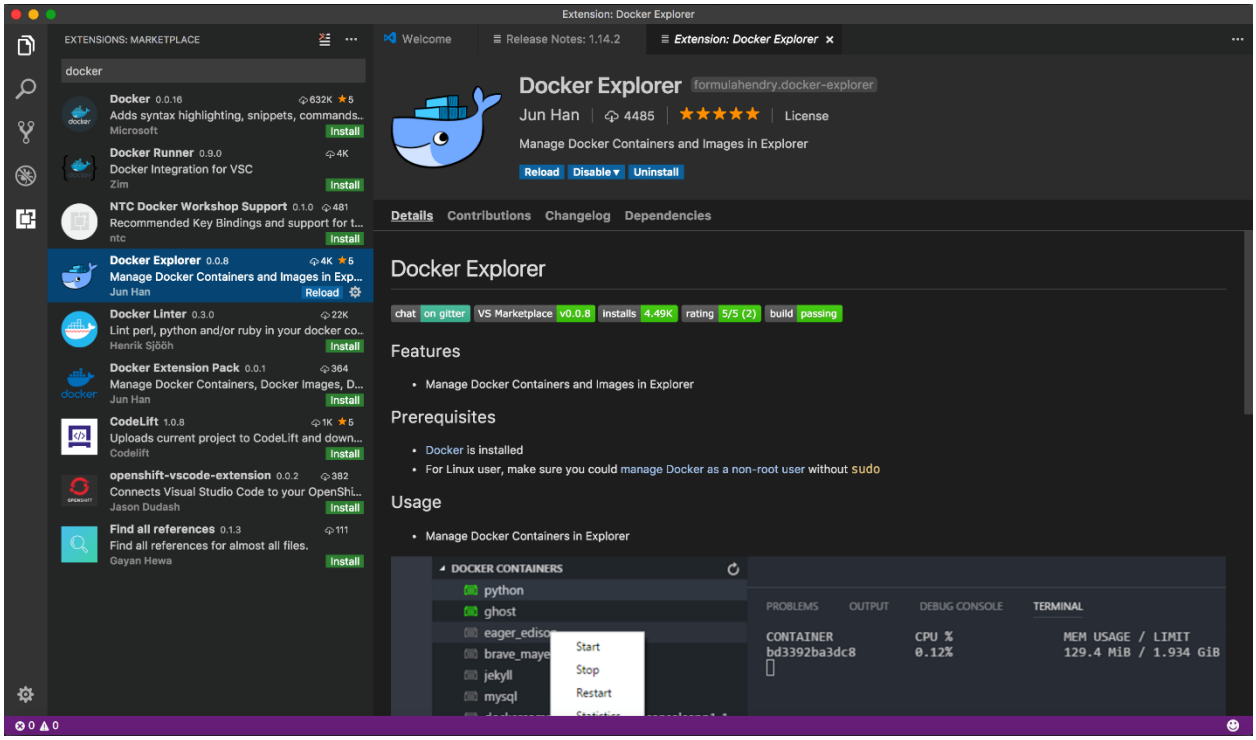


Figure 4.2 Installing the Docker requirements

4.1.2 CHOOSING BETWEEN .NET CORE AND .NET FRAMEWORK FOR DOCKER CONTAINERS

like Sublime, Emacs, vi, and the open-source OmniSharp project, which also provides IntelliSense support.

In addition to the IDEs and editors, the .NET Core can be used CLI tools for all supported platforms.

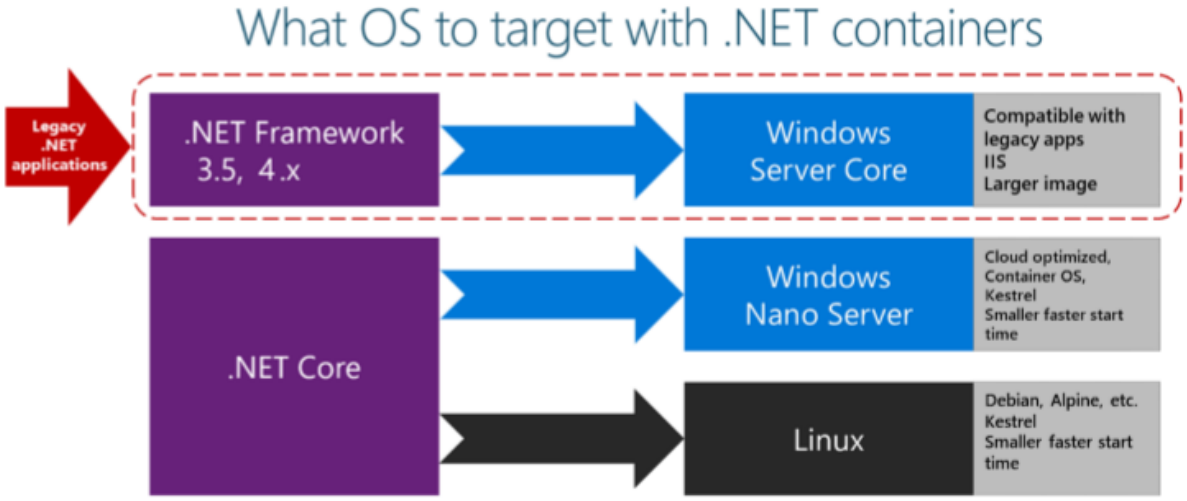


Figure 4-3 Cross platform development of .Net Core

4.2 START TO CODE

Using the .Net Core version 3.1.1 The Latest edition this time , showing the version and how to use The Power Shell to Create an API illustrated in figure 4.-3

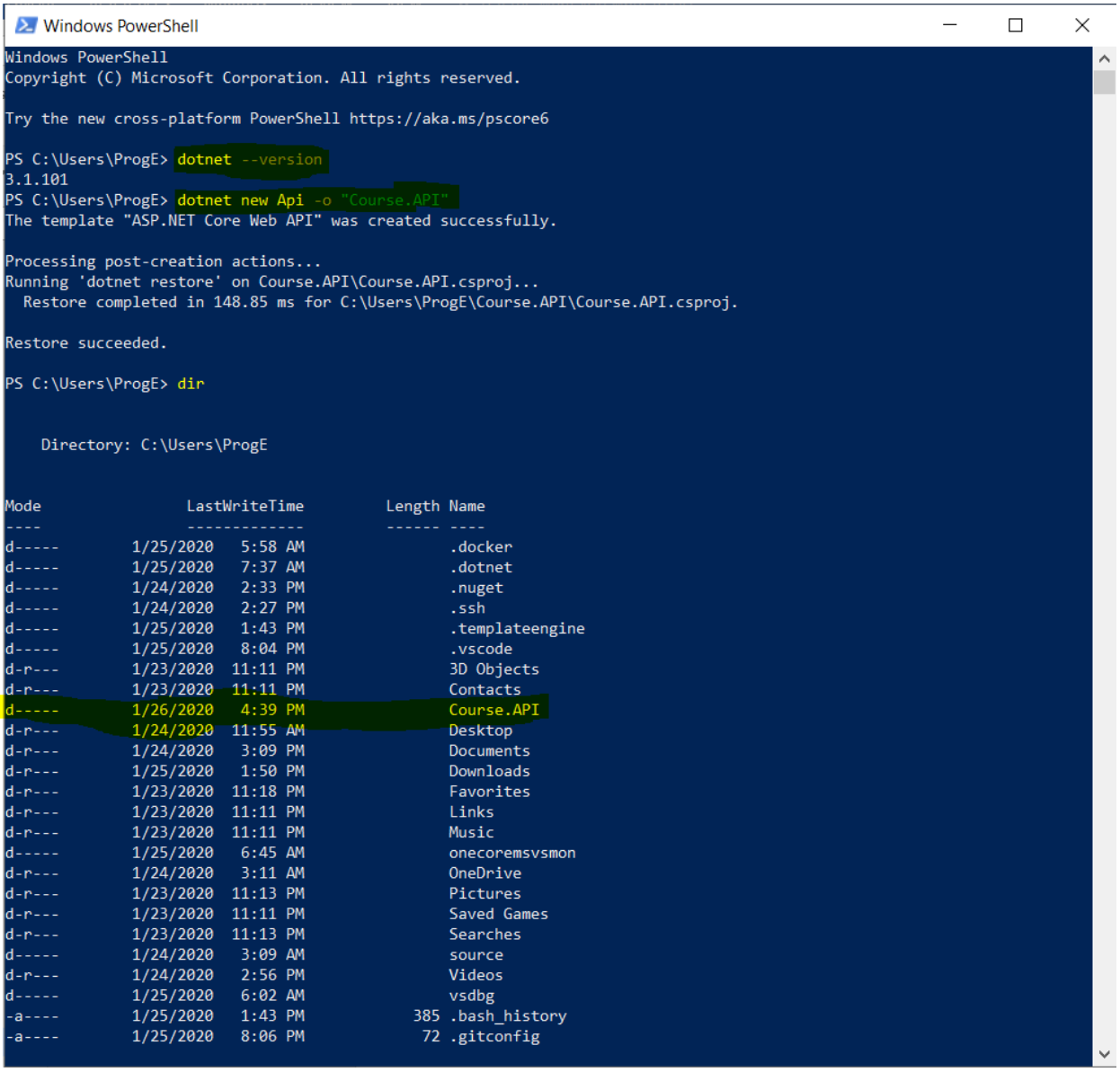


Figure 4-4 Creating an API from a Microsoft's Templates

Showing How it work it's simple to use first describing the program.cs file start the app from the file. So focusing now in the programming features of new development.

4.2.1 THE STARTUP CLASS

The `Startup` class is where:

- Services required by the app are configured.
- The request handling pipeline is defined.

Services are components that are used by the app. For example, a logging component is a service. Code to configure (or *register*) services is added to the `Startup.ConfigureServices` method.

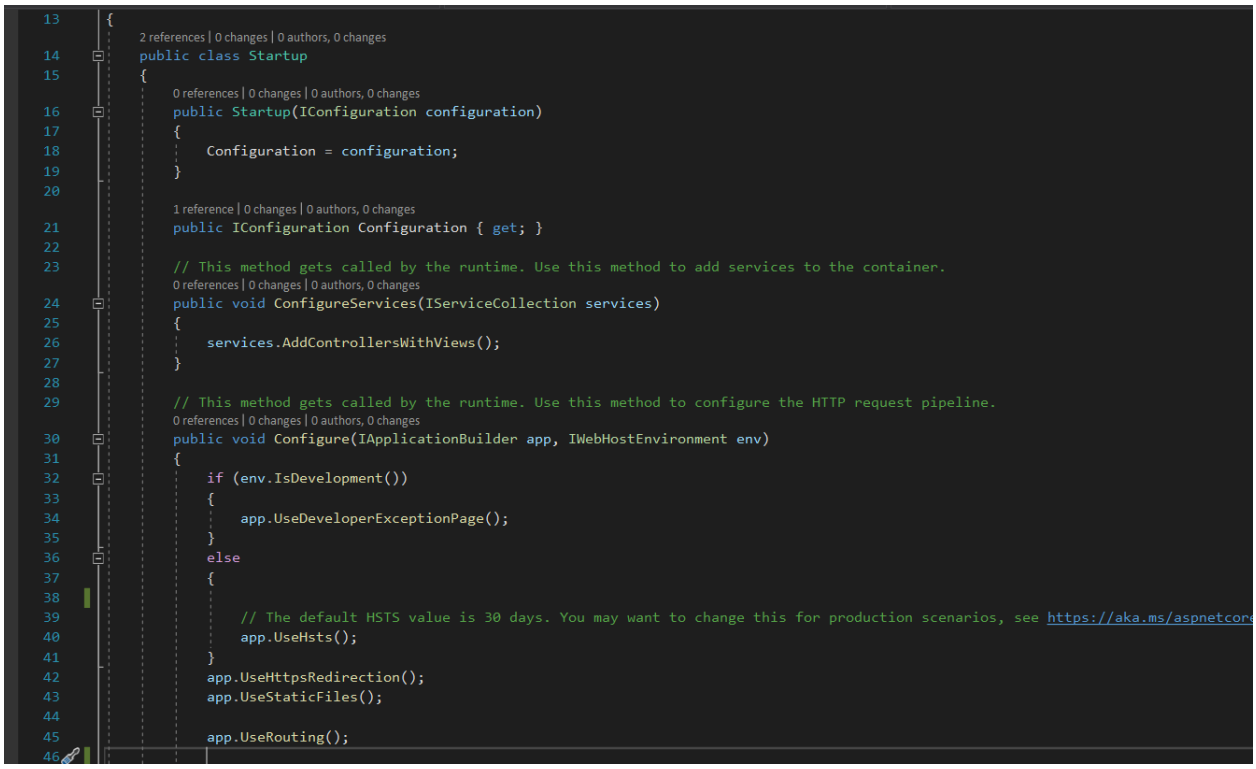


Figure 4.5 The Startup Class of .Net Core Web App

4.2.2 DEPENDENCY INJECTION (SERVICES)

ASP.NET Core has a built-in dependency injection (DI) framework that makes configured services available to an app's classes. One way to get an instance of a service in a class is to create a constructor with a parameter of the required type. The parameter can be the service type or an interface. The DI system provides the service at runtime.

Here's a class that uses DI to get an MongoDB Bson driver context object. The highlighted line is an example of **constructor injection**:

```
lub                                    Hub.Controllers.ChatController          _channels
16
17      [ApiController]
        1 reference | 0 changes | 0 authors, 0 changes
18      public class ChatController : ControllerBase
19      {
20          private readonly IMongoCollection<Domain.Channel> _channels;
21
            0 references | 0 changes | 0 authors, 0 changes
22          public ChatController(IHubNotificationDatabaseSettings settings)
23          {
24              var client = new MongoClient(settings.ConnectionString);
25              var database = client.GetDatabase(settings.DatabaseName);
26              _channels = database.GetCollection<Domain.Channel>(settings.DatabaseName);
27          }
```

Figure 4.6The way to apply the constructor injection for MongoDB driver mapping

While DI is built in, it's designed to let plug in a third-party Inversion of Control (IoC)possible container if you prefer.

For more information, see Dependency injection in ASP.NET Core.

4.2.3 MIDDLEWARE

The request handling pipeline is composed as a series of middleware components. Each component performs asynchronous operations on an **`HttpContext`** and then either invokes the next middleware in the pipeline or terminates the request.

By convention, a middleware component is added to the pipeline by invoking its `Use...` extension method in the **`Startup.Configure`** method. For example, to enable rendering of static files, call **`UseStaticFiles`**.

The highlighted code in the following example configures the request handling pipeline in the illustrated Figure:

```
public void Configure(IApplicationBuilder app, IWebHostEnvironment env)
{
    if (env.IsDevelopment())
    {
        app.UseDeveloperExceptionPage();
    }
    else
    {

        // The default HSTS value is 30 days. You may want to change this for production scenarios, see https://aka.ms/aspnetcore-hsts.
        app.UseHsts();
    }
    app.UseHttpsRedirection();
    app.UseStaticFiles();

    app.UseRouting();

    app.UseEndpoints(endpoints =>
    {
        endpoints.MapControllerRoute(
            name: "default",
            pattern: "{controller=Home}/{action=Index}/{id?}");
    });
}
```

Figure 4.7 Using The Middleware as pipelines

ASP.NET Core includes a rich set of built-in middleware, and writing custom middleware is possible.

For more information, see ASP.NET Core Middleware.

4.2.4 HOST

An ASP.NET Core app builds a HOST on startup. The host is an object that encapsulates all of the app's resources, such as:

- An HTTP server implementation
- Middleware components
- Logging
- DI
- Configuration

The main reason for including all of the app's interdependent resources in one object is lifetime management: control over app startup and graceful shutdown.

Two hosts are available: the Generic Host and the Web Host. The Generic Host is recommended, and the Web Host is available only for backwards compatibility.

The code to create a host is in `Program.Main`:

```
1 reference | 0 changes | 0 authors, 0 changes
public static IHostBuilder CreateHostBuilder(string[] args) =>
    Host.CreateDefaultBuilder(args)
        .ConfigureWebHostDefaults(webBuilder =>
        {
            webBuilder.UseStartup<Startup>();
        });
}
```

Figure 4.8 The Generic host that encapsulate all app's resources

The **CreateDefaultBuilder** and **ConfigureWebHostDefaults** methods configure a host with commonly used options, such as the following:

- Use Kestrel as the web server and enable IIS integration.
- Load configuration from ***appsettings.json***, ***appsettings****.{Environment Name}.json*, environment variables, command line arguments, and other configuration sources.
- Send logging output to the console and debug providers.

For more information, see .NET Generic Host.

Non-web scenarios

The Generic Host allows other types of apps to use cross-cutting framework extensions, such as logging, dependency injection (DI), configuration, and app lifetime management. For more information, see .NET Generic Host and Background tasks with hosted services in ASP.NET Core.

4.3 IMPLEMENTING SWAGGER AS A DOCUMENTATION FOR THE API

When consuming a Web API, understanding its various methods can be challenging for a developer. Swagger, also known as OpenAPI, solves the problem of generating useful documentation and help pages for Web APIs. It provides benefits such as:

- interactive documentation
- client SDK generation
- API discoverability.

4.3.1 WHAT IS SWAGGER / OPENAPI?

Swagger is a language-agnostic specification for describing REST APIs.

The Swagger project was donated to the OpenAPI Initiative, where it's now referred to as OpenAPI. Both names are used interchangeably; however, OpenAPI is preferred. It allows both computers and humans to understand the capabilities of a service without any direct access to the implementation (source code, network access, documentation). One goal is to minimize the amount of work needed to connect disassociated services. Another goal is to reduce the amount of time needed to accurately document a service.

here are three main components to Swashbuckle:

- Swashbuckle.AspNetCore.Swagger: a Swagger object model and middleware to expose SwaggerDocument objects as JSON endpoints.
- Swashbuckle.AspNetCore.SwaggerGen: a Swagger generator that builds SwaggerDocument objects directly from your routes, controllers, and models. It's typically combined with the Swagger endpoint middleware to automatically expose Swagger JSON.
- Swashbuckle.AspNetCore.SwaggerUI: an embedded version of the Swagger UI tool. It interprets Swagger JSON to build a rich, customizable experience for describing the web API functionality. It includes built-in test harnesses for the public methods.

Installing Them Using Nuget CLI or the Nuget previewer (The Package Manager of Dotnet) of Visual Studio

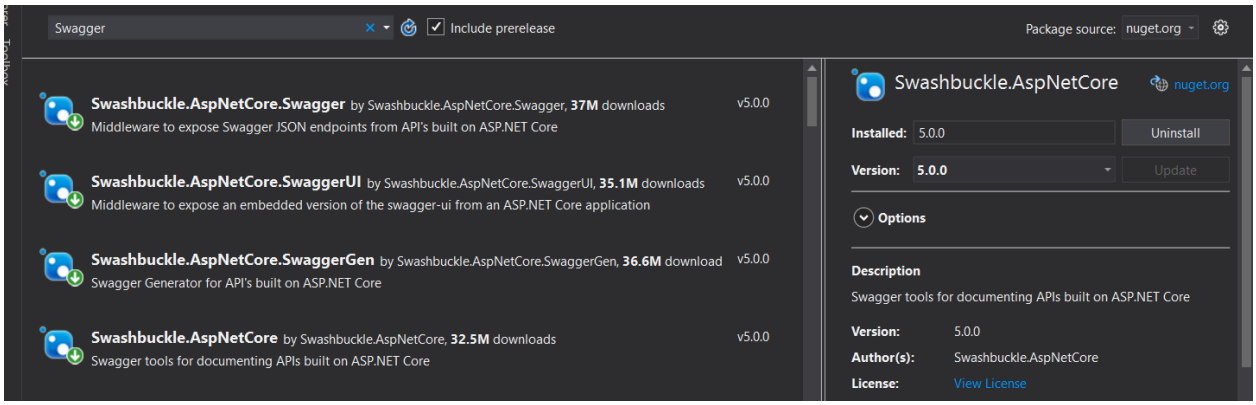


Figure 4.9 The installing of Swagger Component from nuget package manager

configuring this service must be done by implementing options pattern, and assigning the global variables in appsettings.json file, Creating option Repos and in it a helper class SwaggerOptions

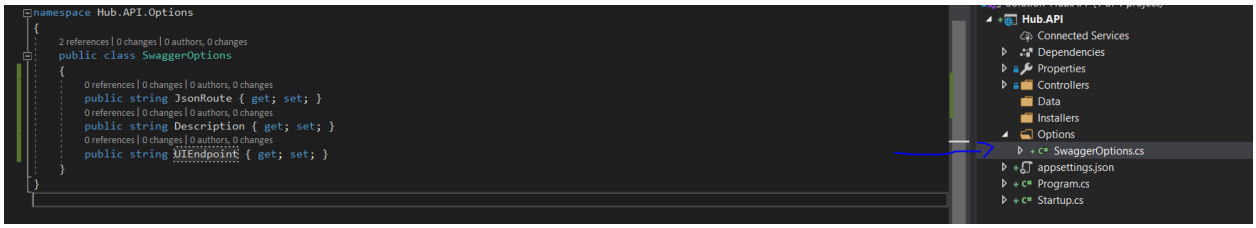


Figure 4.10 The Helper option class implementation

associate the global variables of configuration file appsettings.json illustrated in the following figure

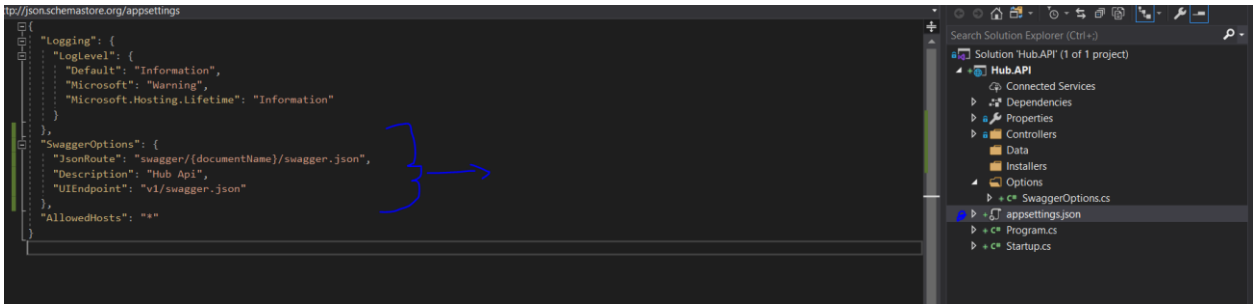


Figure 4.11 assigning the global variables in the configuration file of appsettings.json

Then associating the helper class with the global variables then install this middleware to the pipelines of work by creating an object from SwaggerOptions and **Binding** its variables from appsettings.json to swaggerOptions object

```
0 references | 0 changes | 0 authors, 0 changes
public void Configure(IApplicationBuilder app, IWebHostEnvironment env)
{
    if (env.IsDevelopment())
    {
        app.UseDeveloperExceptionPage();
    }
    else
    {
        app.UseHsts();
    }

    var swaggerOptions = new SwaggerOptions();
    Configuration.GetSection(nameof(SwaggerOptions)).Bind(swaggerOptions);
```

Figure 4.12creating an object to receive the global variable from the configuration file

4.3.2 ADD AND CONFIGURE SWAGGER MIDDLEWARE

Configuring the middleware to options is done throw the middleware section by assigning each global variable into the right place

```
app.UseSwagger(Options => { Options.RouteTemplate = swaggerOptions.JsonRoute; });
app.UseSwaggerUI(Options => { Options.SwaggerEndpoint(swaggerOptions.UIEndpoint, swaggerOptions.Description); });
```

Figure 4.13 Configuration of 2 Middleware and using them after assigning the object values

The adding service to container to run in Runtime using services.AddSwaggerGen() method

```
public void ConfigureServices(IServiceCollection services)
{
    services.AddControllersWithViews();
    services.AddSwaggerGen(x =>
    x.SwaggerDoc("v1", new OpenApiInfo { Title = "Hub Api" , Version = "v1"})

    );
}
```

Figure 4.14 Making it work at runtime

And by run now the application gotta it work:

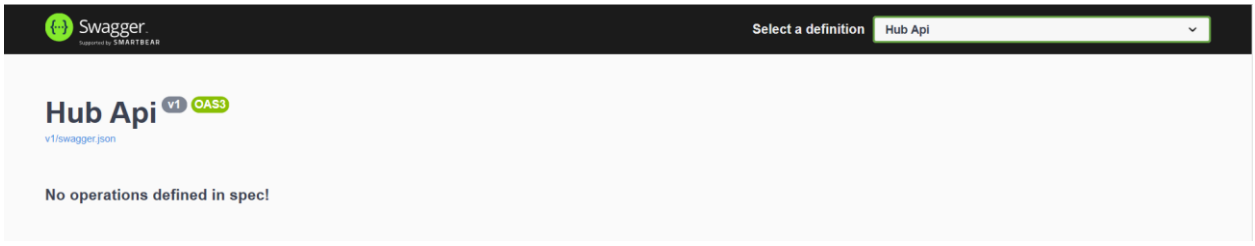


Figure 4.14wagger UI first run before creating the api

4.4 ENABLING CORS (CROSS ORIGIN RESOURCE SHARING)

Browser security prevents a web page from making requests to a different domain than the one that served the web page. This restriction is called the SAME-ORIGIN POLICY. The same-origin policy prevents a malicious site from reading sensitive data from another site. Sometimes, you might want to allow other sites make cross-origin requests to your app. For more information, see the Mozilla CORS article.

Cross Origin Resource Sharing (CORS):

- Is a W3C standard that allows a server to relax the same-origin policy.
- Is **not** a security feature, CORS relaxes security. An API is not safer by allowing CORS. For more information, see How CORS works.
- Allows a server to explicitly allow some cross-origin requests while rejecting others.
- Is safer and more flexible than earlier techniques, such as JSONP.
- To Understand that figured at 4.15

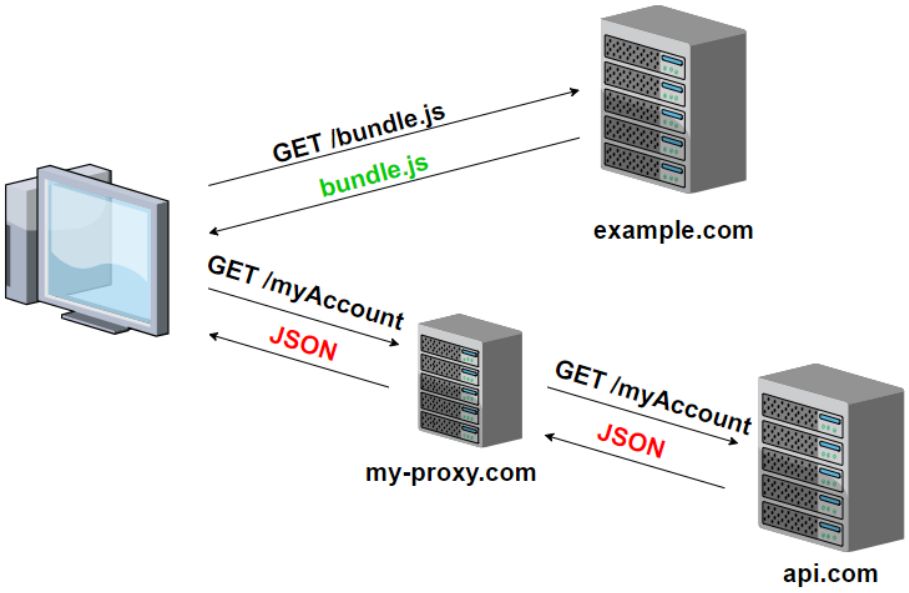


Figure 4.15The Client Request from many servers(origin) as it Enabled for CORS

To allow any client app to request an origin, The CORS must be enabled, illustrated practically in following Figures 4.15, 4.16.

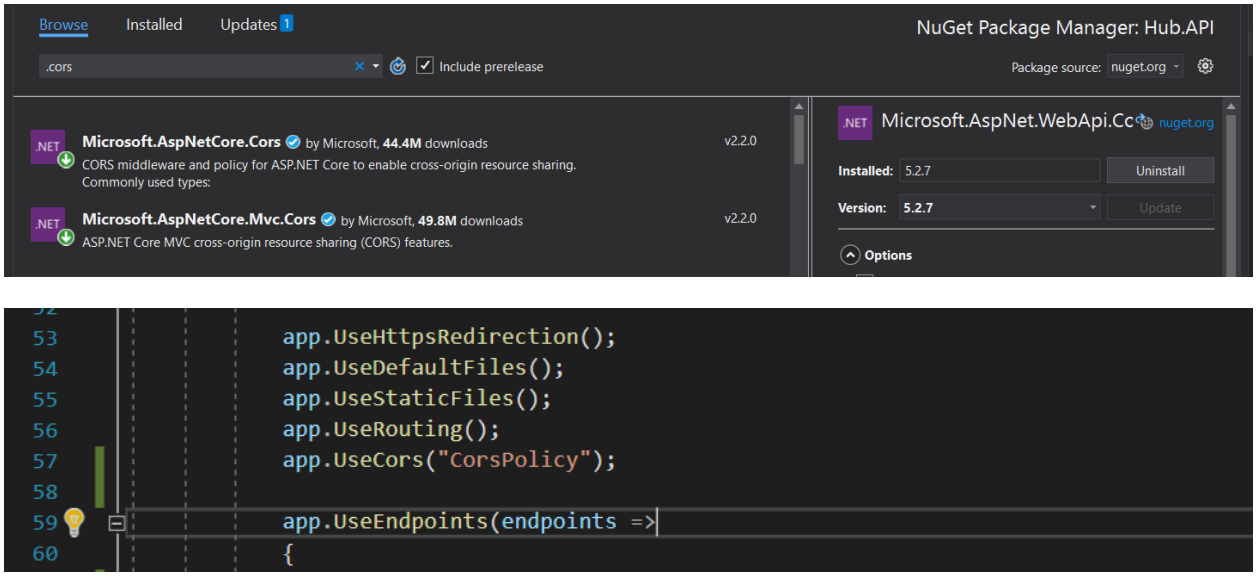
```
services.AddCors(options =>
{
    options.AddPolicy("CorsPolicy", builder => builder
    .WithOrigins("http://localhost:4200")
    .AllowAnyMethod()
    .AllowAnyHeader()
    .AllowCredentials());
});
```

Figure 4.15add the CORS component to the runtime as anyone in the world can consume now this API

It's also can be enabled for some endpoints. Using the policy of **CorsPolicy** That is a mark to follow up.

Using only the LocalHost => 127.0.0.1 with only the port 4200 => the standard IP of Angular Application running.

There is a way to configure every method and every class lonely with its CORS policy by using the Packages of CORS illustrated in next figure.




```
53          app.UseHttpsRedirection();
54          app.UseDefaultFiles();
55          app.UseStaticFiles();
56          app.UseRouting();
57          app.UseCors("CorsPolicy");
58
59          app.UseEndpoints(endpoints =>
60          {
```

Figure 4.16 use the component for the http pipeline

Notice that the function UseCors() must be between the UseRouting() and UseEndpoints() methods for not crashing

4.5 API VERSIONING IMPLEMENTATION

The Branching and versioning is the main backbone of agile processes, so the new versions have the enhancements but for some reason we go back to support many clients with oldest versions, versioning has the capability to make developers and stakeholders to show the past and make no confusion for the clients.

Once creating an API for a client, the client has a fear from the provider for no enhancing and maintenance

It's a contract, API Must be versioned to keep up your clients' support, a viable practice.

The versioning has 4 variables illustrated in the figure 4.17starting from left to right:

- Changing of **The Major** seems that (The entire architecture has been updated⇔ Changed)
- Changing of **The Minor** seems that (only some sections have been updated or enhanced, or a bug fixed but this change must be broadcasted to client to know about it)
- Changing of **The Patch** seems that (a bug fixed, but the client needn't know it)
- **Additional labels** for pre-release and build metadata are available as extensions to the **MAJOR.MINOR.PATCH** format.

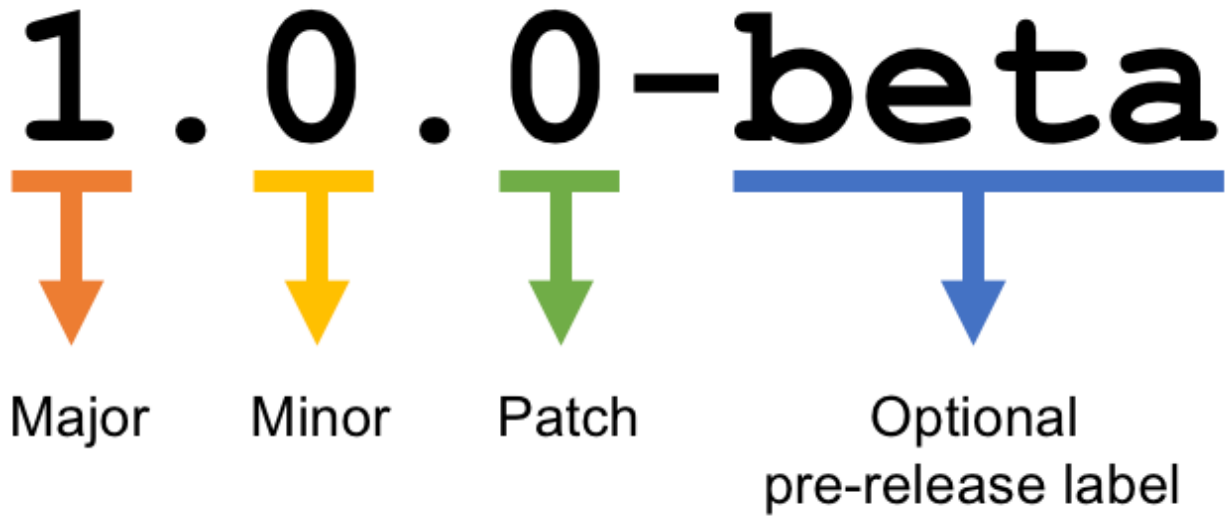


Figure 4.17 The Versioning numeric/alphabetical logical system

Now by creating a new controller called **ChatController** for a scaffolding technique as a template it's not versioned because the route is empty from the version route shown in the figure 4.18.

Figure 4.18 Not Versioned Controller from scaffolding an empty API controller template

4.5.1 HOW TO VERSIONING

A simple way to create many controllers with different versions but it's a bad practice illustrated in following figures

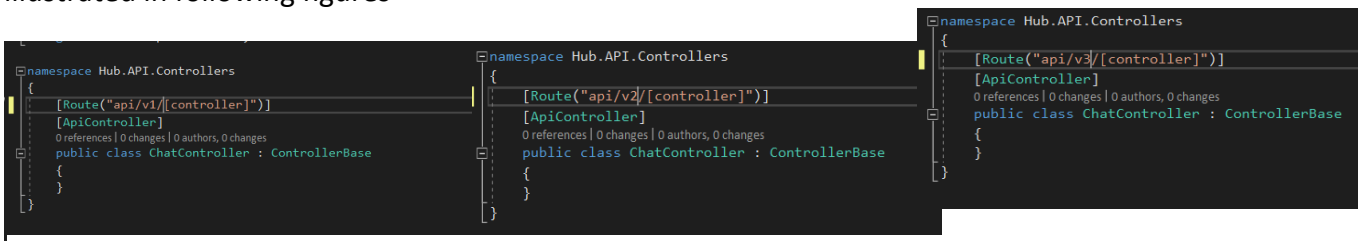


Figure 4.19 Bad practice of Versioning

so let's find a way, first Creating a folder [V1] in the Controller folder to have all version 1 controllers then moving the ChatController inside it. Secondly creating a folder for Contracts to contain the reason of versioning as shown in figure 4.20:

- ApiRoutes sharing routes versions
- Requests View Models
- Responses View Model

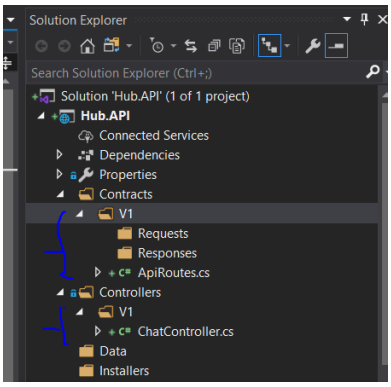


Figure 4.20 The Versioning folders

Don't forget to change the namespace name while moving for no confusion(Hub.Controllers.V1), trying now to create some routes to the chat API to use them in ChatController.cs , making a class called ApiRoutes.cs containing many internal static classes {Chat , Notification},

```
namespace Hub.API.Contracts.V1
{
    0 references | 0 changes | 0 authors, 0 changes
    public class ApiRoutes
    {
        public const string Root = "api/";

        public const string Version = "v1/";

        public const string Base = Root + Version ;

        0 references | 0 changes | 0 authors, 0 changes
        public  static class Chat
        {
            public const string ChatBase = Base + "chat/";

            public const string GetChannel = ChatBase + "{CID}";
            public const string GetChannels = ChatBase + "{IID}";

        }
        0 references | 0 changes | 0 authors, 0 changes
        public  static class Notification
        {
            public const string NotiBase = Base + "Noti/";
        }
```

Figure 4.21The ApiRoutes Class for versioning

each class is logically mapped to a controller, ApiRoutes contain many constant values that encapsulate routes shown as figure 4.21.

Now moving to check versioned classes to controller by making a fake operation calling in the API Get HttpGet route ([HttpGet(ApiRoutes.Chat.GetChannel)]) to check out the compatible swagger interact with the versioned classes illustrated in figure 4.22.

```
using System.Collections.Generic;
using System.Linq;
using System.Threading.Tasks;
using Hub.API.Contracts.V1;
using Microsoft.AspNetCore.Http;
using Microsoft.AspNetCore.Mvc;

namespace Hub.API.V1.Controllers
{

    [ApiController]
    0 references | 0 changes | 0 authors, 0 changes
    public class ChatController : ControllerBase
    {
        [HttpGet(ApiRoutes.Chat.GetChannel)]
        0 references | 0 changes | 0 authors, 0 changes
        public IActionResult GetChannel() => Ok(new { Message1 = "Hello one", Message2 = "Hello tow" });
    }
}
```

Figure 4.22 Fake operation to get some data from API

So the result work on Swagger perfectly illustrated in Figure 4.23.

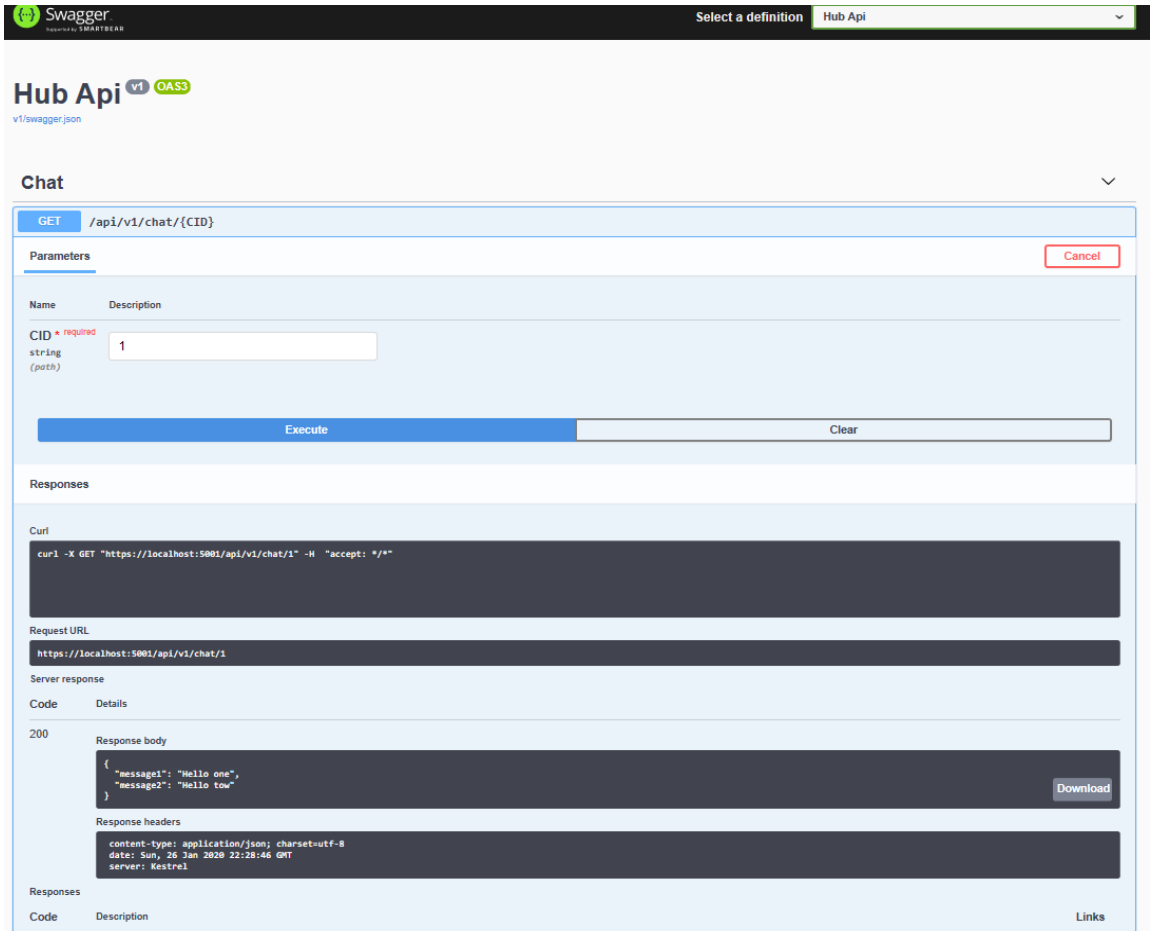


Figure 4.23 Checking for results

4.6 DEPENDENCY INJECTION AND CLEAR SERVICE REGISTERATION

Logically it's not accepted to register all the services in one method, make this method have multiple responsibilities and this attack the SOLID principles of Single Responsibility Principle (SRP) make it not clear architecture and lose its performance and a single point of failure, it's the default way shown at figure 4.24.

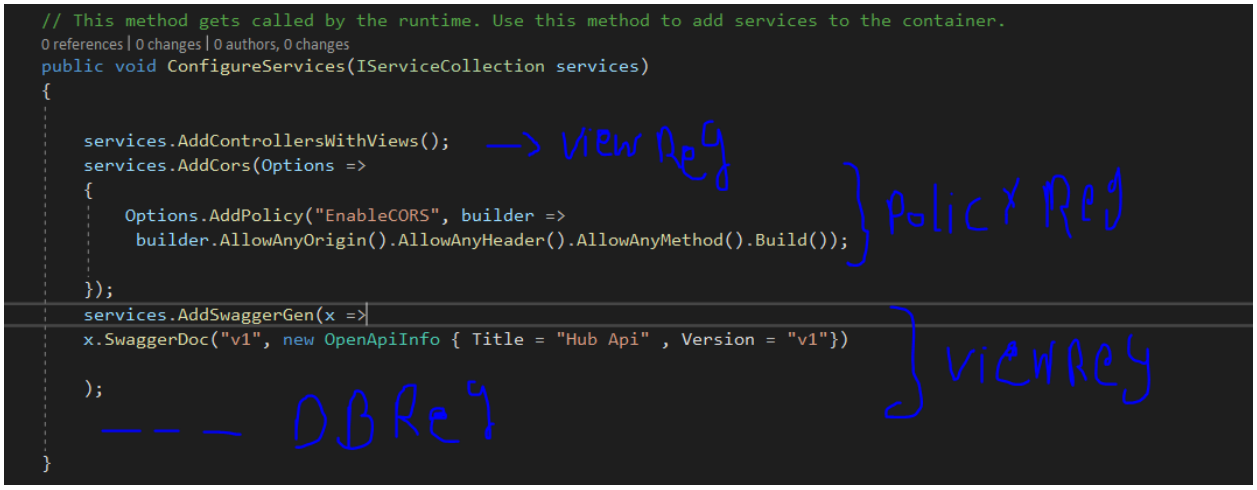


Figure 4.24 Heterogeneous services registered in one method place Bad practice

4.6.1 IMPLEMENTING SEPARATION OF CONCERNS IN DI SOLID (SINGLE RESPONSIBILITY PRINCIBLE)

First creating a folder for services to registered in (Installers) and has an Interface (IInstaller) for Dynamic Binding to all services for Dependency Injection

The interface has a method to be overridden is InstallServices() shown in figure 4.25.

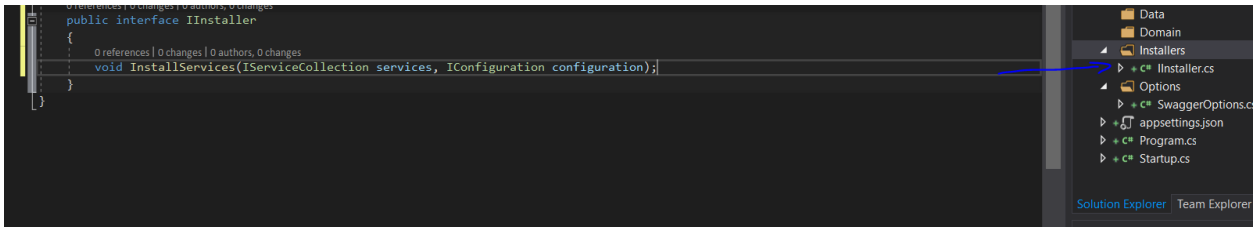


Figure 4.25 Interface for installing services

Second moving every register from the Startup class to its class type of installers by implementing many classes inherit from interface of IInstaller illustrated in the following figures.

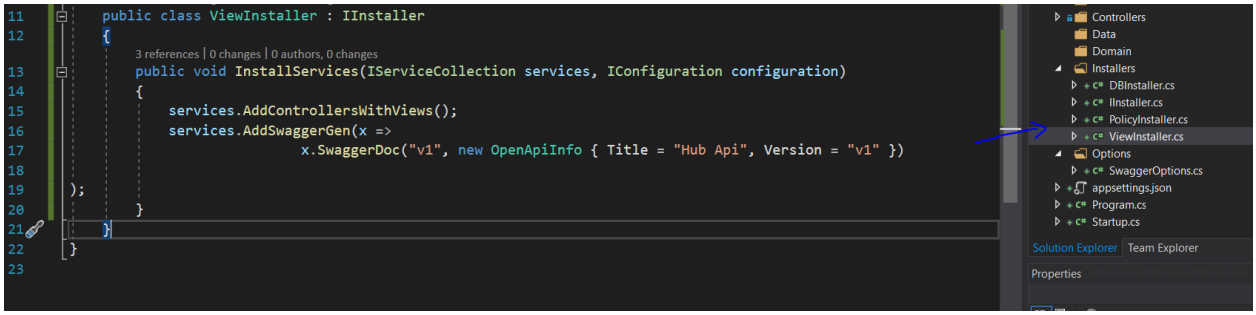


Figure 4.26The View Installer contains registers of view types

Figure 4.27 The Policies installer contains register of CORS

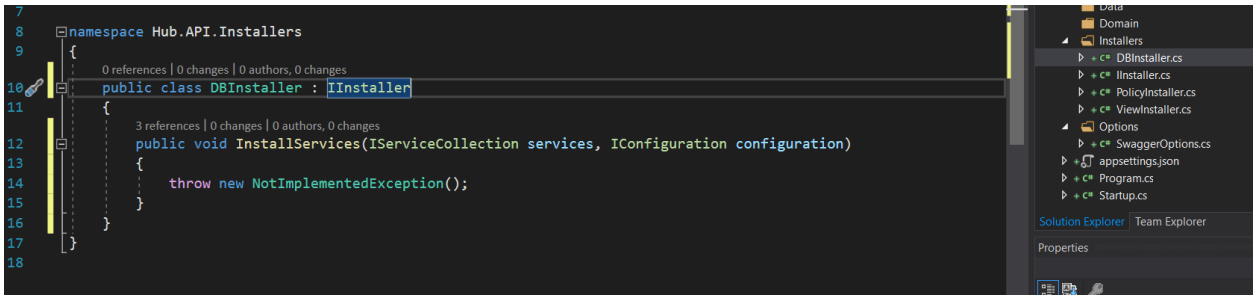


Figure 4.28 The DB Installer using for future use of DBs

Then Actually must assign all services to the main configuration by getting all in a loop shown in a figure

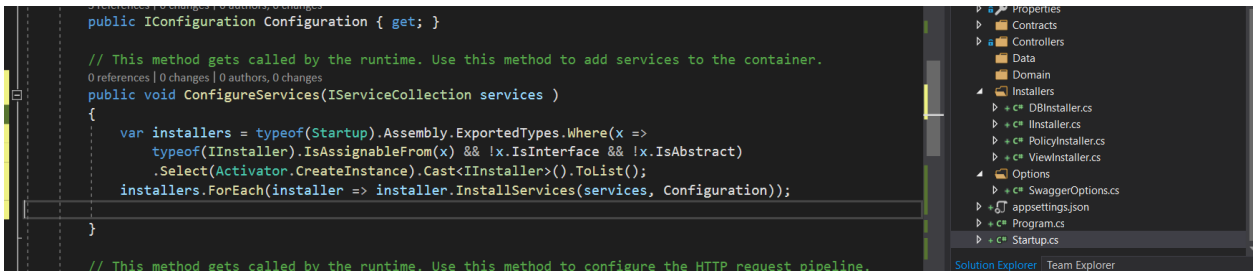


Figure 4.29 Configure all registers

4.6.2 ACHIEVE THE OCP SOLID PRINCIPLE (OPEN FOR EXTENSION CLOSED FOR MODIFICATION)

To make the installers means to the OCP in SOLID principles (Open for extension and closed for modification) a clear code must contain the extensibility for that Creating a static class (InstallerExtensions) which agree with the OCP principle by accept an extension method for atomicity of code and moving the code from the registered services in startup class to the extension one shown in figure 4.30.

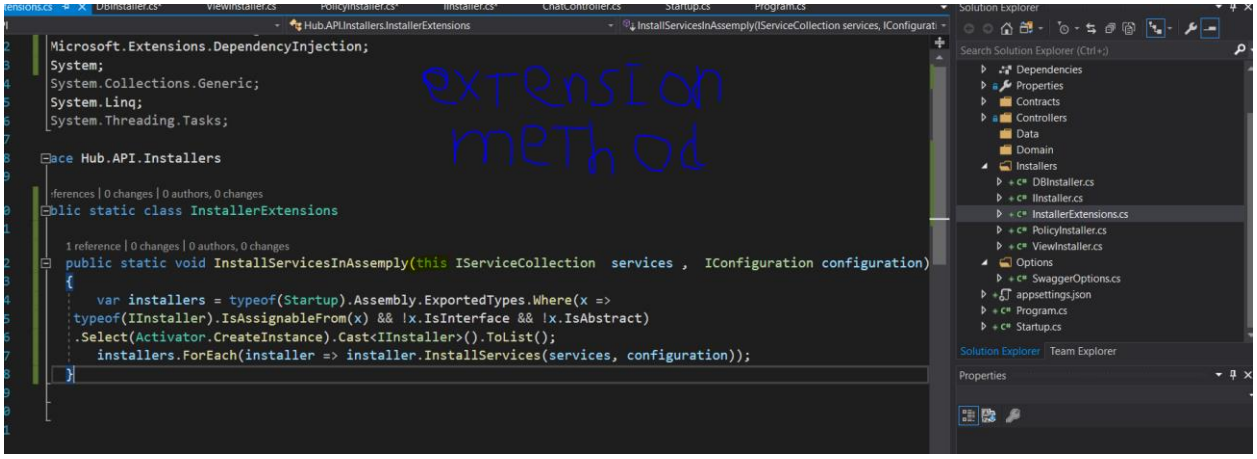


Figure 4.30Extension method to apply any service registered

Now calling the method as one of the services object method from the startup shown in the figure 4.31.

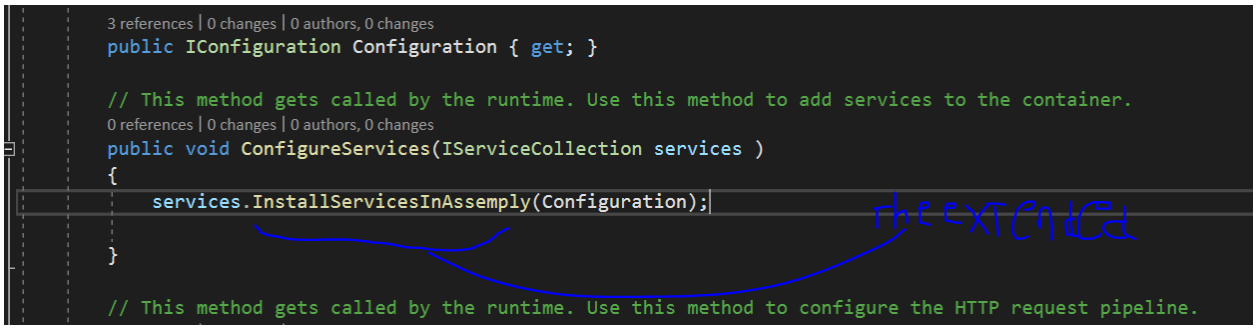


Figure 4.31Calling the extended method from services object.

4.7 NOSQL(OODB) VS SQL(RELATIONALDB) IN DESIGN (WHICH ONE DO I CHOOSE?)

Before starting the challenge between NoSQL and SQL, it must show to us easily more, because of relational DB use a DBMS that define schemes to manipulates these types and using many layer to manage the retrieve and write the data. These things make overheads that decrease the performance but it's secure enough as a paradigm to keeps our

data safe and persistent, these schemes are not found in NoSQL paradigms which means high performance and scalable as you go.

Let’s define each one and show the trends today:

4.7.1 WHAT IS SQL?

Structured Query language (SQL) **pronounced as "S-Q-L" or sometimes as "See-Quel**" is the standard language for dealing with Relational Databases. A relational database defines relationships in the form of tables.

SQL programming can be effectively used to insert, search, update, delete database records. [9]

That doesn't mean SQL cannot do things beyond that. It can do a lot of things including, but not limited to, optimizing and maintenance of databases. [9]

Relational databases like MySQL Database, Oracle, Ms SQL Server, Sybase, etc. use SQL. [9]

It’s good for an OLAP when need of more analytics than OLTP when need more transactions, and good choice when need more secure data so this project use the SQL SERVER as the DB of Identity Microservices, seems less transactions for creating account or registering and login, these are one time operation by session.

Need more info see this video, The Schema of relational Db seems like figure 4.32.

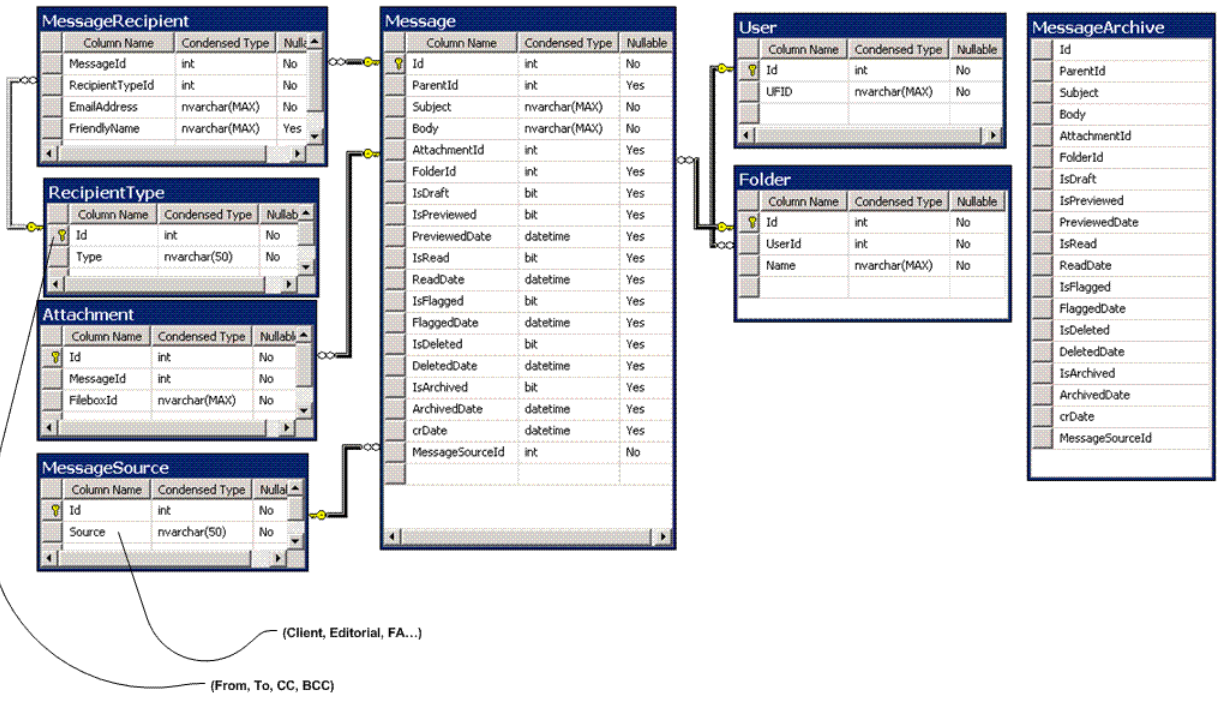


Figure 4.32 The Schema of a SQL DB

4.7.2 WHAT IS NOSQL?

NoSQL is a non-relational DMS, that does not require a fixed schema, avoids joins, and is easy to scale. NoSQL database is used for distributed data stores with humongous data storage needs. NoSQL is used for Big data and real-time web apps. For example companies like Twitter, Facebook, Google that collect terabytes of user data every single day.

NoSQL database stands for "Not Only SQL" or "Not SQL." Though a better term would NoREL NoSQL caught on. Carl Strozz introduced the NoSQL concept in 1998.

Traditional RDBMS uses SQL syntax to store and retrieve data for further insights. Instead, a NoSQL database system encompasses a wide range of database technologies that can store structured, semi-structured, unstructured and polymorphic data. [9]

So microservices is a good way to implement the 2 ways together because it uses the **single database per service design pattern** as shown as in the Architecture figure, choosing the MS SQL Server (SQL Type) for the Identity Microservices (login and register and user management) and the MongoDb for the other Microservices illustrated in the Figure 4.33.

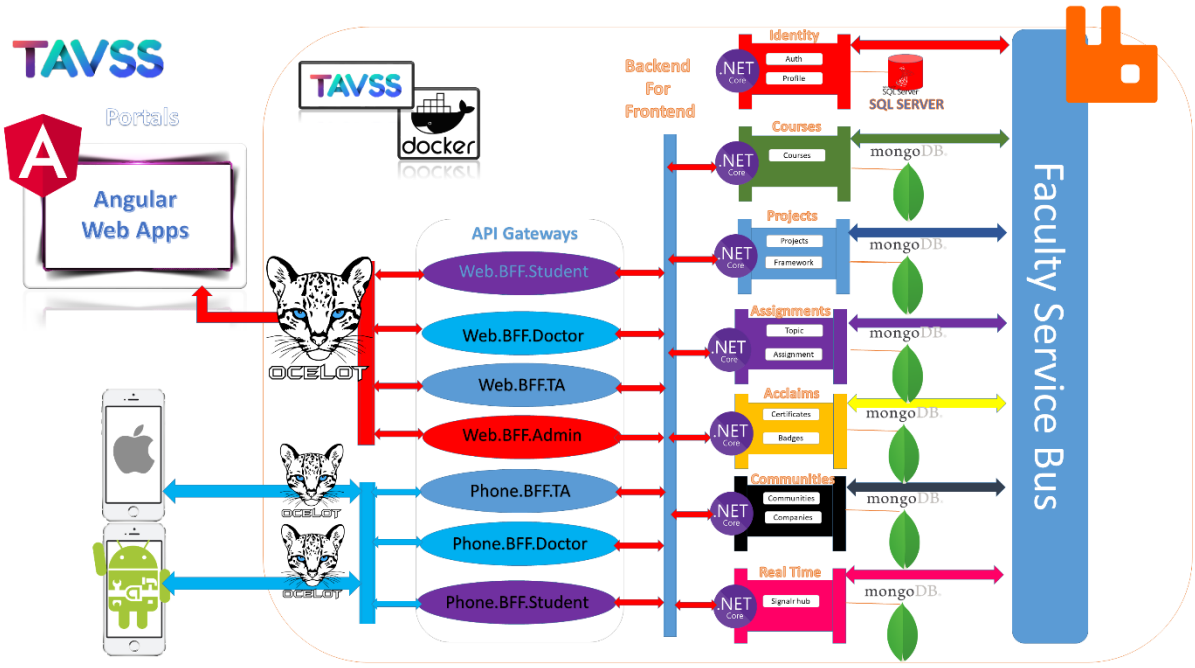


Figure 4.33 The Architecture show the Heterogeneity of using SQL/NoSQL DBs (MS SQL Server and MongoDb)

4.7.3 ACID VS BASE

Acids and Bases are one of the most important parts of chemistry, but also play their significant role in another field of science. There are many definitions which differentiate the substances as acid and base, but the most accepted are the Arrhenius theory, Bronsted-Lowry theory and the Lewis theory of acid/base. Together acids and bases react to form salts.

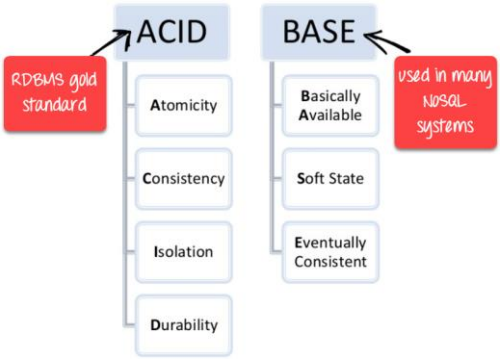


Figure 4.34 The ACID and BASE properties

But when going to the concept of databasing it's just the properties of how transactions must operate and don't violate these models, ACID is Stands for (Atomicity – Consistency – Isolation - Durability) this is RDBMS gold standard and every book or reference talking about the RDBMS must talk about it, also BASE is like that in OODBMS (object oriented DBMS) such as any NoSQL driver, BASE is stands for (Basically Available – Soft state – Eventually consistent) let's show what is meaning showing in figure

The ACID Consistency Model

Many developers are familiar with ACID transactions from working with relational databases. As such, the ACID consistency model has been the norm for some time.

The key ACID guarantee is that it provides a safe environment in which to operate on your data. The ACID acronym stands for:

Atomic

- All operations in a transaction succeed or every operation is rolled back.

Consistent

- On the completion of a transaction, the database is structurally sound.

Isolated

- Transactions do not contend with one another. Contentious access to data is moderated by the database so that transactions appear to run sequentially.

Durable

- The results of applying a transaction are permanent, even in the presence of failures.

ACID properties mean that once a transaction is complete, its data is consistent (tech lingo: write consistency) and stable on disk, which may involve multiple distinct memory locations. [10]

The BASE Consistency Model

For many domains and use cases, ACID transactions are far more pessimistic (i.e., they're more worried about data safety) than the domain actually requires.

In the NoSQL database world, ACID transactions are less fashionable as some databases have loosened the requirements for immediate consistency, data freshness and accuracy in order to gain other benefits, like scale and resilience.

(Notably, the .NET-based RavenDB has bucked the trend among aggregate stores in supporting ACID transactions.)

Here's how the BASE acronym breaks down:

Basic Availability

- The database appears to work most of the time.

Soft-state

- Stores don't have to be write-consistent, nor do different replicas have to be mutually consistent all the time.

Eventual consistency

- Stores exhibit consistency at some later point (e.g., lazily at read time).

BASE properties are much looser than ACID guarantees, but there isn't a direct one-for-one mapping between the two consistency models (a point that probably can't be overstated).

A BASE data store values availability (since that's important for scale), but it doesn't offer guaranteed consistency of replicated data at write time. Overall, the BASE consistency model provides a less strict assurance than ACID: data will be consistent in the future, either at read time or it will always be consistent, but only for certain processed past snapshots. [10]

The SQL DBs is Scalable Vertically means the performance is Decreased

The NoSQL DBs is Scalable Horizontally means the performance is constant but less restrictions over consistency.

Last thing would exist here is all have their advantages and drawbacks but the judgement is kept on eyes, you can find many ways to same goal and you can optimize them.

4.8 NOSQL MONGODB ACCEPTING IN .NET ENVIRONEMENT (OODB)

The project use MongoDb to many reasons:

- Aggregation Framework
- BSON Format
- Sharding
- Ad-hoc Query
- Capped Collection
- Indexing
- File Storage
- Replication
- MongoDB Management Service (MMS)

4.7.1 WORKING WITH MONGODB

Let's test the environment of the mongo, running from CLI or the Compass after installing it, using the web shell or open the community edition and try the commands to test by creating a collection (Channels) showing in figure 4.35.

```
MongoDB Web Shell

Click to connect
Connecting...
MongoDB shell version v4.2.0
connecting to: mongodb://127.0.0.1:27017/?
authSource=admin&compressors=disabled&gssapiServiceName=mongodb
Implicit session: session { "id" : UUID("0d712300-ebb9-42e2-9c16-9908cc3672e8") }
MongoDB server version: 4.2.0
type "help" for help
>>> db
test
>>> use examples
switched to db examples
>>> db.createCollection('Channels')
{ "ok" : 1 }
>>>
```

Full Reset Clear

Figure 4.35 Mongo Web Shell testing environments creating a collection channels

By Inserting the 2 objects and the driver reply with acknowledgement of true success and generate 2 Ids

```
>>> db.Channels.insertMany([{'Name':'Ahmed Khalil','Body':'I saw that is awesome',},
{'Name':'Dr Samir','Body':'Hi Ahmed'}])
{
    "acknowledged" : true,
    "insertedIds" : [
        ObjectId("5e2f6736a2597f141c37825c"),
        ObjectId("5e2f6736a2597f141c37825d")
    ]
}
```

Clear

Figure 4.36 Inserting 2 objects in the Channel Collection

Then retrieving again, the objects of JSON structure **pretty.**

```
>>> db.Channels.find({}).pretty()
{
    "_id" : ObjectId("5e2f6e3a2ca7f8ec8cc74ddd"),
    "Name" : "Ahmed Khalil",
    "Body" : "I Saw that is awesome"
}
{
    "_id" : ObjectId("5e2f6e3a2ca7f8ec8cc74dde"),
    "Name" : "Dr Samir",
    "Body" : "Hi Ahmed"
}
```

Reset Clear

Figure 4.37 retrieving back the objects created

4.7.2 INSTALLING THE MONGO SERVICES INTO .NET ENVIRONMENT

Now let's connect the middleware to the environment of Hub Microservice API, Installing the Middleware from nugget package manager the (Mongo.Driver, Mongo.BSON) illustrated in figure 4.38.

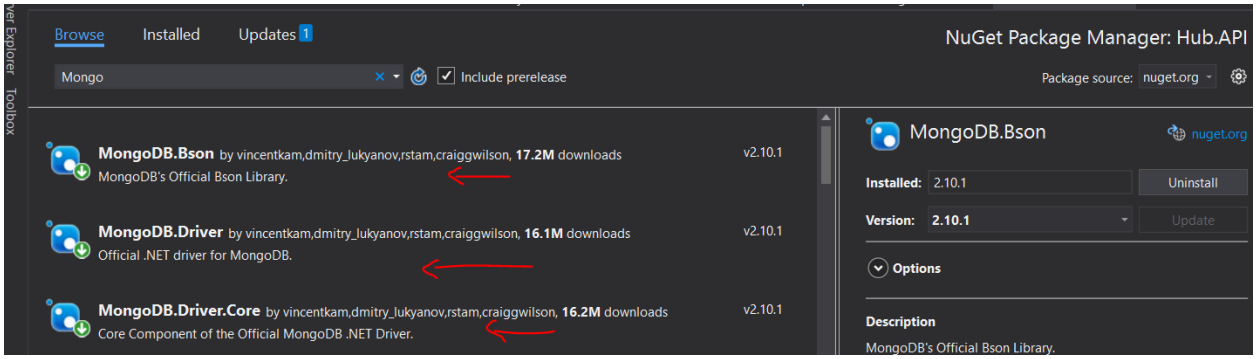


Figure 4.38Installing mongo component to .Net Environment

Then Configuring the application by defining the environment variables of database that must take in account when manipulating the mongo driver showing create of 2 collections (Channels, Notification) in 2 objects in appsettings.json file illustrated in figure 4.39.

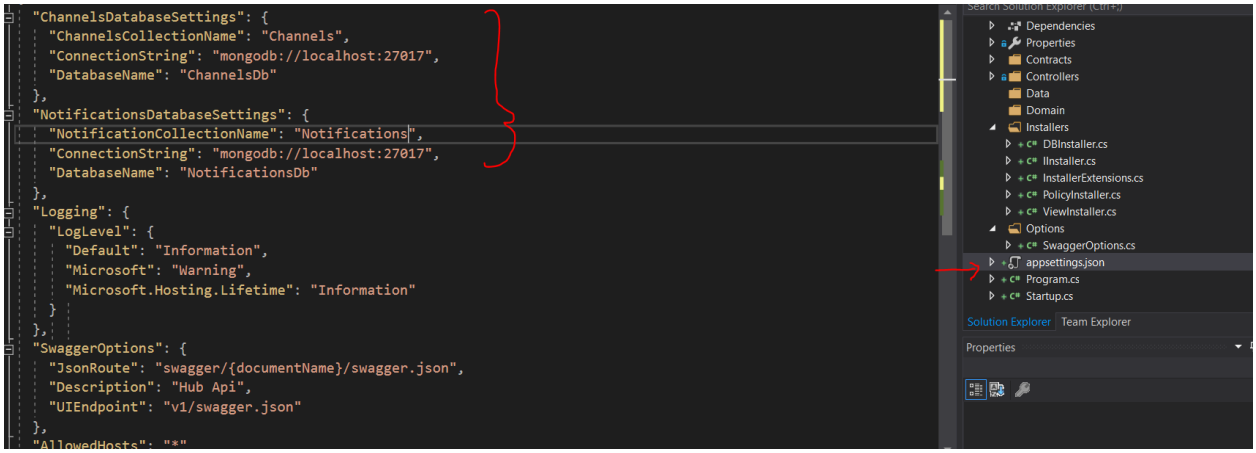


Figure 4.39 Inserting the environment variables for 2 collection of Dbs (NotificationsDb, ChannelsDb)

Then creating the configuration models for accepting these variables to middleware, The JSON and C# property names are named identically to ease the mapping process illustrated in figures 4.40, 4.41.

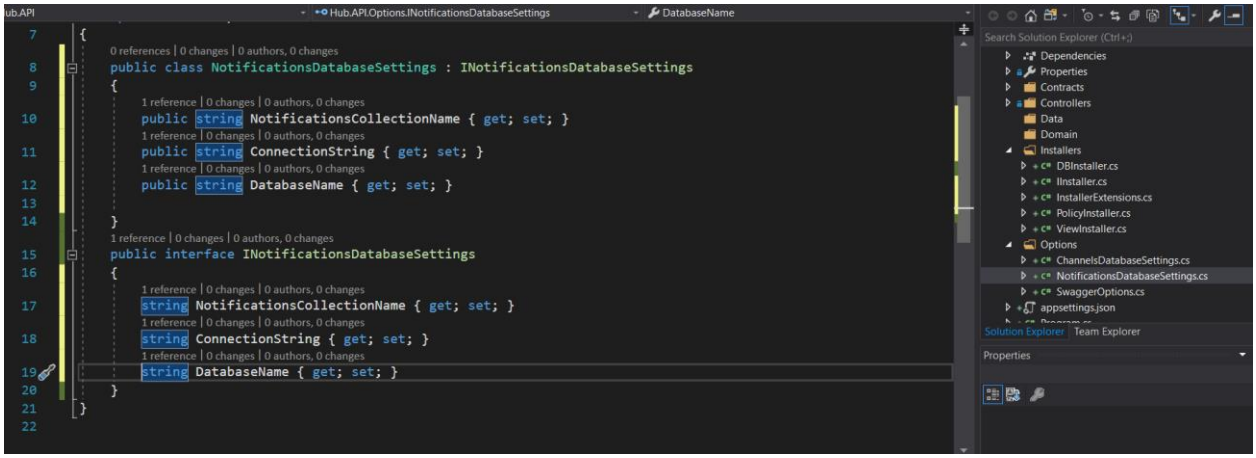


Figure 4.40Creating the Configuration model class for NotificationDb variables

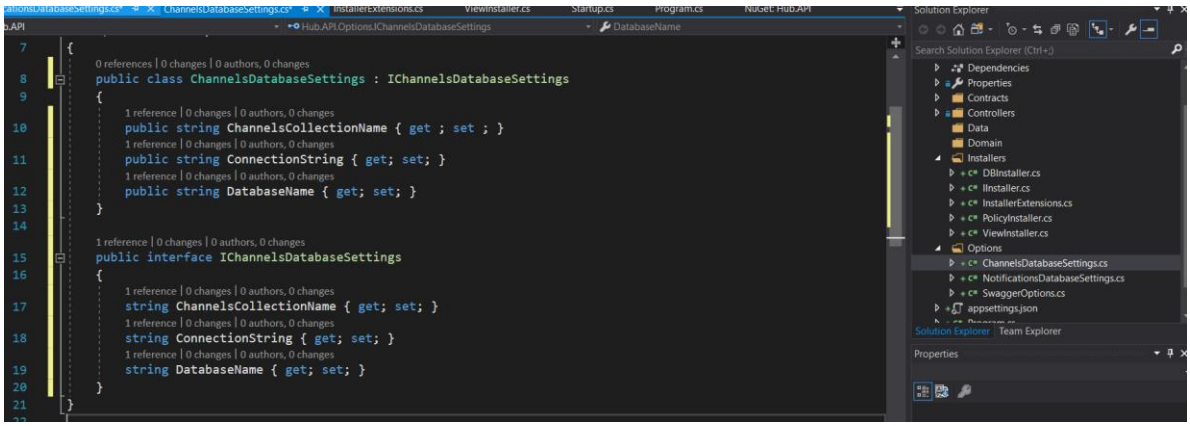


Figure 4.41 Creating the Configuration model class for ChannelsDb variables

Now registering the services to installers and map the JSON properties to its C# variables using the unused class of DBInstaller.cs then adding the singleton pattern to consume it from only one object for each database illustrated in figure 4.42.

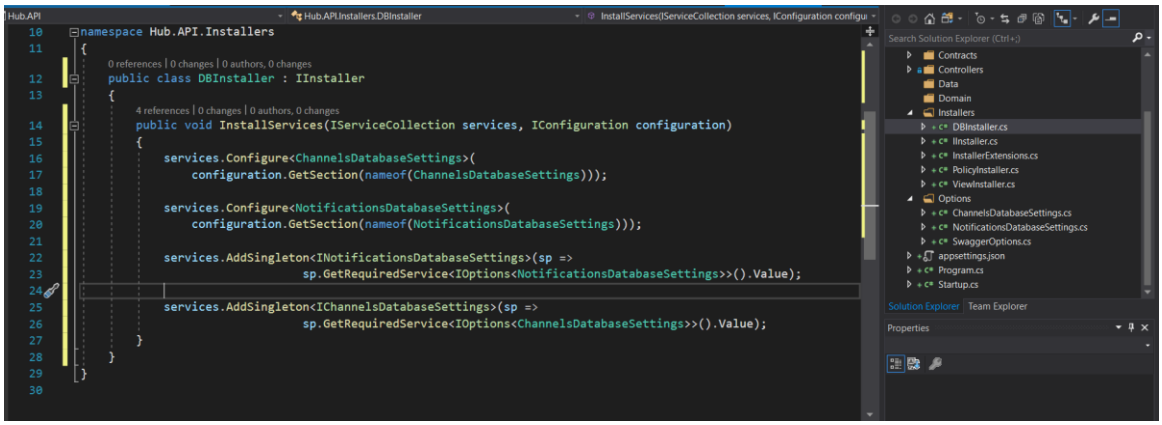


Figure 4.42 Configuring the Mapping and adding the singleton object to each database

4.7.3 ISOLATING THE BUSINESS LOGIC FROM API CONTROLLERS

The versioned controllers have complexity to control all the business logic of the application and it can contain many functionalities repeated so to keep it clean, adding dependency injection from the business logic to make it easy for controllers, then applying dependency injection to inject these services in controllers, best practice to do it shown in figures 4.43, 4.44.

Figure 4.43 Dependency injection of Business Logic Chatting service

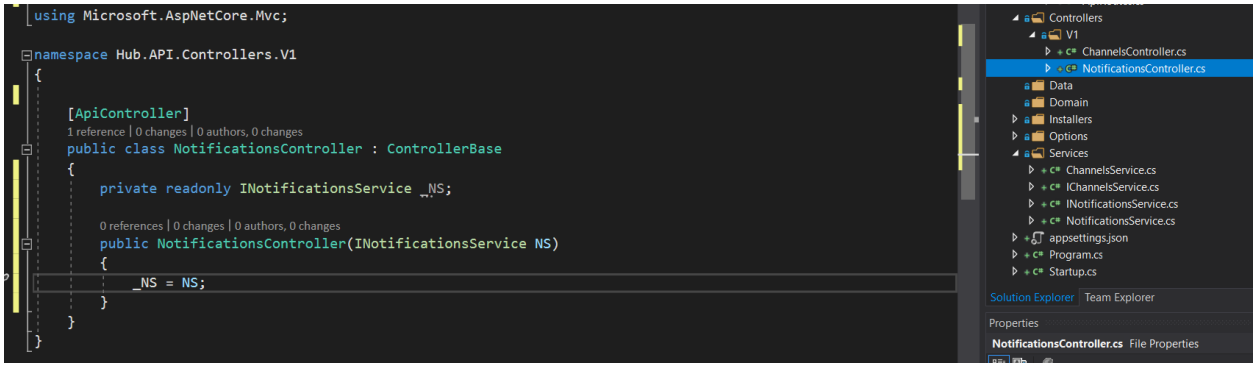


Figure 4.44 Dependency injection of Business Logic Notification service

4.7.4 CREATING BUSINESS LOGIC BY APPLYING DI OF MONGO.DRIVE MIDDILEWARE

Working as Microservices, it's must apply one of critical paradigms that measures the human being's nature for his needs, wants, it's like the user stories order server and the backend is serve, this is a design pattern called Backend for frontend design pattern (BFF design pattern) and from that making the whole business from the visions of human beings showing in figure 4.45.

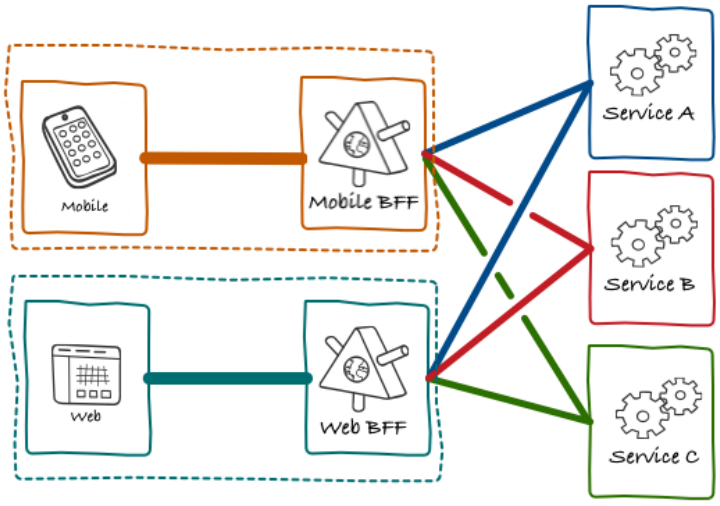


Figure 4.45 The Backend for frontend Design pattern technique

And for that, must take in account the routes back to **Contracts folder** and modifying the ApiRoutes.cs by analysis it shown that routes become such figure 4.45.

4.9 IMPLEMENT IOS APP

4.9.1 PAPERONBOARDING

is a material design UI slider. iOS UI Animation LibraryOnboarding is an important feature that helps guide your users through and familiarise them with the app. This process enables businesses to strategically communicate with their users, expressing the app's value and facilitating a positive user experience illustrated in figure 4-46.

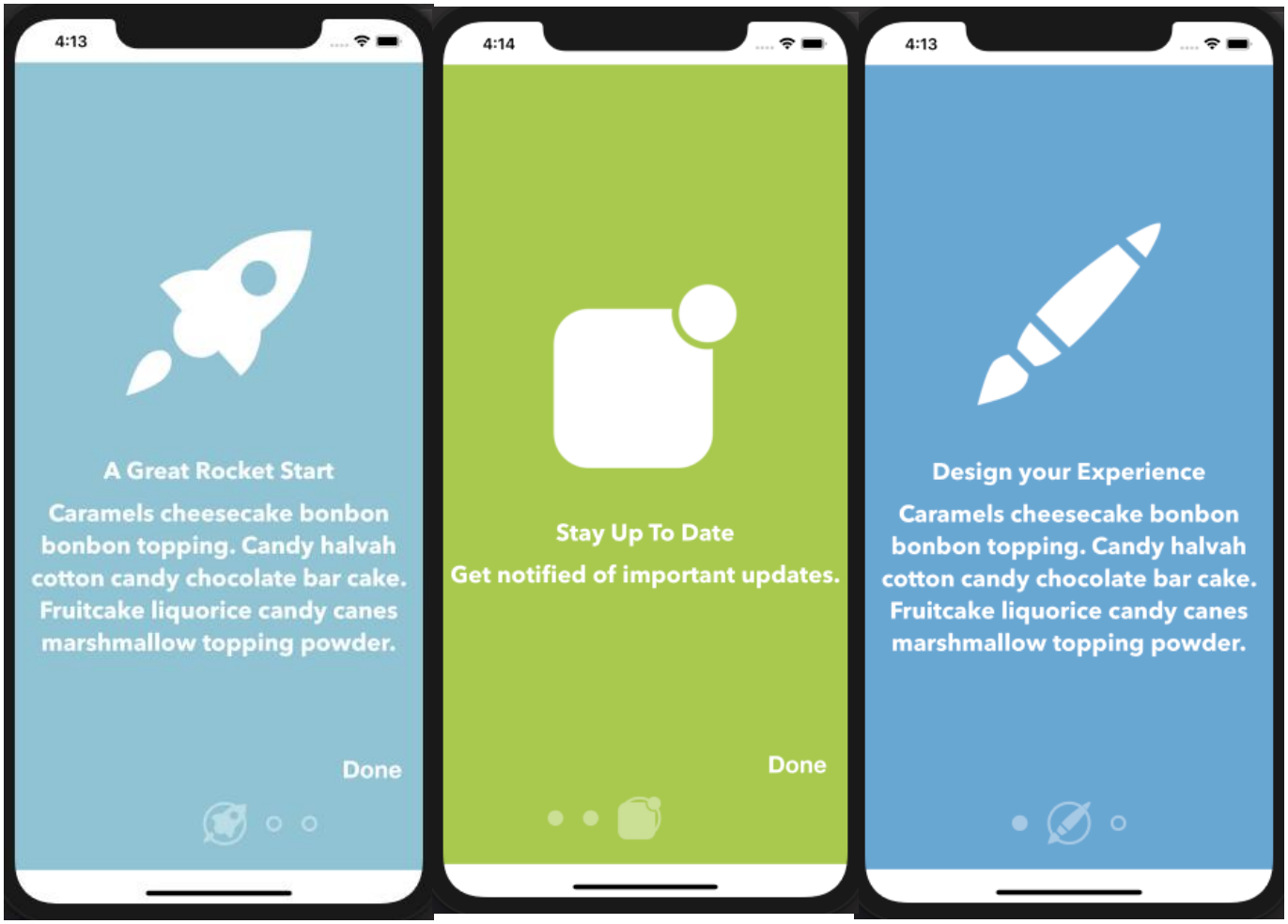


Figure 4-46 The Paper One Boarding to say a message to a user

4.9.2 AUTHENTICATION

logging in (or logging on, signing in, or signing on) is the process by which an individual gains access to a app system by identifying and authenticating themselves. The user credentials are typically some form of "username" and a matching "password", and these credentials themselves are sometimes referred to as a login (or a logon or a sign-in or a sign-on) illustrated in figure 4-47.

In practice, modern secure systems often require a second factor such as email or SMS confirmation for extra security.

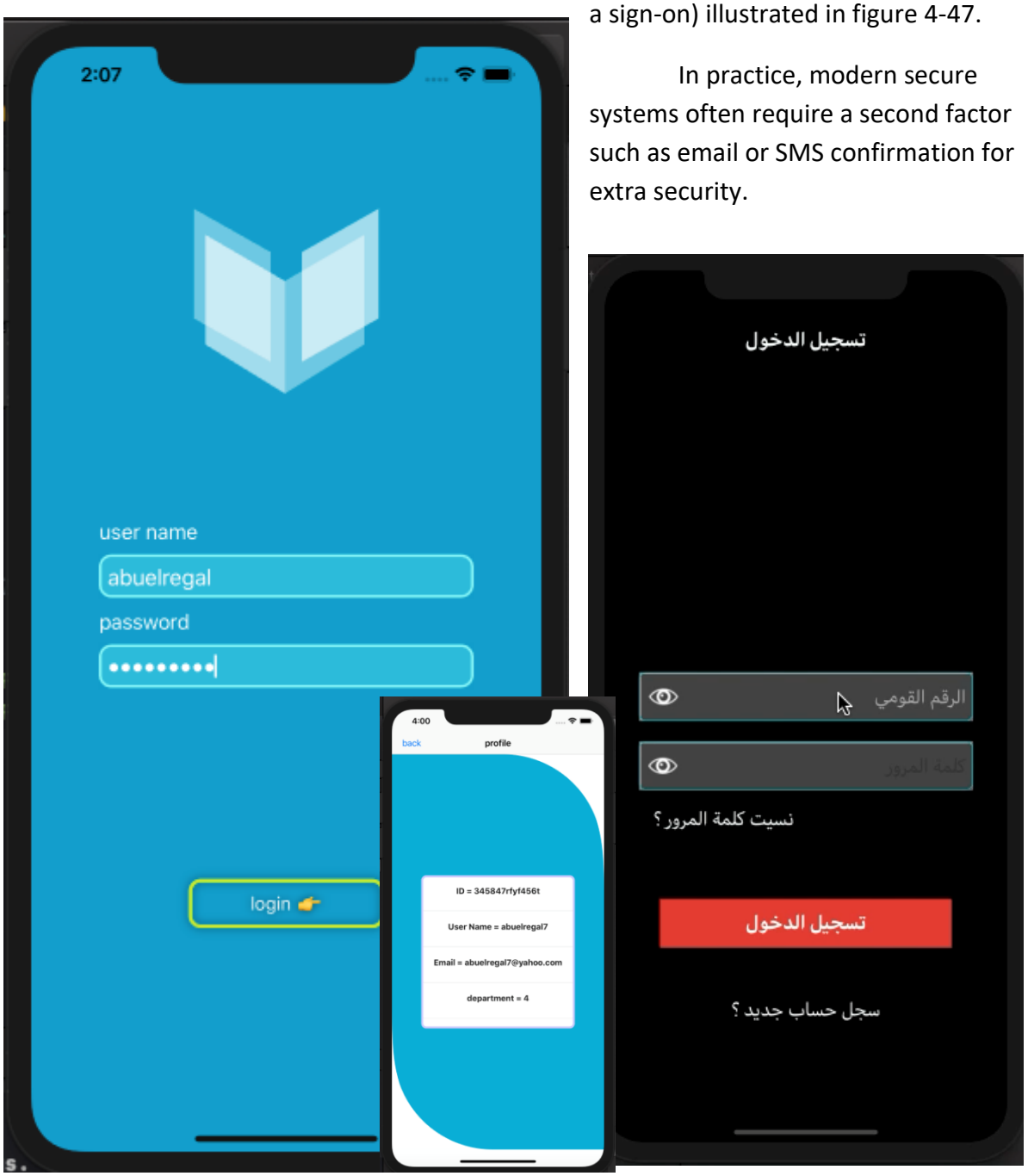


Figure 4-47 Loginning in UIs

4.9.3 THE UIS COLLECTIOS OF MOBILE APP

The collection of courses illustrated in figures 4.48,4.49,4.50

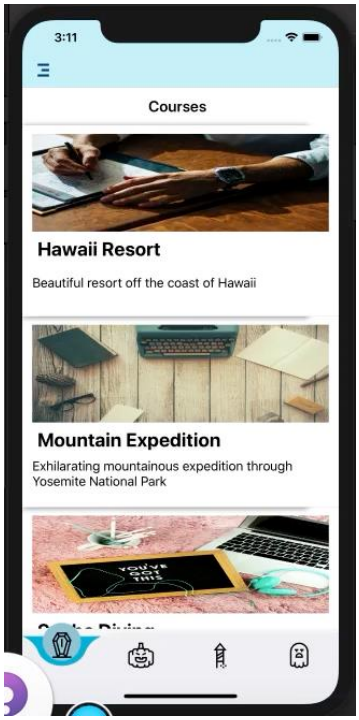


Figure 1.48

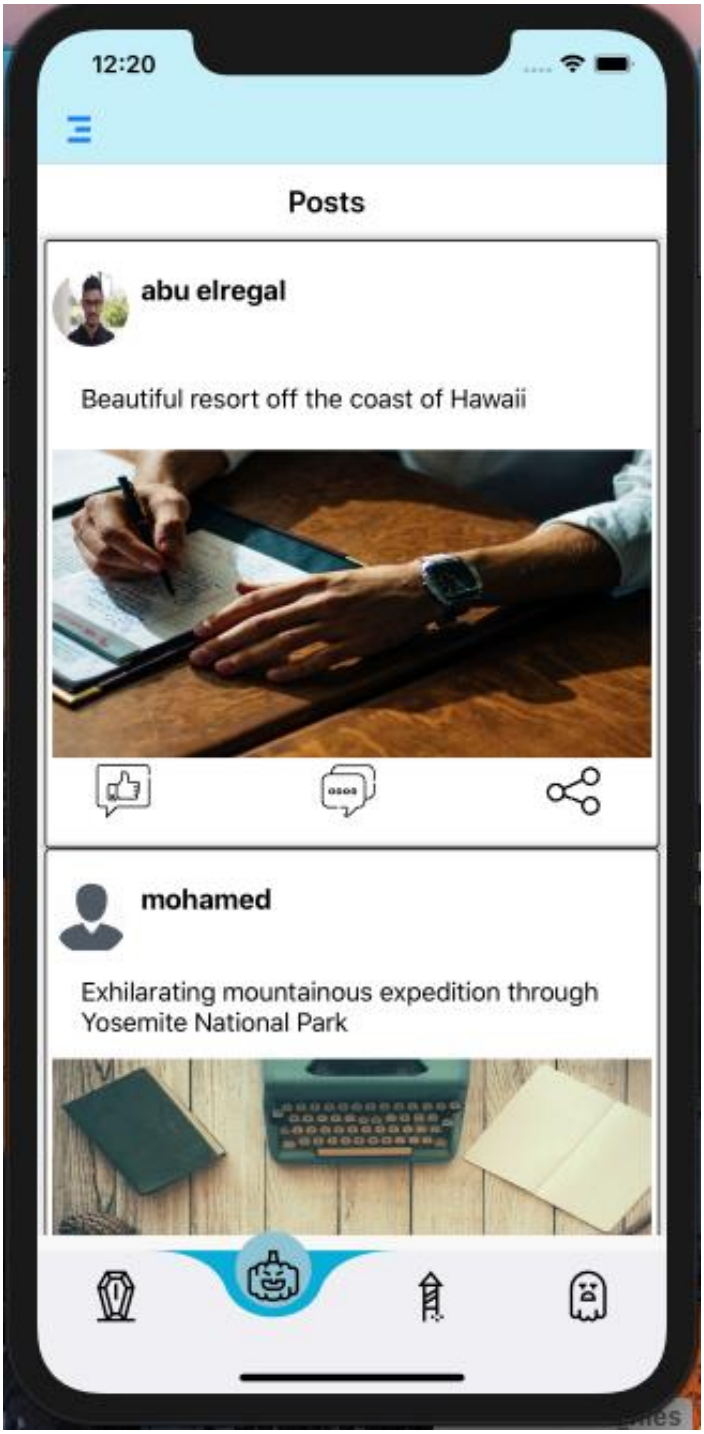


Figure 4.49

Figure 4.50

THE RESOURCES VIEWERS

The Viewers that implemented for interactive meanings illustrated in figures4.51,4.52,4.53

Figure 4.52

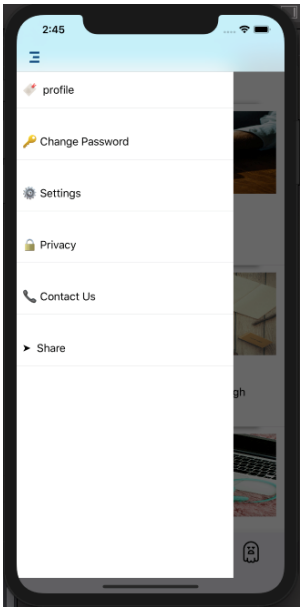


Figure 4.51

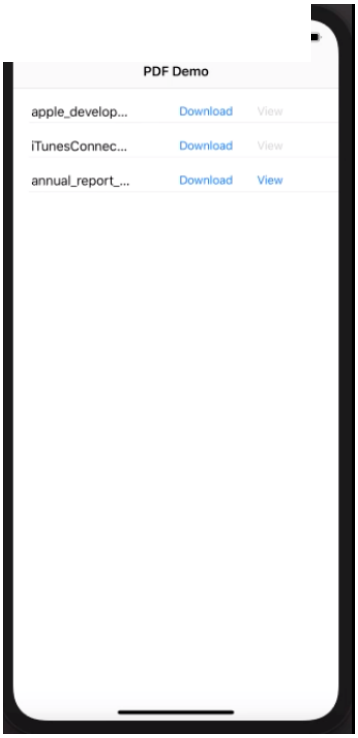


Figure 4.53

Adding The view of Realtime illustrated in the following figures 4.54,4.55,4.56

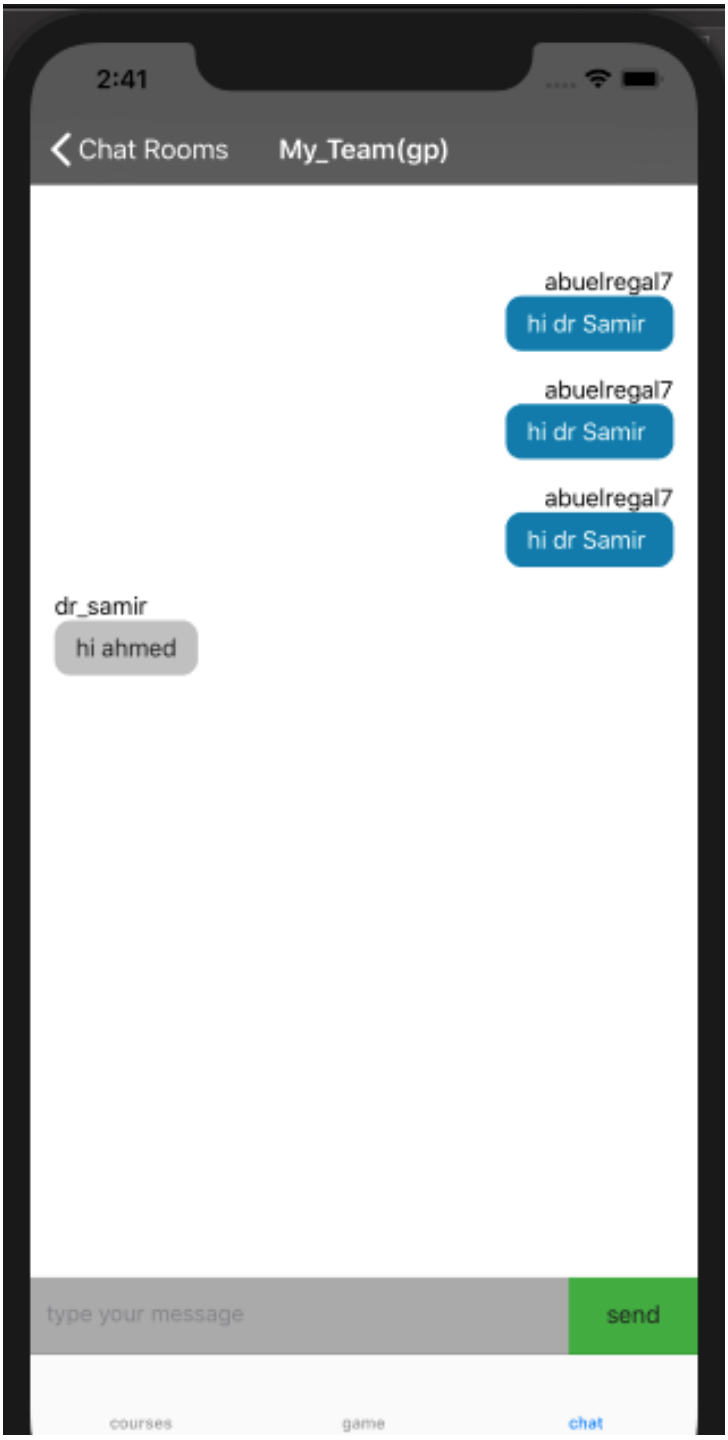


Figure 4.55

Figure 4.54

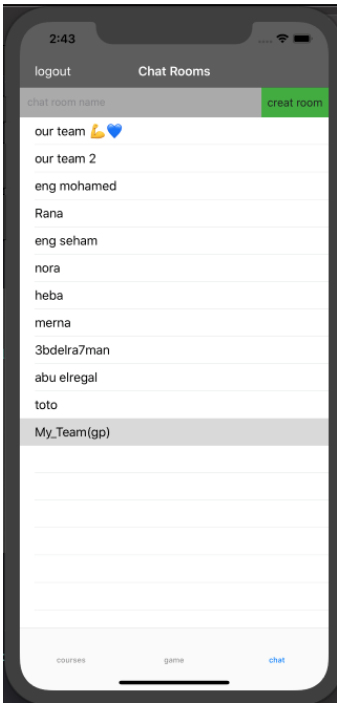


Figure 4.56

4.9.4 THE ARCHITECTURE OF IOS APP

The Architecture of Mobile IOS app built on the Data-Driven Architecture of MVC that implements the Separation of concerns between the layers, it's a simple way to develop illustrated in the figure of solution 4.57.

- Programming Language: Swift
- Patter division of Repos
    - Controller
        - Auth
        - Home
        - Menu
        - Profile
        - ChagePassword
    - View
        - Profile
    - Model
        - Helper
        - ProfileModel
        - ChangePasswordModel
        - Design
        - Config
- The Serial framework
    - Main.Storyboard

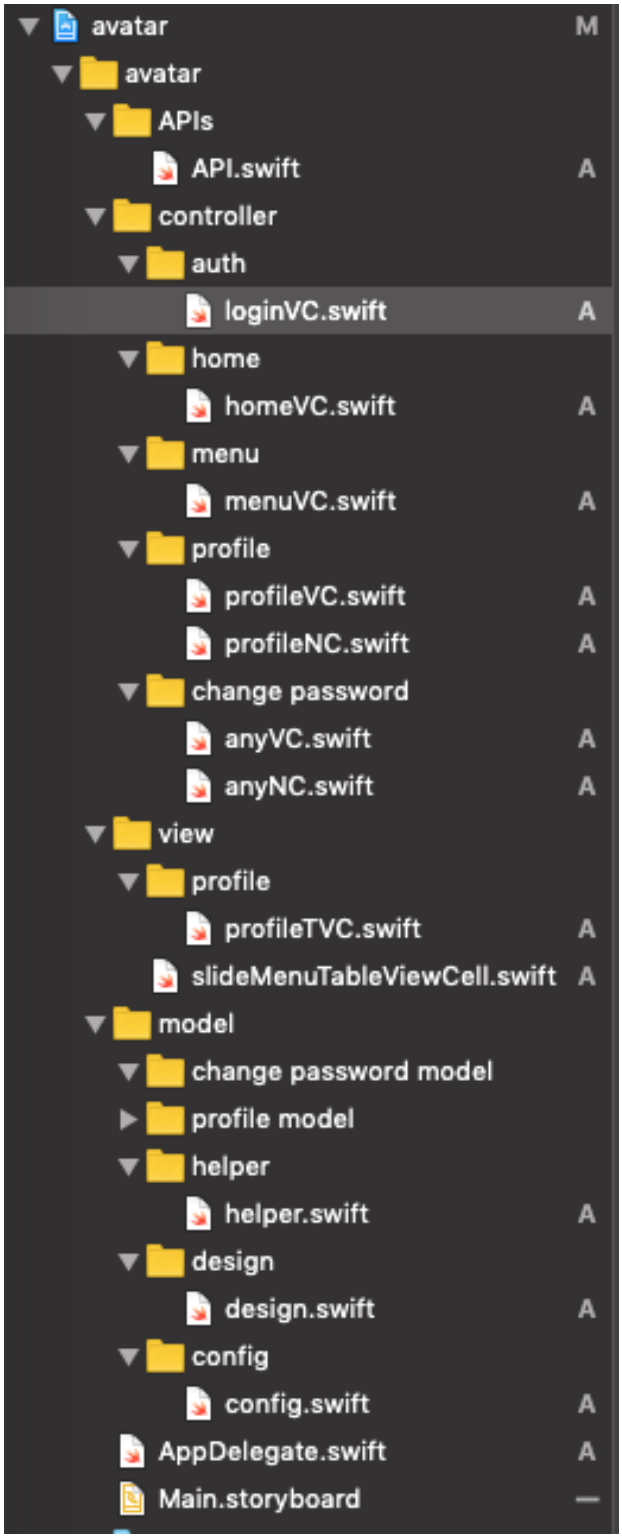


Figure 4.57The Solution Explorer of IOS app Development

4.9.5 THE SERIAL FRAMEWORK {STORYBOARD}

Storyboard is a collection of UIS that present the Whole IOS App serially illustrated in figure 4.58.

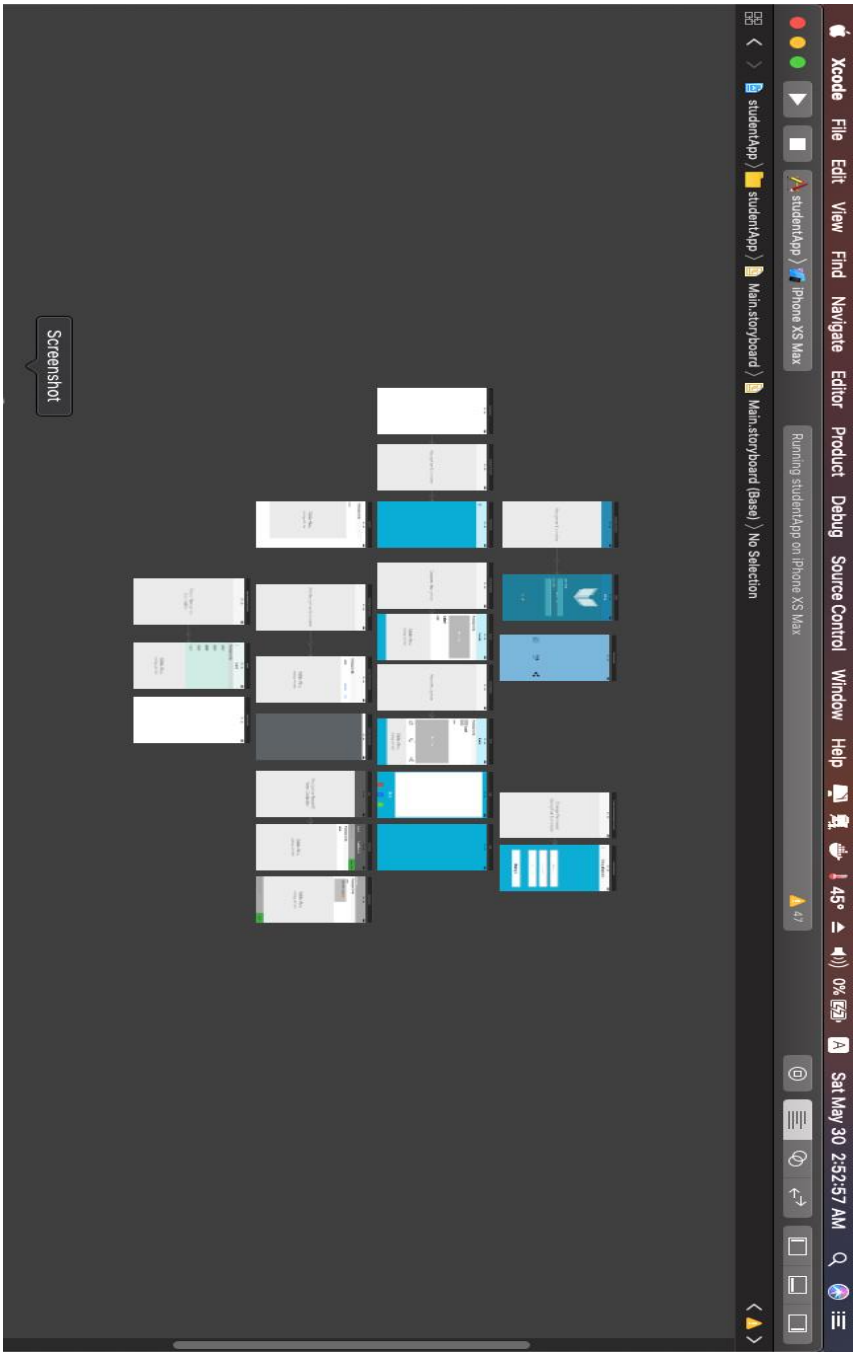


Figure 4.58StoryBoard of IOS App

4.9.6 THE LIFE CYCLE OF THE IOS APP

Life cycle of application with App delegate and define tab bar animation, app delegate object manages app's shared behaviors. The app delegate is effectively the root

object of your app, and it works in conjunction with UIApplication to manage some interactions with the system. Like the UIApplication object, UIKit creates your app delegate object early in your app's launch cycle so it is always present illustrated in figure 4.59

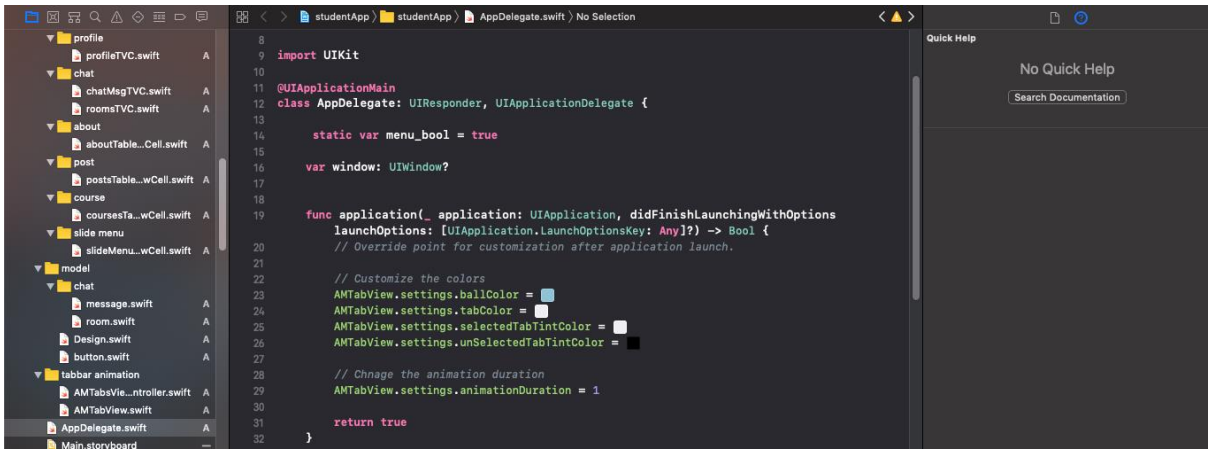


Figure 4.59

4.9.7 THE RSET CLIENT ON IOS USING ALAMOFITRE

Alamofire is a Swift-based, HTTP networking library. It provides an elegant interface on top of Apple's Foundation networking stack that simplifies common networking tasks. Its features include chainable request/response methods, JSON and Codable decoding, authentication and more, the implementation is illustrated in figure 4.60

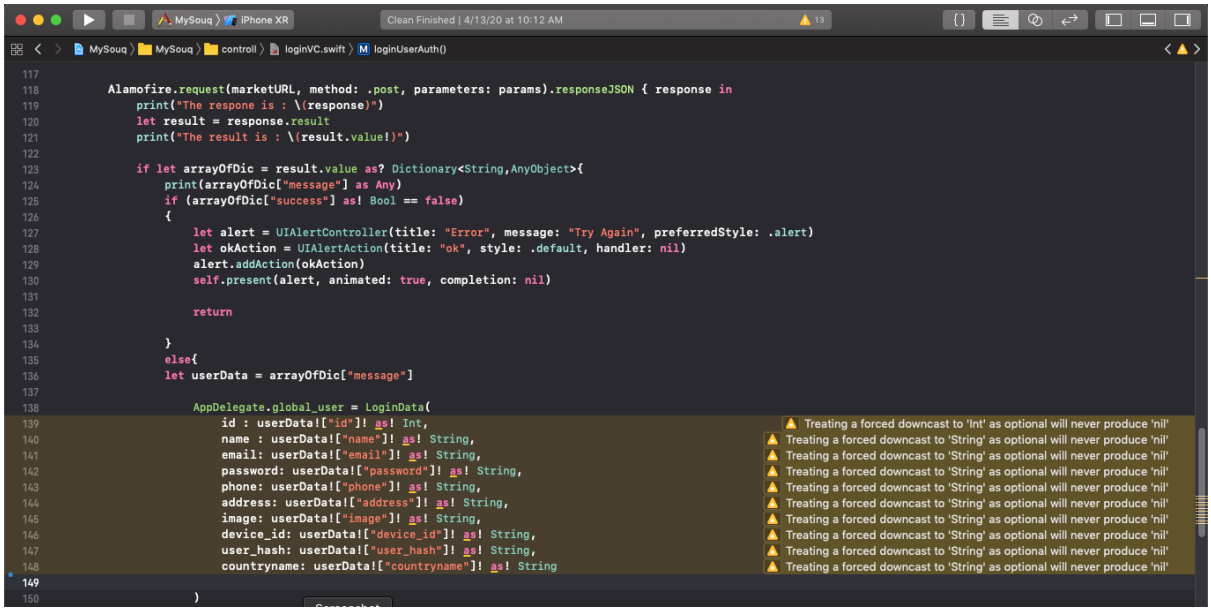


Figure 4.60

.4.9.8 VALIDATION AND MANAGING IDENTITY

a framework of policies and technologies for ensuring that the proper people in an enterprise have the appropriate access to technology resources. IdM systems fall under the overarching umbrellas of IT security and data management figured at 4.61

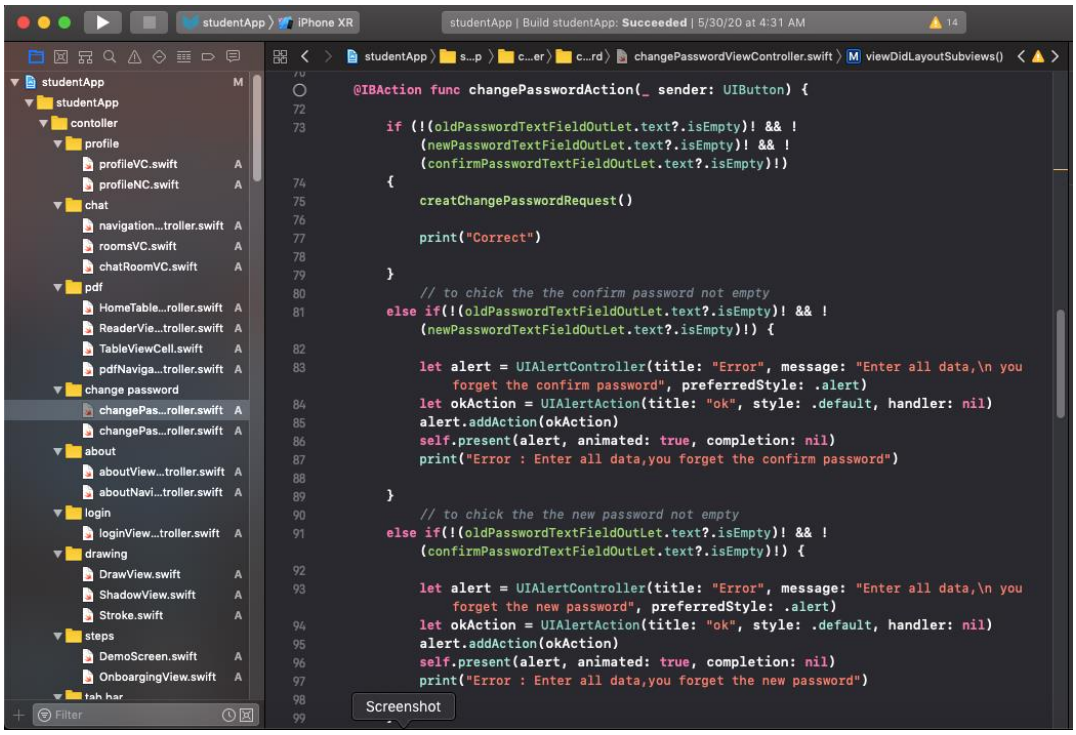


Figure 4.61

4.9.9 IMPLEMENT REALTIEM ON IOS

observer message function to load data into table view and to enter reference in database in RestAPI and to enter rooms and rooms id and message figured at 4.62

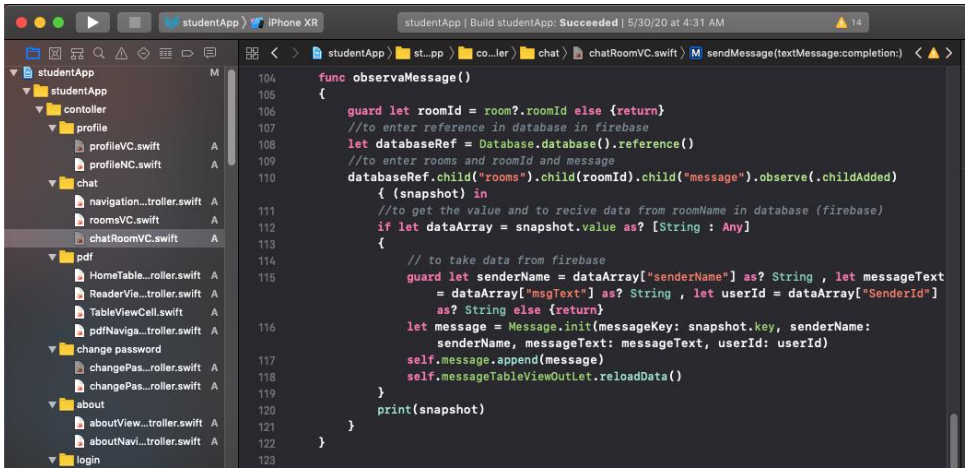


Figure 4.62

4.10 IMPLEMENT BLAZOR

4.10.1 WHAT IS BLAZOR?

Blazor is a Single Page Application development framework. The name Blazor is a combination/mutation of the words Browser and Razor (the .NET HTML view generating engine). The implication being that instead of having to execute Razor views on the server in order to present HTML to the browser, Blazor is capable of executing these views on the client.Figure 4.62

Blazor lets us build interactive web UIs using C# instead of JavaScript. Blazor apps are composed of reusable web UI components implemented using C#, HTML, and CSS. Both client and server code is written in C#, allowing you to share code and libraries.

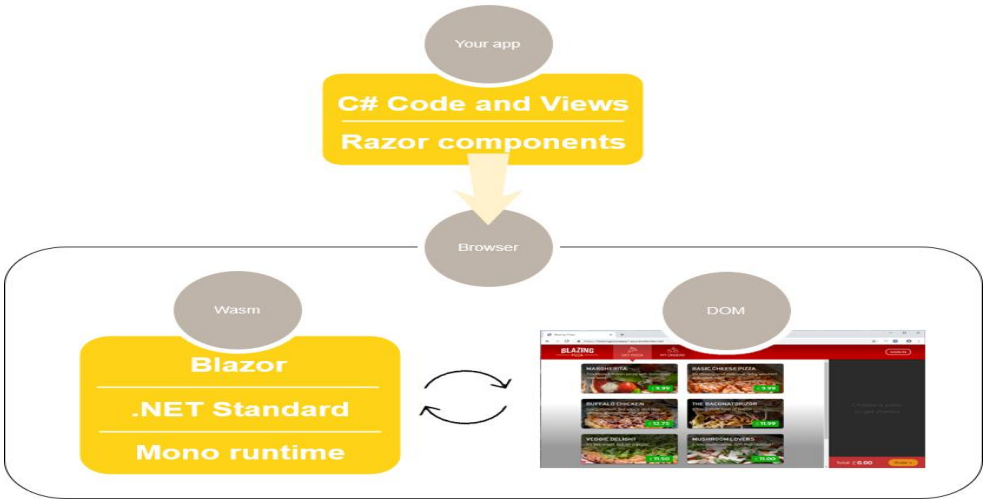


Figure 4.62

4.10.2 BLAZOR IS OPEN-SOURCE

Blazor source code is available on github. The source code is owned by The .NET Foundation.

4.10.3 BUILT ON OPEN WEB STANDARDS

Blazor uses open web standards without plugins or code transpilation. Blazor works in all modern web browsers, including mobile browsers.

Code running in the browser executes in the same security sandbox as JavaScript frameworks. Blazor code executing on the server has the flexibility to do anything you would normally do on the server, such as connecting directly to a database.

4.10.4 BLAZOR RUN ON WEBASSEMBLY

Single-page apps that are downloaded to the client's web browser before running. The size of the download is larger than for Blazor Server, depends on the app, and the processing is entirely done on the client hardware. However, this app type enjoys rapid response time. As its name suggests, this client-side framework is written in WebAssembly, as opposed to JavaScript.

Blazor can run your client-side C# code directly in the browser, using WebAssembly. Because it's real .NET running on WebAssembly, you can re-use code and libraries from server-side parts of your application.Figure 4.63

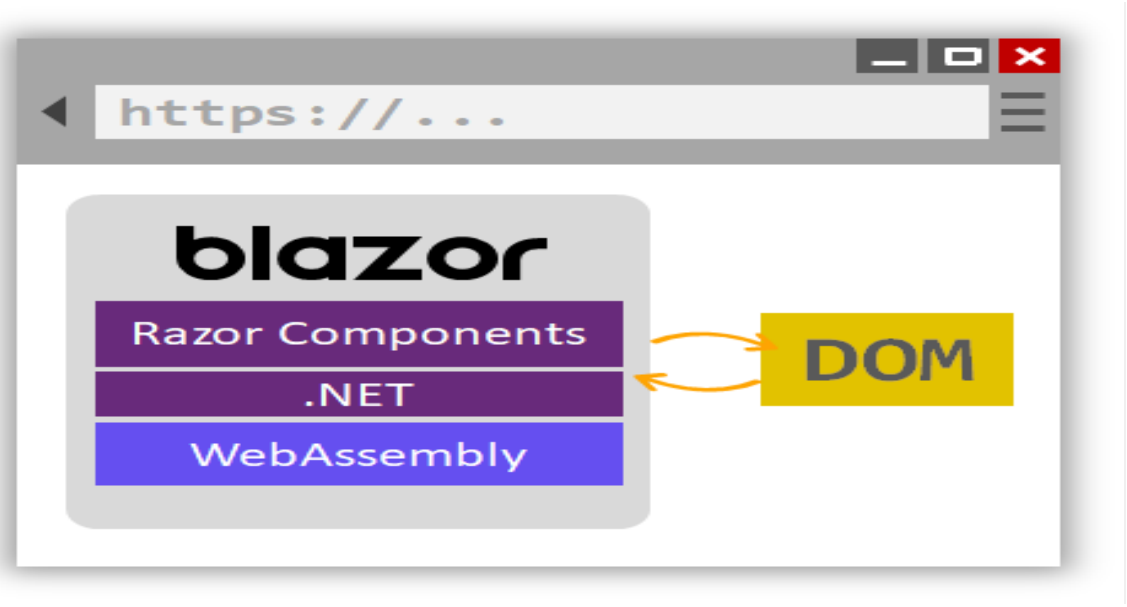


Figure 4.63

4.10.5 BLAZOR RUN ON SERVER

Blazor apps are hosted on an ASP.NET Core server in ASP.NET Razor format. Remote clients act as a thin clients, meaning that the bulk of the processing load is on the server. The client's web browser downloads a small page and updates its UI over a SignalR connection.

Blazor can run your client logic on the server. Client UI events are sent back to the server using SignalR - a real-time messaging framework. Once execution completes, the required UI changes are sent to the client and merged into the DOM.Figure 4.64

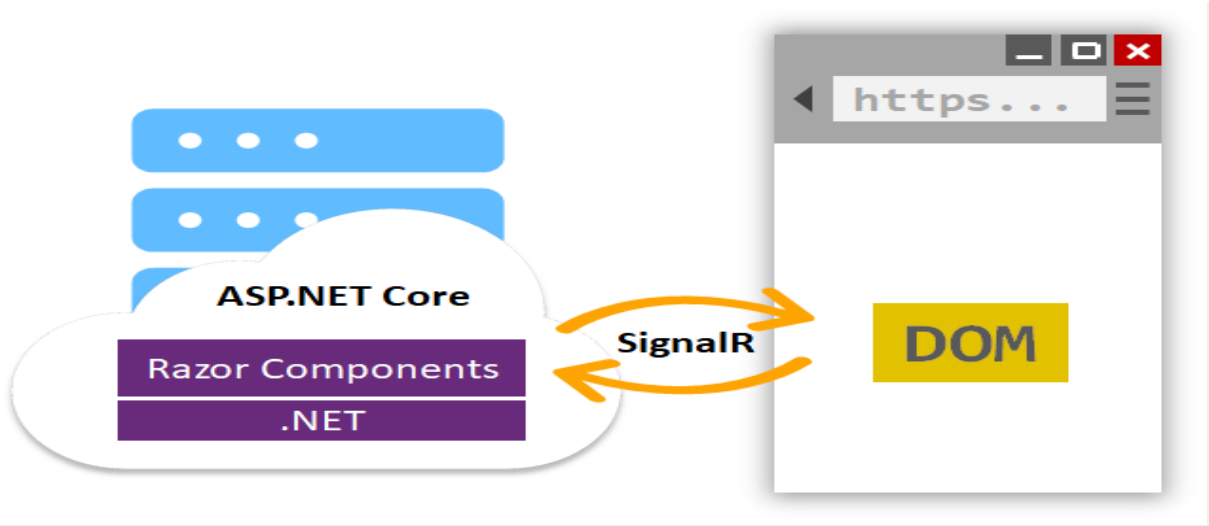


Figure 4.64

4.10.6 PROGRAM CLASS

Program class contain the main method that is the entry point for the whole application inside main method the host is built by calling CreateHostBuilder method after that CreateHostBuilder configure the webhost by using Start class.Figure 4.65

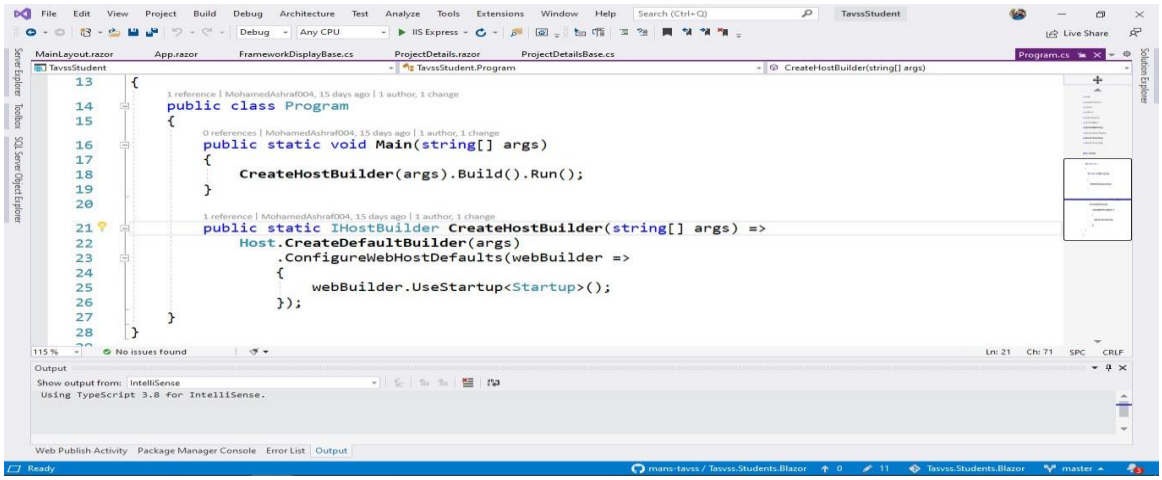


Figure 4.65

4.10.7 STARTUP CLASS

Startup class contains two methods ConfigureServices and Configure.

ConfigureServices: inside it done injecting httpclient to call the api by using

services.AddHttpClient<>()

Configure: inside it done excuting pipelines and calling endpoints to call BlazorHub and calling _Host.cshtml by MapFallbackToPage("/_Host") to render components.Figure 4.66

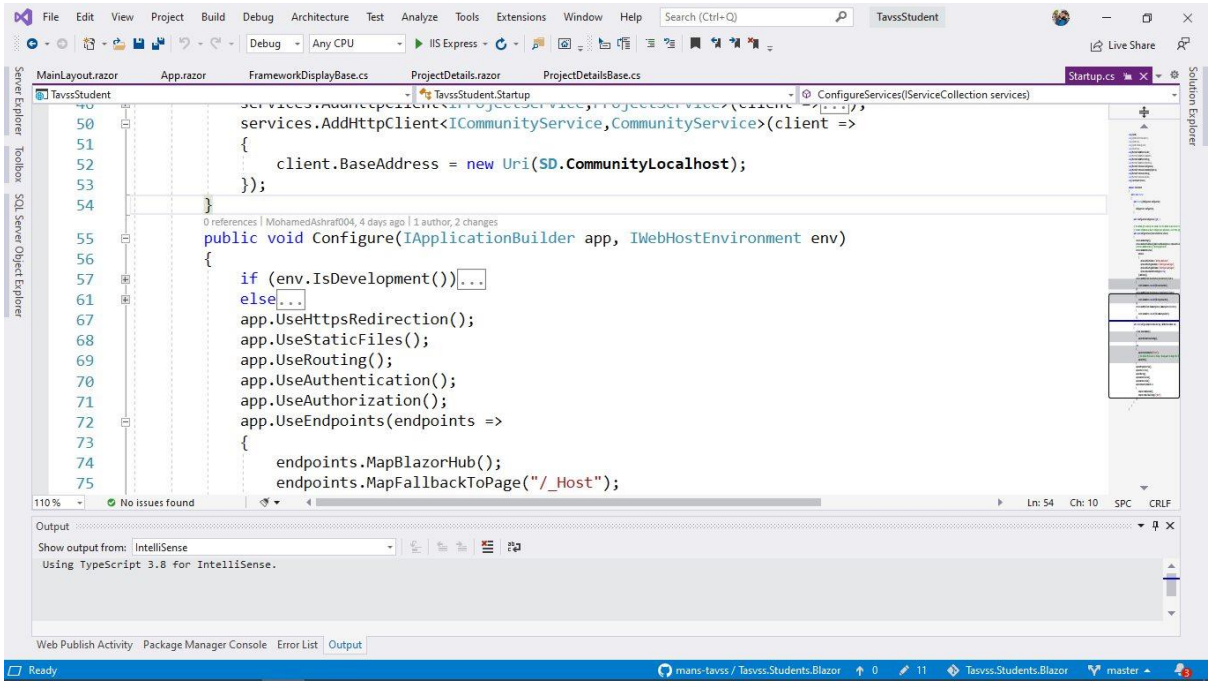


Figure 4.66

4.10.8 HOST PAGE

The _Host page inside it is done calling css , javascript , render components by using tag component and render-mode then calling app.razor component by type attribute.

Figure 4.67

Student Application has used blazor server with signalR Connection to browser.

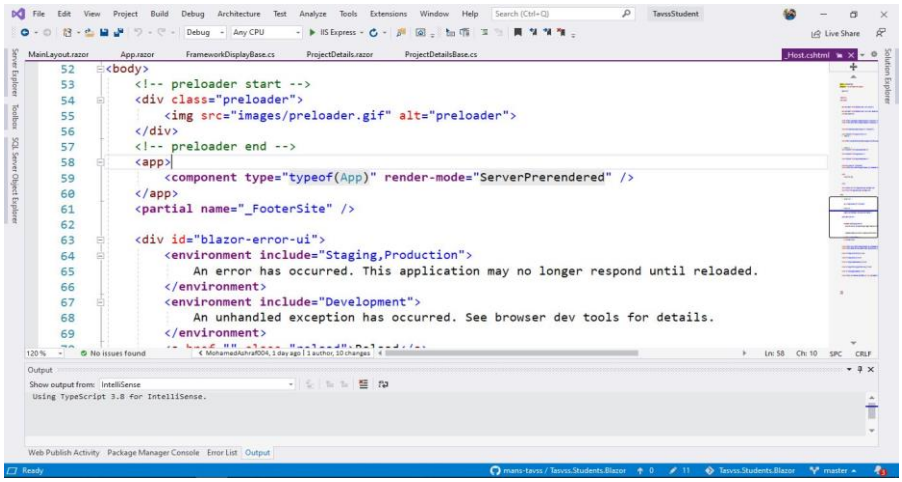


Figure 4.67

4.10.9 APP.RAZOR COMPONENT

App component setup the router using Found and NotFound attribute and setup authentication by CascadingAuthenticationState , AuthorizeRouteView tags and assigning DefaultLayout for the application.Figure 4.68

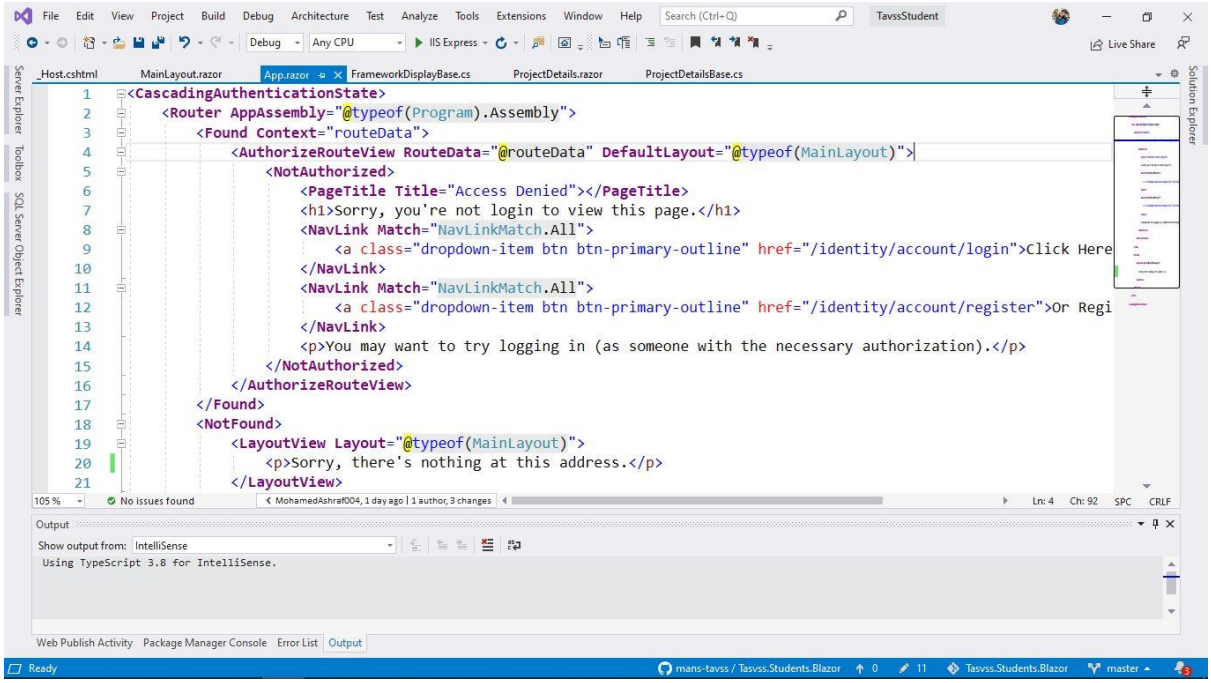


Figure 4.68

4.10.10 MAIN LAYOUT

Main layout Contains NavMenu component that render navbar and Body property that render the components inside the whole application.Figure 4.69

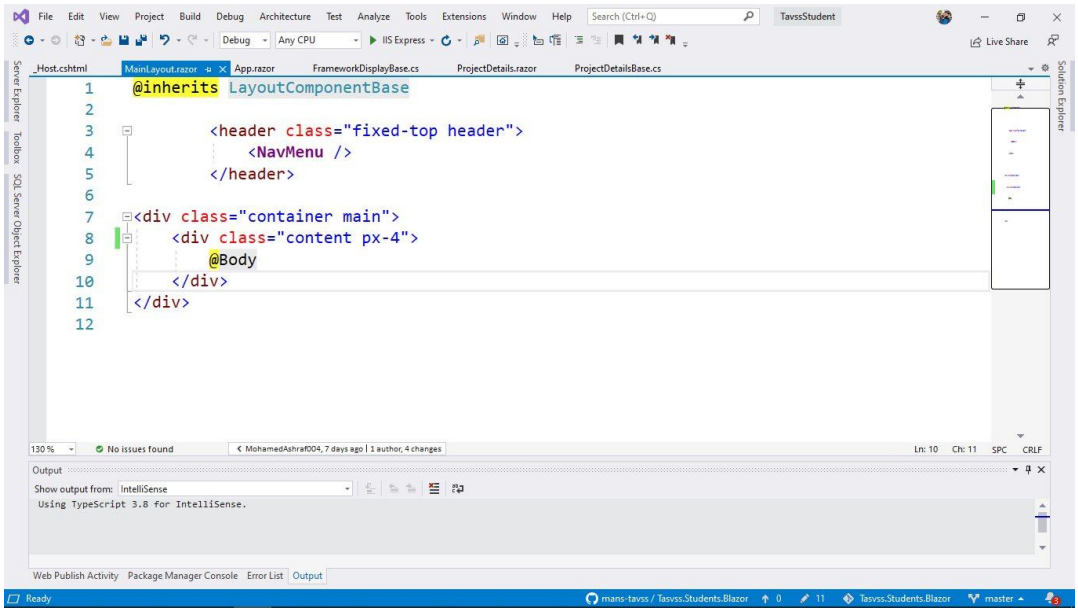


Figure 4.69

4.10.11 REPOSITORY SERVICES

Repository service is a design pattern used in blazor to sperate calling the api from the server by injecting httpclient in the constructor of the service. to convert data from and to json format Microsoft.AspNetCore.Blazor.HttpClient has used.Figure 4.70

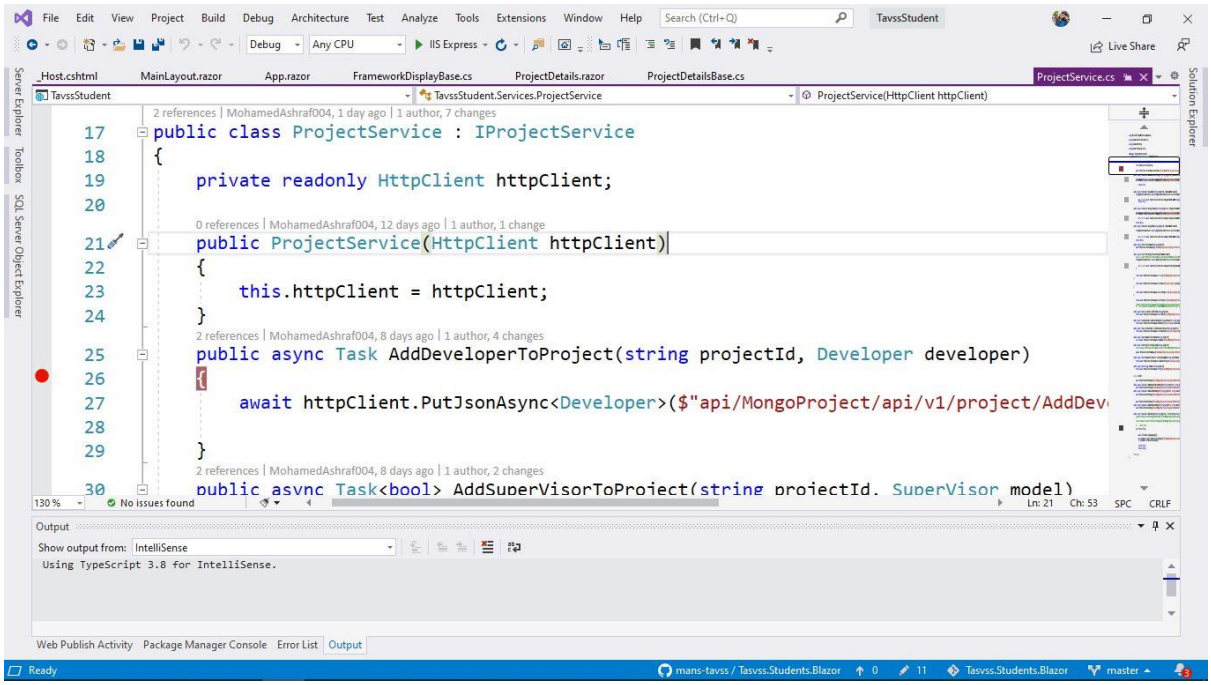


Figure 4.70

4.10.12 COMPONENTS CLASSES IN BLAZOR

Components are implemented in Razor component files (.razor) using a combination of C# and HTML markup. A component in Blazor is formally referred to as a Razor component.

The UI for a component is defined using HTML. Dynamic rendering logic (for example, loops, conditionals, expressions) is added using an embedded C# syntax called Razor. When an app is compiled, the HTML markup and C# rendering logic are converted into a component class. The name of the generated class matches the name of the file. Members of the component class are defined in an @code block. In the @code block, component state (properties, fields) is specified with methods for event handling or for defining other component logic. More than one @code block is permissible. Component members can be used as part of the component's rendering logic using C# expressions that start with @.

After the component is initially rendered, the component regenerates its render tree in response to events. Blazor then compares the new render tree against the previous one and applies any modifications to the browser's Document Object Model (DOM).

Components are ordinary C# classes and can be placed anywhere within a project. Components that produce webpages usually reside in the Pages folder. Non-page components are frequently placed in the Shared folder or a custom folder added to the project as figure 4.71 and figure 4.72explain.

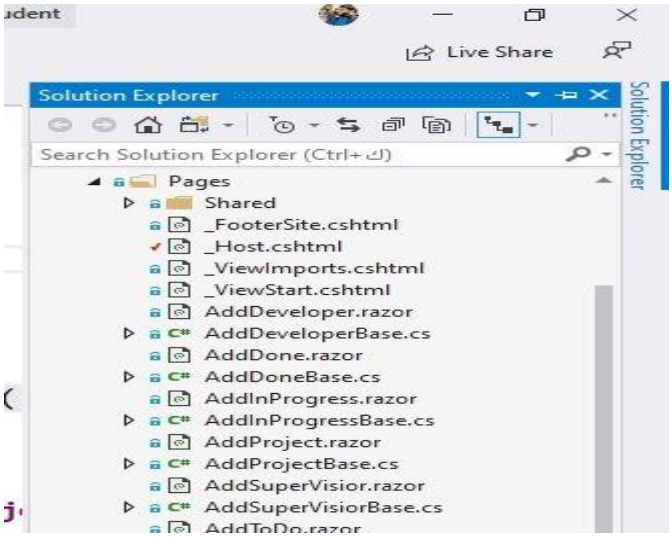


Figure 4.71

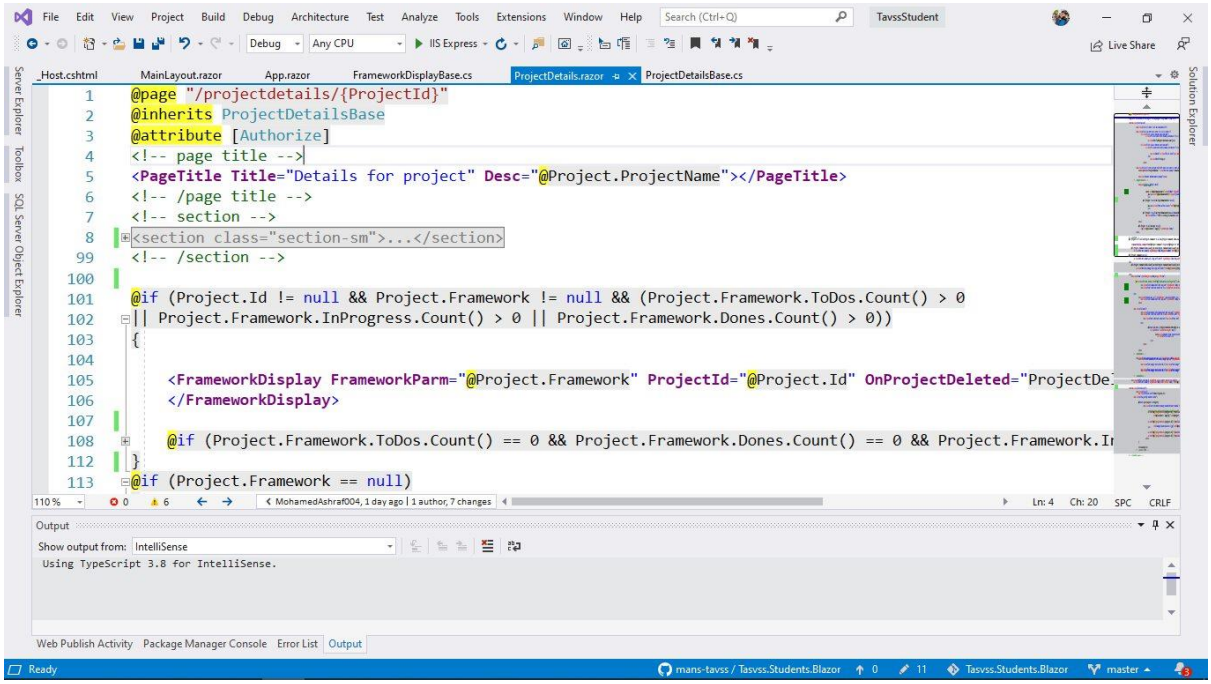


Figure 4.72

4.10.13 BLAZOR LIFECYCLE

The Blazor framework includes synchronous and asynchronous lifecycle methods. Override lifecycle methods to perform additional operations on components during component initialization and rendering. Lifecycle methods Component initialization methods OnInitializedAsync and OnInitialized are invoked when the component is initialized after having received its initial parameters from its parent component. Use OnInitializedAsync when the component performs an asynchronous operation and should refresh when the operation is completed.Comoponets are using IHttpClientFactory to inject services to connect to apis.Figure 4.73

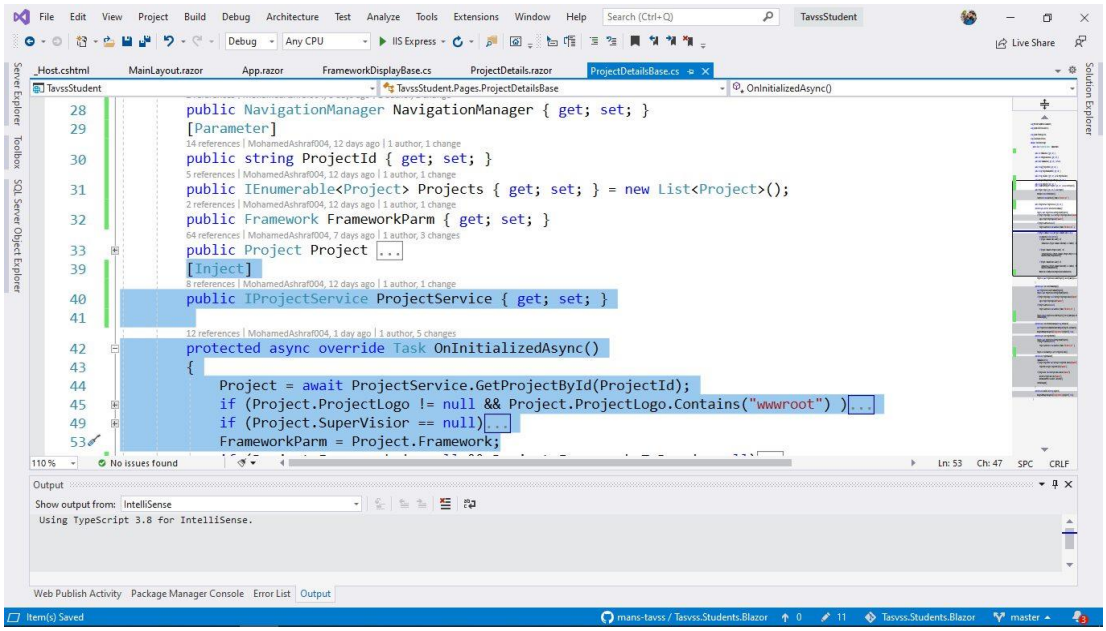


Figure 4.73

4.10.14 PROS AND CONS OF BLAZOR

➔Pros of server-side Blazor

Is fully compatible with any .NET libraries and .NET tooling

Uses exactly the same syntax as the client-side Blazor

3. Small size of client-side components

4. Works with thin clients

➔ Cons of server-side Blazor

1. Does not have performance benefits of the client-side version

2. .NET server is required

3. Reduced scalability

4.10.15 RESULTS

(Figure 4.74) explain part of community page.

(Figure 4.75) explain part of project page.

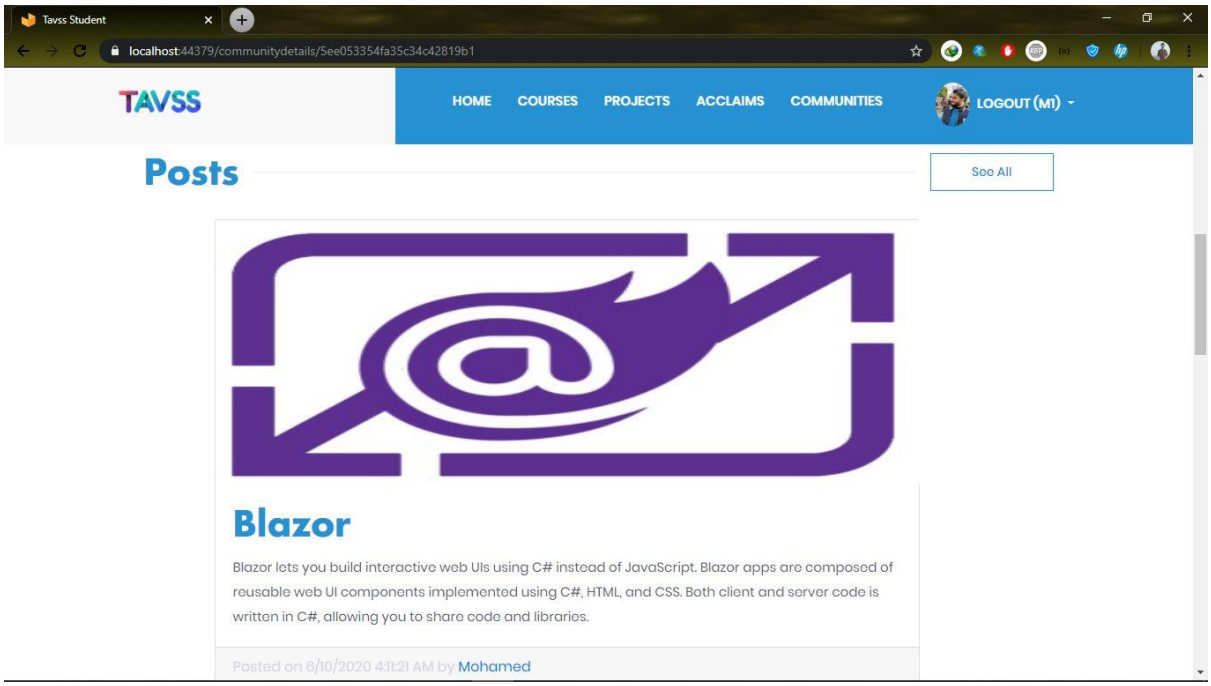


Figure 4.74

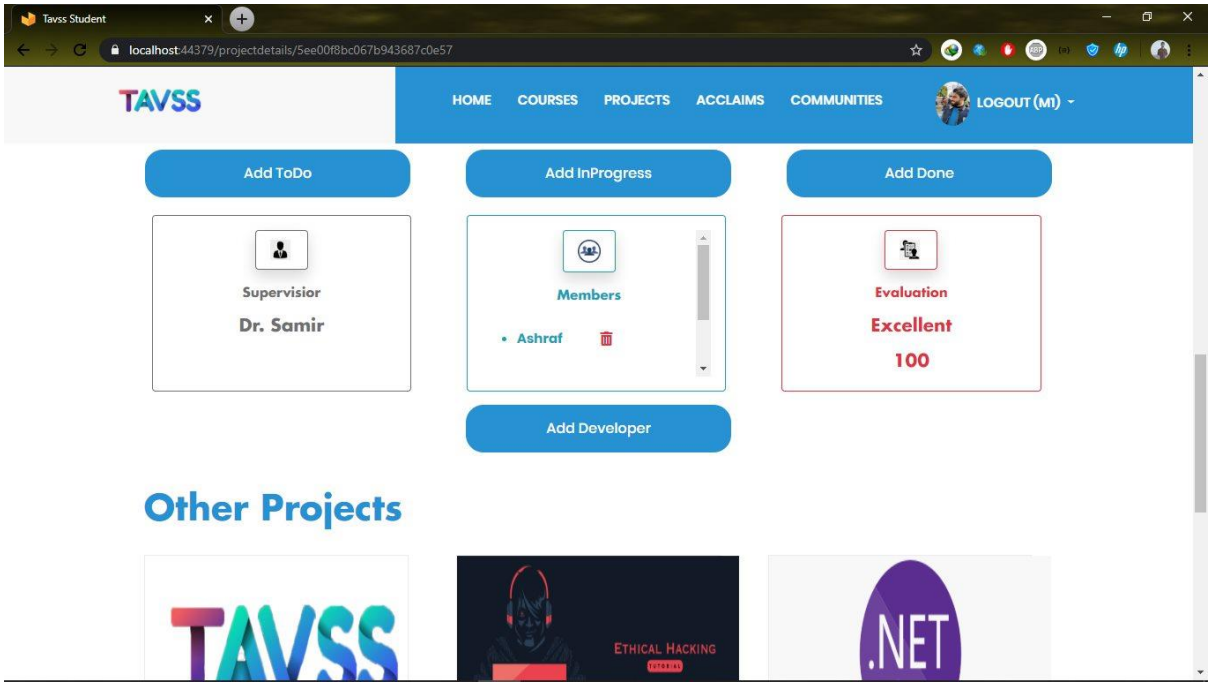


Figure 4.7

CHAPTER 5: REAL-TIME SERVICES IMPLEMENTATION

The new paradigms of systems need to be based upon the real time services, real-time means the realistic interaction of components like the world is real-time, any change must be observable to clients in the real-time but these types of services don't depend in the client-server architecture so they use new design patterns to handle these changes automatically, most of the browser support web sockets communication illustrated in the figure 5.1 and to following updates click this link.

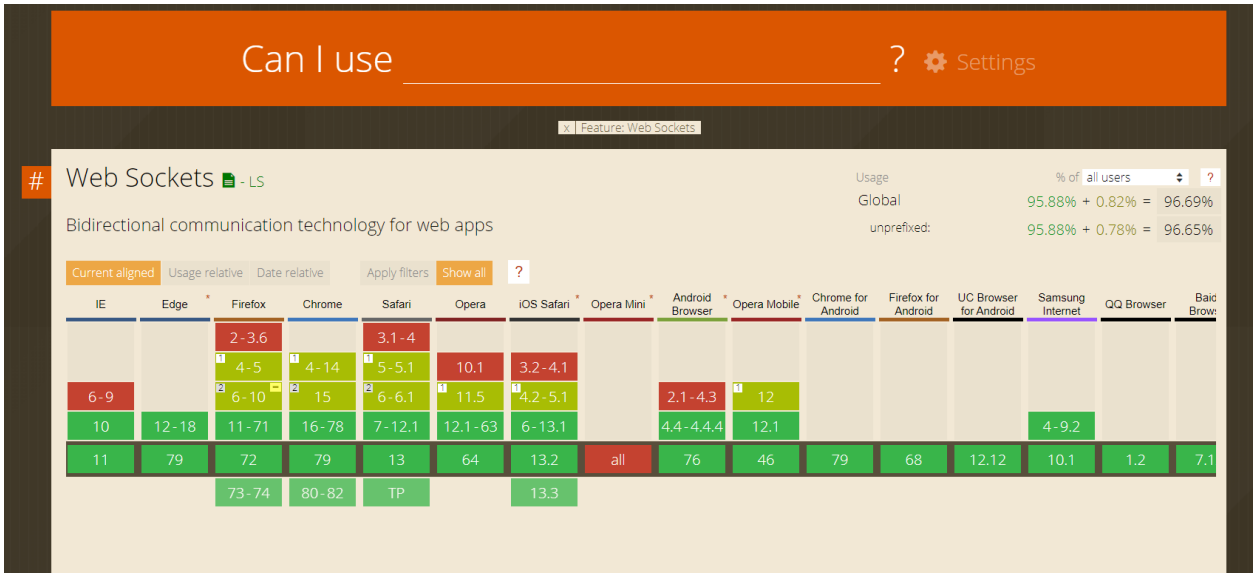


Figure 5.1 The Web Socket supported browsers (Bidirectional Communication).

5.1 HTTP, THE CLIENT IN REAL-TIME, THE CLIENT IS THE BOSS

An HTTP operation is based on a **request-response schema**, which is always started by the client. This procedure is often referred to as the **pull model**: When a client needs to access a resource hosted by a server, it purposely initiates a connection to it and requests the desired information using the "language" defined by the HTTP protocol. The server processes this request, returns the resource that was asked for (which can be the contents of an existing file or the result of running a process), and the connection is instantly closed.[11]

5.1.1 TRADITIONAL REQUES-RESPONSE MODEL

This paradigm is often used in every request the client do through the internet when requesting a web page containing Multimedia contents, request the item from the server by http then server listen to the request and process it to create the desired response then

sending to the browser what client requested then connection closed. This is the traditional way of request-response schema illustrated in figure 5.2.

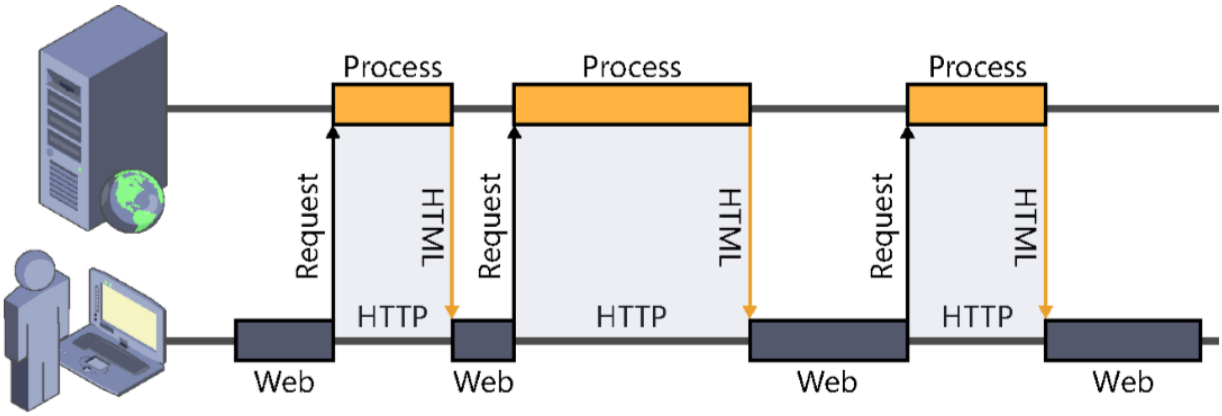


Figure 5.2 The Request-Response Schema of traditional client-server Architecture

5.1.2 CONTINUOUS REQUEST-RESPONSE OVER SAME PAGE (AJAX)

The HTTP protocol itself can support the needs for asynchrony of modern applications, owing to the techniques generally known as **AJAX (Asynchronous JavaScript And XML)**.

Using AJAX techniques, the exchange of information between the client and the server can be done without leaving the current page. At any given moment, the client can initiate a connection to the server by using JavaScript, request a resource, and process it (for example, updating part of the page).

What is truly advantageous and has contributed to the emergence of very dynamic and interactive services, such as Facebook or Gmail, is that these operations are carried out asynchronously—that is, the user can keep using the system while the latter communicates with the server in the background to send or receive information.

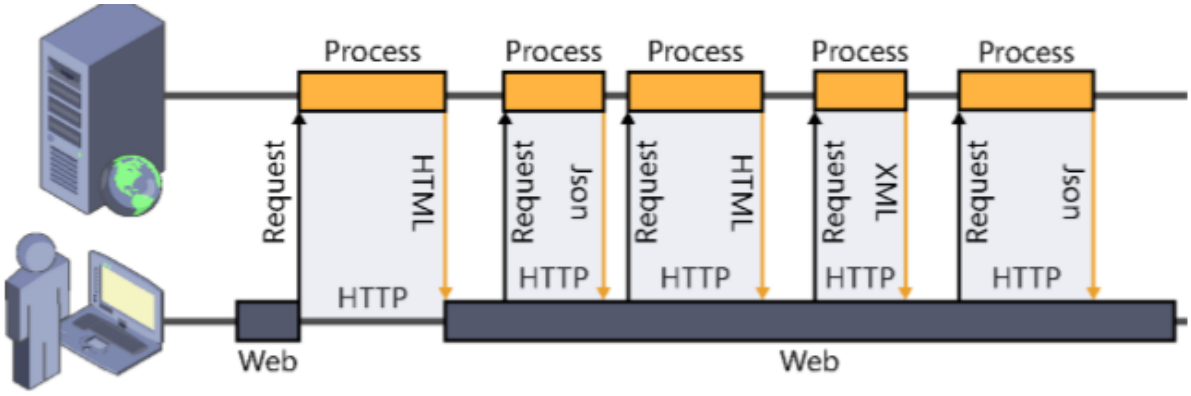


Figure 5.3 AJAX handles the continuous requesting model.

This operating schema continues to use and abide by the HTTP protocol and the client-driven request-response model. The client is always the one to take the initiative, deciding when to connect to the server illustrated in figure 5.3.

But it is not solving the problem of real-time systems, someone can tell AJAX can handle it, but not true, they operate it like polling technique, but this is another design pattern to allow real-time, let's cover all these design pattern to choose which is the idle.

5.1.3 REAL-TIME SERVICES DESIGN PATTERNS & TECHNIQUES

The reason is simple: **HTTP is not oriented to real time**. There are other protocols, such as the popular **IRC2**, which are indeed focused on achieving **swifter communication** to offer more dynamic and interactive services than the ones we can obtain **using pull**. In those, the server can take the initiative and send information to the client at any time, without waiting for the client to request it expressly.

POLLING: THE ANSWER?

As web developers, when facing a scenario in which the server is needed to be the one sending information to the client on its own initiative, the first solution that intuitively comes to minds is to use the technique known as polling. Polling basically consists in making periodic connections from the client to check whether there is any relevant update at the server, as shown in Figure 5.4.

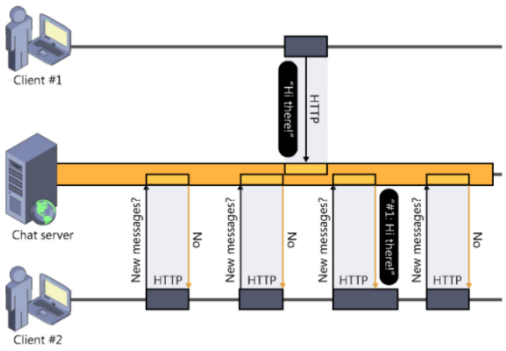


Figure 5.4 Polling technique.

It's the simplest way to perform the real-time because it's still http requests, and it's just a pulling not more.

The cost of polling technique is significantly huge, as it's proportionally increase with clients increase, imagine that there are 300,000 users chats to many users of them and groups imagining what is the disaster of this problem is impossible. If everyone has 10 rooms and the polling every 3 seconds then the requests to server would be for only the chats 1,000,000 request per second, and you can have only a question (What is the type of network can observe them?)

PUSH: THE SERVER TAKES THE INITIATIVE

There are applications where the use of pull is not very efficient. Among them, like instant-messaging systems, real-time collaboration toolsets, multiuser online games, information broadcasting services, and any kind of system where it is necessary to send information to the client right when it is generated.

This is precisely the idea behind the push, or server push, concept. This name does not make reference to a component, a technology, or a protocol: it is a concept, a communication model between the client and the server where the latter is **the one taking the initiative in communications**.[11]

This concept is not new. There are indeed protocols that are push in concept, such as **IRC** illustrated in figure 5.5, the protocol that rules the operation of classic chat room services, or **SMTP (Mail protocol)** illustrated in figure 5.6, the protocol in charge of coordinating email sending. These were created before the term that identifies this type of communication was coined.

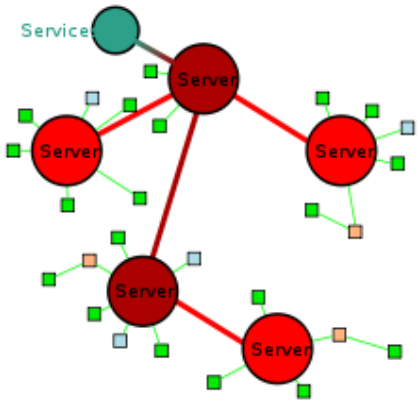


Figure 5.5 IRC protocol model working.

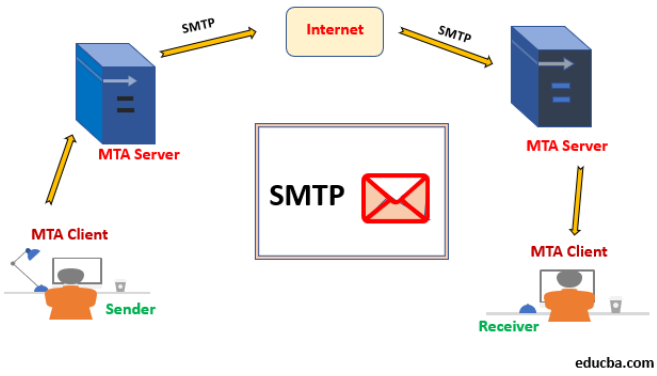


Figure 5.6 SMTP working model

Nevertheless, push is something that we need right now. Users demand ever more interactive, agile, and collaborative applications. To develop them, we must make use of techniques allowing us to achieve the immediacy of push but taking into account current limitations in browsers and infrastructure. At the moment, we can obtain that only by making use of the advantages of HTTP and its prevalence.

Given these premises, it is easy to find multiple conceptual proposals on the Internet, such as Comet, HTTP push, reverse AJAX, AJAX push, and so on, each describing solutions (sometimes coinciding) to achieve the goals desired. In the same way, different specific techniques can be found that describe how to implement push on HTTP more or less efficiently, such as long polling, XHR streaming, or forever frame.

WEBSOCKETS

The WebSockets standard consists of a development API, which is being defined by the W3C (World Wide Web Consortium, http://www.w3.org), and a communication protocol, on which the IETF (Internet Engineering Task Force, http://www.ietf.org) has been working.

Basically, it allows the establishment of a persistent connection that the client will initiate whenever necessary and which will remain open. A two-way channel between the client and the server is thus created, where either can send information to the other end at any time.

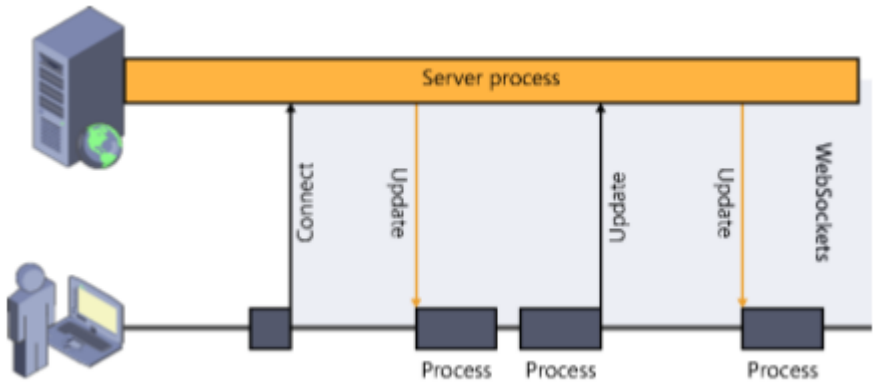


Figure 5.7The WebSockets working model

From the perspective of a developer, WebSockets offers a JavaScript API that is really simple and intuitive to initiate connections, send messages, and close the connections when they are not needed anymore, as well as events to capture the messages received:

```
connectButton.onclick = function() {
    stateLabel.innerHTML = "Connecting";
    socket = new WebSocket(connectionUrl.value);
    socket.onopen = function (event) {
        updateState();
        commsLog.innerHTML += '<tr>' +
            '<td colspan="3" class="commslog-data">Connection opened</td>' +
        '</tr>';
    };
    socket.onclose = function (event) {
        updateState();
        commsLog.innerHTML += '<tr>' +
            '<td colspan="3" class="commslog-data">Connection closed. Code: ' + htmlEscape(event.code) +
            '. Reason: ' + htmlEscape(event.reason) + '</td>' +
        '</tr>';
    };
    socket.onerror = updateState;
    socket.onmessage = function (event) {
        commsLog.innerHTML += '<tr>' +
            '<td class="commslog-server">Server</td>' +
            '<td class="commslog-client">Client</td>' +
            '<td class="commslog-data">' + htmlEscape(event.data) + '</td></tr>';
    };
};
```

Figure 5.8 Implementing web sockets in Java Script

Actually, this implementation of websockets will be focused in the next section.

SERVER-SENT EVENTS (API EVENT SOURCE)

Server-Sent Events, also known as API Event Source, is the second standard on which the W3 consortium has been working. Currently, this standard is in candidate recommendation state. But this time, because it is a relatively straightforward JavaScript API and no changes are required on underlying protocols, its implementation and adoption are simpler than in the case of the WebSockets standard.

In contrast with the latter, Server-Sent Events proposes the creation of a one-directional channel from the server to the client, but opened by the client. That is, the client "subscribes" to an event source available at the server and receives notifications when data are sent through the channel, Illustrated in the figure 5.9.

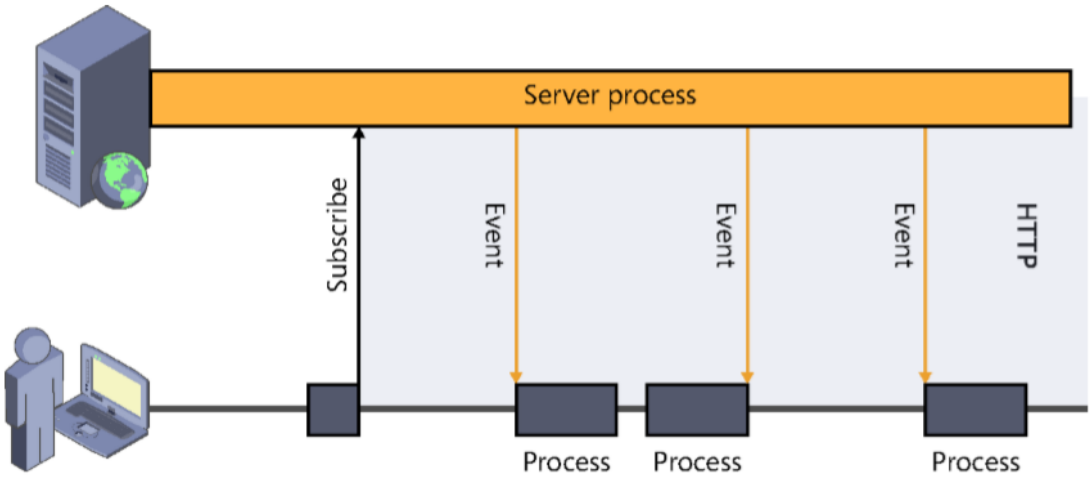


Figure 5.9 The API Event source model working

All communication is performed on HTTP. The only difference with respect to a more traditional connection is the use of the content-type text/event-stream in the response, which indicates that the connection is to be kept open because it will be used to send a continuous stream of events or messages from the server.

LONG POLLING

A push technique, but is quite similar to the polling with modification to optimize the efficiency and immediacy of communication.

The client also polls for updates, but, unlike in polling, if there is no data pending to be received, the connection will not be closed automatically and initiated again later. In long polling, the connection remains open until the server has something to notify, illustrated in figure 5.10.

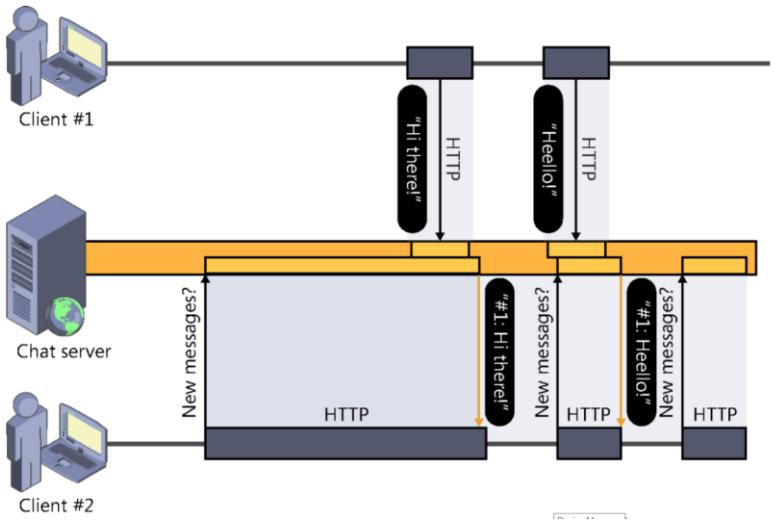


Figure 5.10 Long polling technique

Resource consumption with long polling is somewhat higher than with other techniques where a connection is kept open. The reason is that there are still many connection openings and closures if the rate of updates is high, not forgetting the additional connection that has to be used when the client wants to send data to the server. Also, the time it takes to establish connections means that there might be some delay between notifications. These delays could become more evident if the server had to send a series of successive notifications to the client. Unless we implemented some kind of optimization, such as packaging several messages into one same HTTP response, each message would have to wait to be sent while the client received the previous message in the sequence, processed it, and reopened the channel to request a new update.

FOREVER FRAME

The other technique is called forever frame and uses the HTML <IFRAME> tag cleverly to obtain a permanently open connection. In a way, this is very similar to Server-Sent Events.

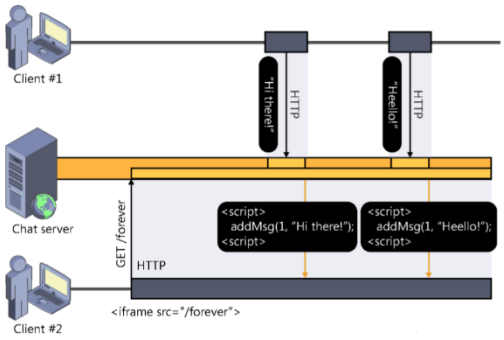


Figure 5.11 The forever frame technique.

Broadly, it consists in entering an <IFRAME> tag in the page markup of the client. In the source of <IFRAME>, the URL where the server is listening is specified. The server will maintain this connection permanently open (hence the “forever” in its name) and will use it to send updates in the form of calls to script functions defined at the client. In a way, we might say that this technique consists in streaming scripts that are executed at the client as they are received illustrated in figure 5.11.

5.1.4 THE WORLD NEEDS MORE THAN JUST PUSH

Until now, the techniques that allow us to achieve push have been seen; that is, they allow the server to be able to send information to the client asynchronously as it is generated. the initiative have been given to an element that would normally assume a passive role in communications with the client. However, in the context of asynchronous, multiuser, and real-time applications, push is but one of the aspects that are indispensable. To create these always surprising systems, we need many more capabilities. Here there are list a few of them:

- **Managing connected users:** The server must always know which users are connected to the services, which ones disconnect, and, basically, it must control all the aspects associated with monitoring an indeterminate number of clients.

- **Managing subscriptions:** The server must be capable of managing "subscriptions," or grouping clients seeking to receive specific types of messages. For example, in a chat room service, only the users connected to a specific room should receive the messages sent to that room. This way, the delivery of information is optimized and clients do not receive information that is not relevant to them, minimizing resource waste.

- **Receiving and processing actions**: The server be capable not only of sending information to clients in real time but also of receiving it and processing it on the fly to check what is the data contain.

- **Monitoring submissions**: Because guarantying that is impossible all clients connect under the same conditions, there might be connections at different speeds, line instability, or occasional breakdowns, and this means that it is necessary to provide for mechanisms capable of queuing messages and managing information submissions individually to ensure that all clients are updated.

- **Offering a flexible API**, capable of being consumed easily by multiple clients This is even truer nowadays, when there are a wide variety of devices from which we can access online services.

enumerating many more, but these examples are more than enough to give an idea of the complexity inherent in developing these types of applications.

5.2 SIGNALR CHAT DEVELOPMENT

Have more fun with these libraries that can develop more than a system but a life.

5.2.1 INTRODUCING SIGNALR

SignalR is a library from **Microsoft** that offers real-time web development for ASP.NET applications.

SignalR is primarily used by applications that require push notifications from server to client; for example, applications such as **chat, stock market, gaming, and dashboards**.

Prior to SignalR, application developers used to implement real-time web functionalities by using **pooling methods** such as **long/short polling** in which a client will poll the server for new information based on a time interval illustrated the other techniques in previous sections.

This approach is always performance intense, network offensive, and requires more hardware. SignalR solves the problem by providing a **persistent connection** between the client and the server. It uses the **Hubs API** to push notifications from server to client, and it supports **multiple channels such as WebSocket, server-sent events, and long polling in abstraction level illustrated in figure 5-12**.

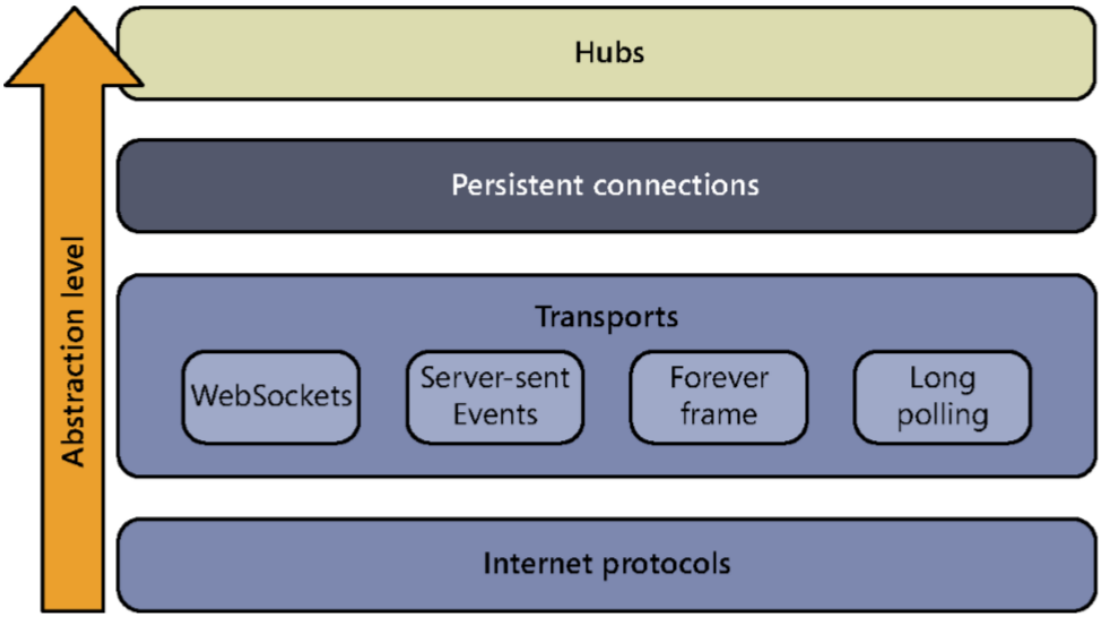


Figure 5-12 the API Abstractions of SignalR

SignalR supports multiple clients ranging from C#/C++ to JavaScript. SignalR supports SQL Server, Redis, Azure Service Bus, and more to achieve scalability.

As the development paradigm shifts toward ASP.NET Core, Microsoft is redesigning and rebuilding its traditional SignalR to support a new ASP.NET Core framework.

The new SignalR is a complete rewrite from scratch, because ASP.NET Core has a lot of new features such as new HttpContext, dependency injection, and configuration. At the same time, the .NET Core's SignalR version should be portable with the .NET Standard. Some of the new changes in the latest SignalR for .NET Core are as follows:

- No dependency on JQuery. This will make the new SignalR run on the client side without JQuery references. The ASP.NET Core team plans to use most of the default features of the latest browsers.

- Hubs are mapped to routes, through which the single connection dependency was removed. Different clients can connect to hubs of their choice through different URLs.

- Just like traditional SignalR, the new version also supports WebSocket, server-sent events, and long polling transport types.

- Extensive support for binary data.

- The new SignalR will implement a new scale-out design that is more flexible than the existing one.

- User presence support, which can be used to track a user's lost or idle connections.

- The reconnection feature from traditional SignalR has been removed because of memory leaks and complicated unnecessary logic inside SignalR to make sure messages are durable.

- Traditional SignalR was used to allow clients to change servers between reconnections, but in new SignalR except WebSocket, all other connections require sticky sessions.

5.2.2 IMPLEMENTING SIGNALR

First it must be installed from nuget package manager the Microsoft.AspNetCore.SignalR component and Microsoft.AspNetCore.SignalR.Core as illustrated in figure 5-13.

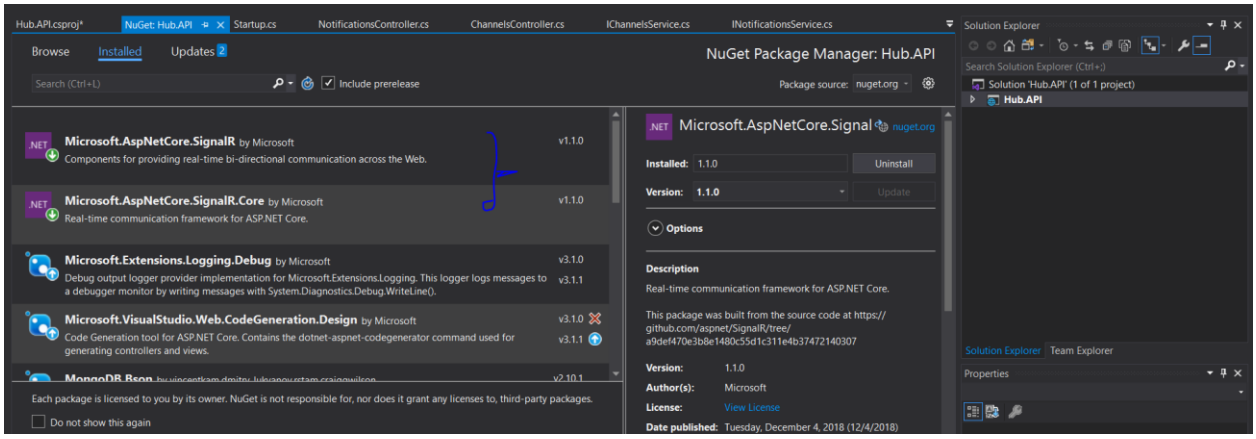


Figure 5-13 SignalR nuget packages to install.

5.2.3 ANGULAR APPLICATION TO CONSUME CHAT SERVICES

INSTALLING PREREQUESTED PACKAGES & LIBRARIES

Now, by creating the angular app using the Node JS package manager, now using the angular CLI to install required packages:

- **Bootstrap 4**: is an open source toolkit for developing with HTML, CSS, and JS. To develop responsive grid system, extensive prebuilt components, and powerful plugins built on jQuery.
    - **$ npm install bootstrap --save**

- **JQuery**: First,It must be installed as the Bootstrap is built on it, the JQuery, jQuery is a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. With a combination of versatility and extensibility, jQuery has changed the way that millions of people write JavaScript.
    - **$ npm i JQuery@1.9.1 --save**

- **Popper**.js: Given an element, such as a button, and a tooltip element describing it, Popper will automatically put the tooltip in the right place near the button. It will position any UI element that "pops out" from the flow of your document and floats near a target element. The most common example is a tooltip, but it also includes popovers, drop-downs, and more. All of these can be generically described as a "popper" element.

- **$ npm i @popperjs/core --save**
- **$ npm I popper.js --save**

- **SignalR:** Can be Integrated with the frontend application to ease use the ASPNET signalr services
  - **$ npm install @aspnet/signalr –save**

CONFIGURING THE FRONTEND PACKAGES

Now, configuring these libraries and packages with the application, going to angular.json file to make use of them.

Configuring the 3 packages of frontend {Bootstrap 4 , Jquery , Popper.js} globally for all application, it's come from the angular.json file, the main file of configuration illustrated in figure 5-14.

Figure 5-14 configuring the UIs packages

The packages need to be configured to all components as style sheets or Java scripts so in angular.json file adding to the styles array the path of the bootstrap CSS file and in scripts mapping the files by passes too, but it must be arranged because the call of methods come from bottom files to upper and the styles override, be aware.

GENERATING UI COMPONENT TO RECEIVE WHO IS THE USER

The Application is created now, to simulate the chatting rooms between the users so first, creating a page to know who is the user first. So, creating new component called login to receive the id from user using the following command:

$ ng generate component login

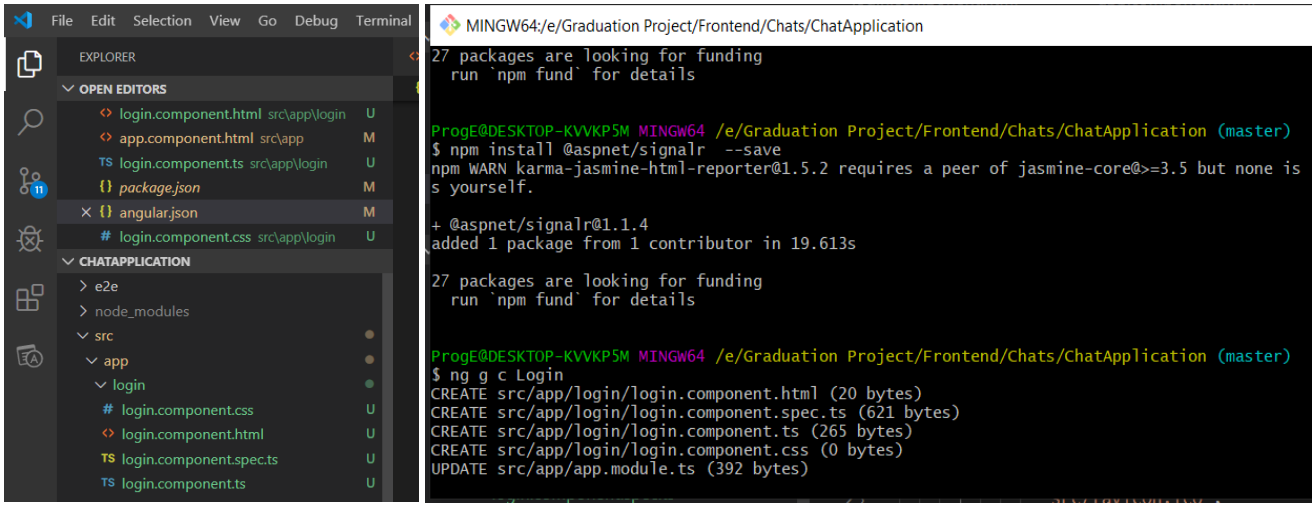


Figure 5,15 Generating login component as a UI module to work with.

Running this command generates a folder with 4 files:

- The Html component: the structure and the elements of the page.
- The CSS component: the style sheet where we write the CSS elements.
- The Spec TS file: where the component can be tested as a unit.
- The TS file: mapping the application services to the components (gets and sets parameters, control the UI Component…)

By writing the CSS and The Html of Login component illustrated in figure 5.16 and run the application using command:

$ ng serve -o

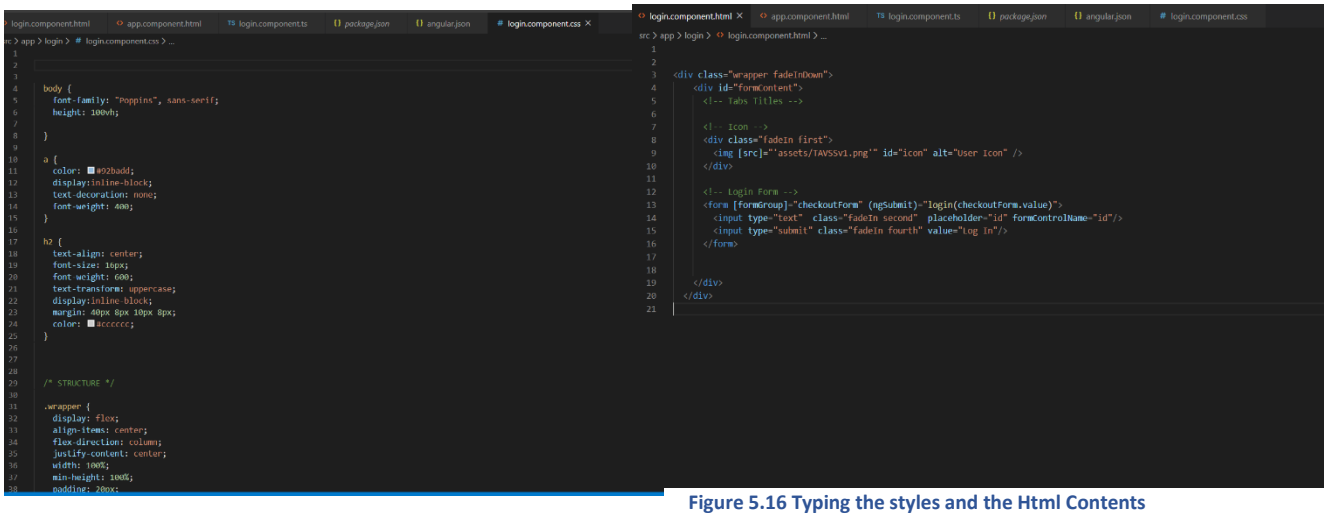


Figure 5.16 Typing the styles and the Html Contents

Adding the logo of TAVSS app in the assets to run with logo. Then now calling the component in the main component to make it feasible.

Now illustrating the figure of running in 5.17.

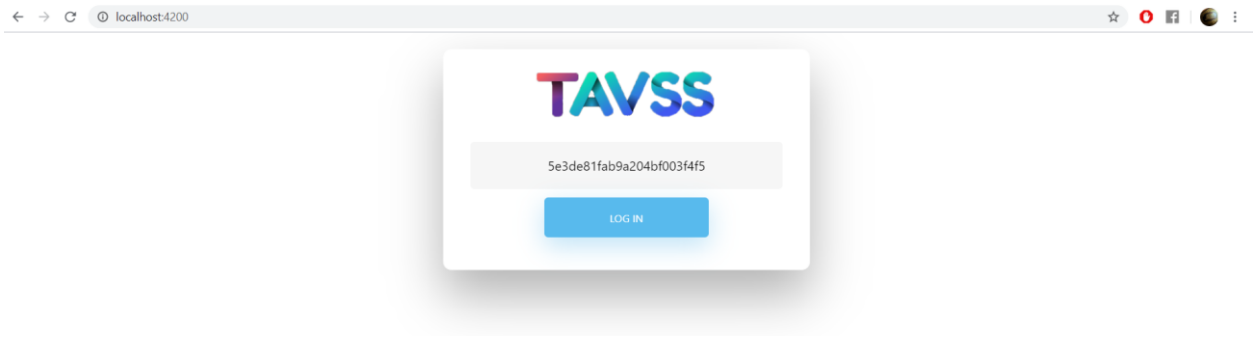


Figure 5.17The UI running result.

THE BACKEND SIDE OF CHATTING APP

Now, going to code the backend side to receive the id then respond with the channels of user.

Using the Versioning design pattern to control the directions of the application, and creating the routes of controller by The ApiRoutes.cs file as static mempers to call shown at figure 5.18.

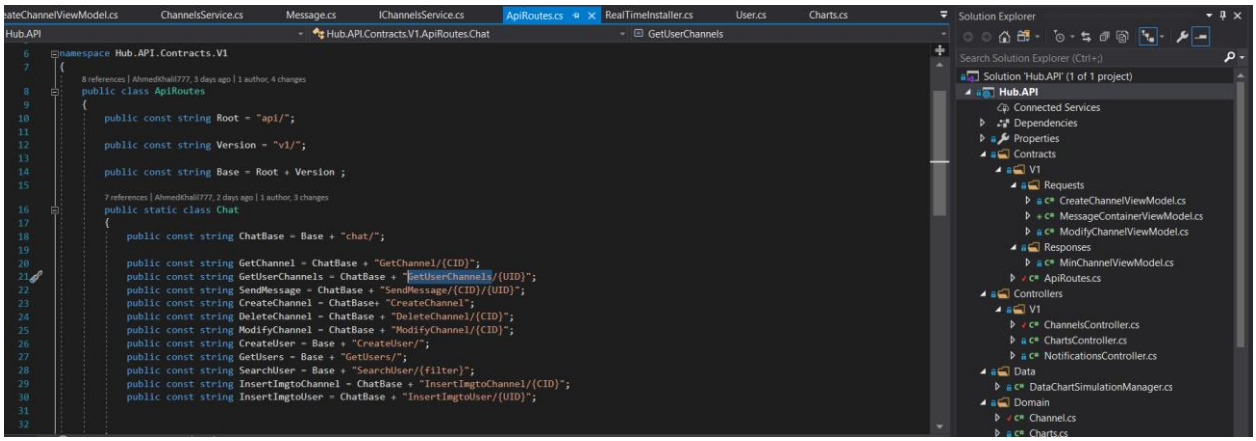


Figure 5.18 The API Routes of Backend definitions.

Then creating the data access models of mongo DB to manipulate the data come from the server of mongo and map the ids as a BSON Ids, creating 2 pages illustrated in figure 5-19:

- The Channel Collection: [Messages, Users, Meta data of the channel]
- The User Collection: [Id, name, …….]

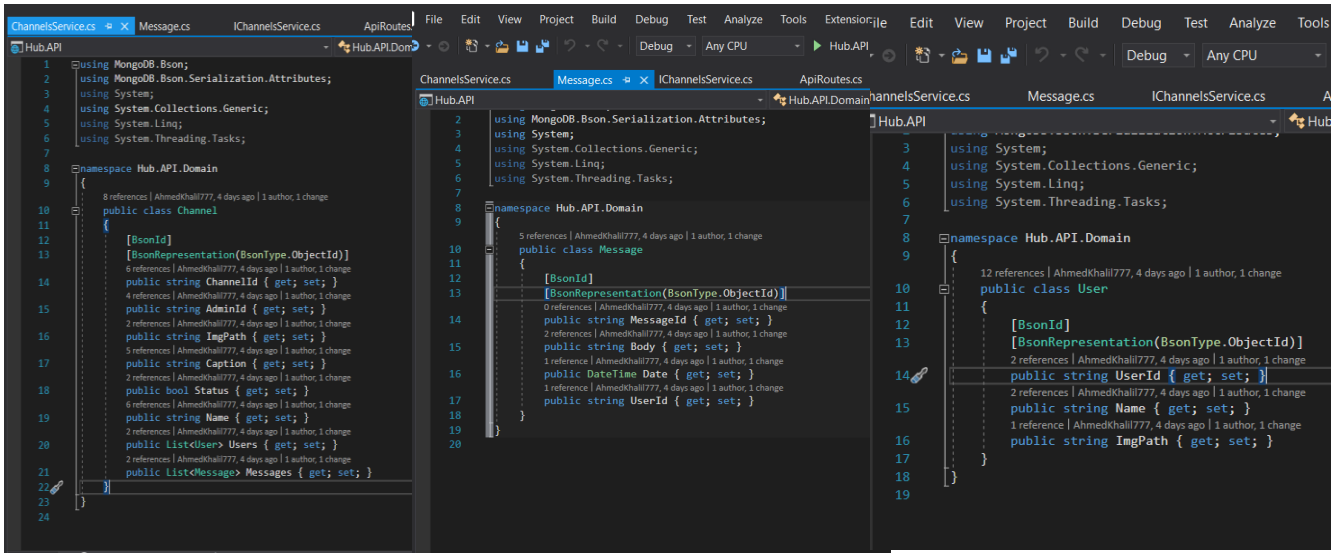
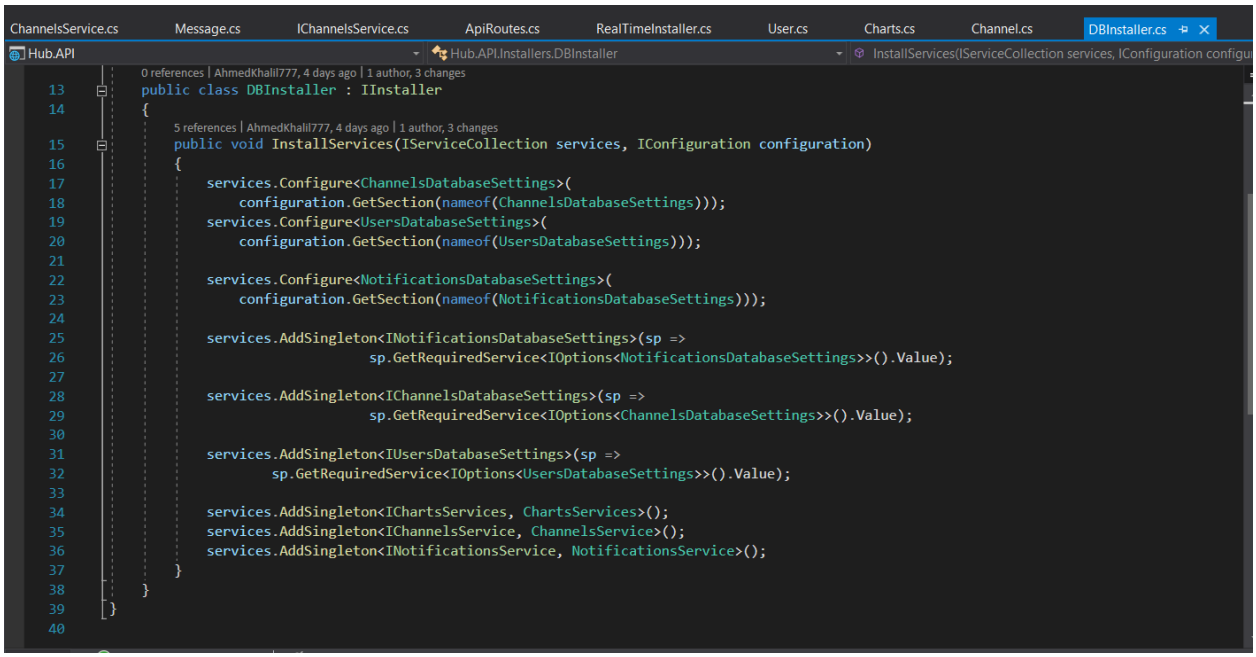


Figure 5-19 The Data access classes to map data from mongo DB

Now, mapping the MongoDB driver to the solution using singleton objects then map the services to create the business logic component to API illustrated in figure 5-20.



```
public class DBInstaller : IInstaller
{
    public void InstallServices(IServiceCollection services, IConfiguration configuration)
    {
        services.Configure<ChannelsDatabaseSettings>(
            configuration.GetSection(nameof(ChannelsDatabaseSettings)));
        services.Configure<UsersDatabaseSettings>(
            configuration.GetSection(nameof(UsersDatabaseSettings)));

        services.Configure<NotificationsDatabaseSettings>(
            configuration.GetSection(nameof(NotificationsDatabaseSettings)));

        services.AddSingleton<INotificationsDatabaseSettings>(sp =>
                        sp.GetRequiredService<IOptions<NotificationsDatabaseSettings>>().Value);

        services.AddSingleton<IChannelsDatabaseSettings>(sp =>
                        sp.GetRequiredService<IOptions<ChannelsDatabaseSettings>>().Value);

        services.AddSingleton<IUsersDatabaseSettings>(sp =>
                sp.GetRequiredService<IOptions<UsersDatabaseSettings>>().Value);

        services.AddSingleton<IChartsServices, ChartsServices>();
        services.AddSingleton<IChannelsService, ChannelsService>();
        services.AddSingleton<INotificationsService, NotificationsService>();
    }
}
```

Figure 5-20 Installing DB services of 3 collections and map the Business logic services

BUSINESS LOGIC OF CHATTING DEVELOPMENT

Creating no the interfaces and the classes to map the logic of every route used, it make a method for every route used by declaring them in the IChannelServices.cs interface illustrated in figure 5-21.

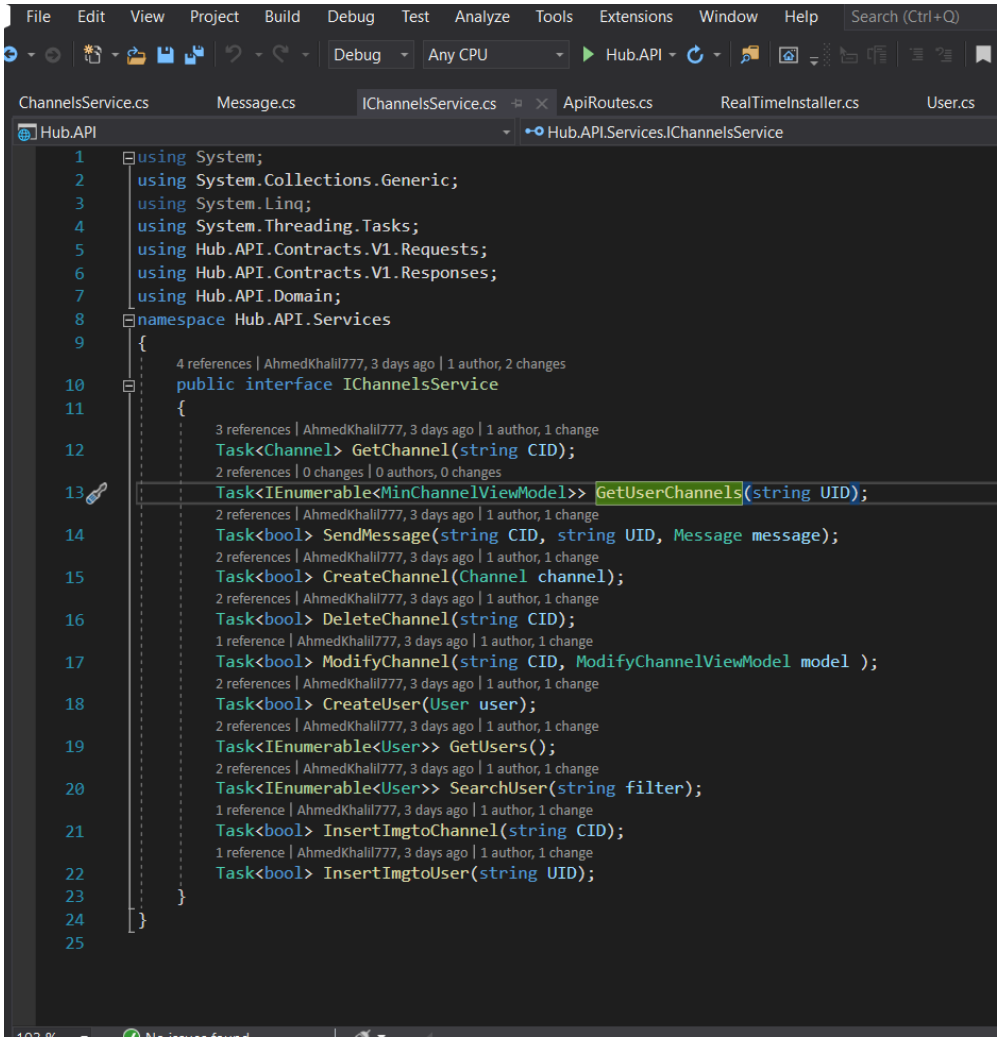


Figure 5-21 Declaring the methods of Business Logic layers

Now, Implement this interface and creating the business logic of it, in class ChannelsServices.cs illustrated in figure 5-22.

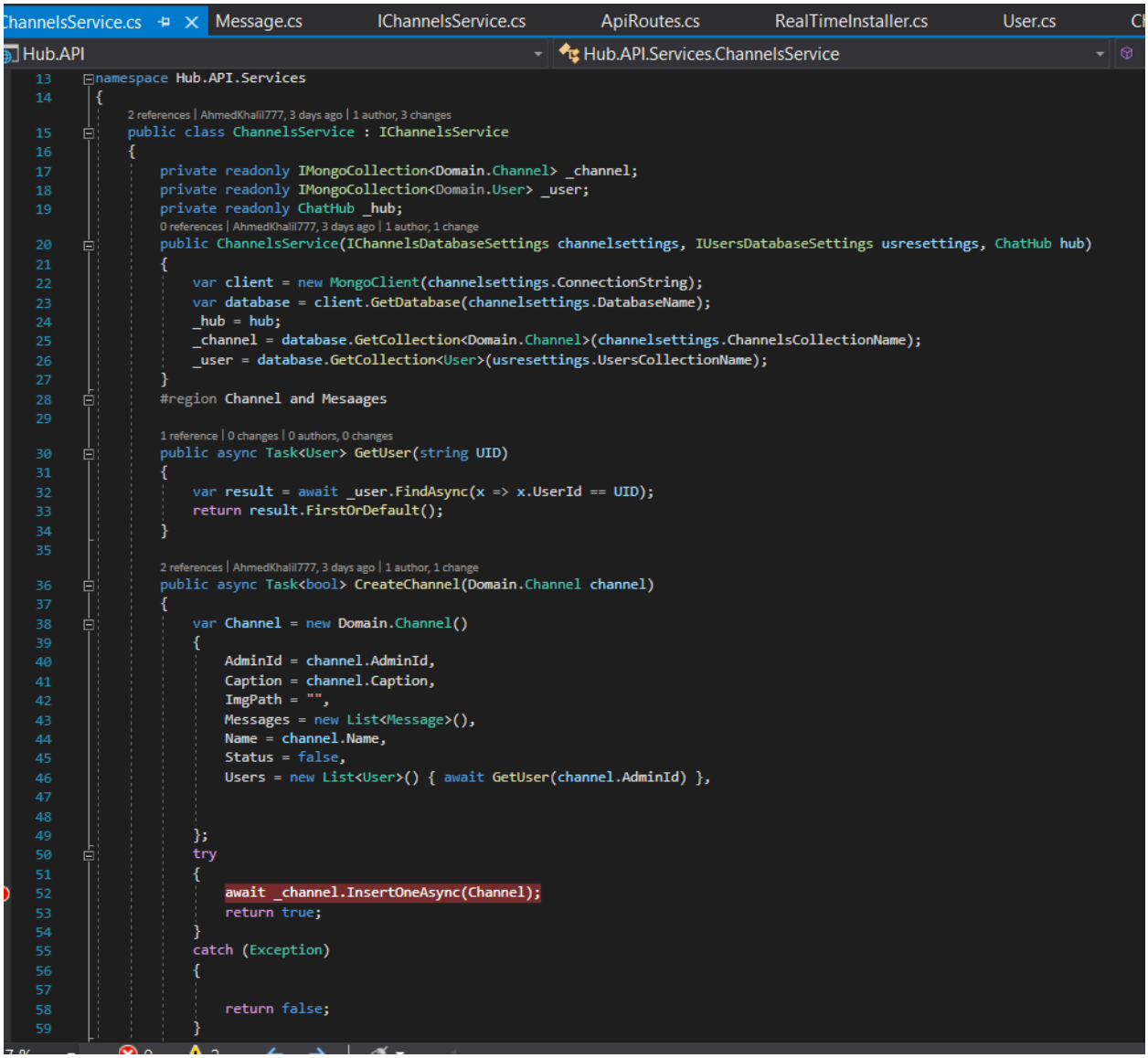


Figure 5-22Implementation of some of channels business logic

Mapping The controllers to these services using DI design pattern and by creating a singleton illustrated in figure 5-23, then scaffolding a controller then inject the services and calling the business logic and routing shown in figure 5-24.

```
            services.AddSingleton<IChartsServices, ChartsServices>();
            services.AddSingleton<IChannelsService, ChannelsService>();
            services.AddSingleton<INotificationsService, NotificationsService>();
        }
    }
}
```

Figure 5-23creating a container as a singleton to inject in controller

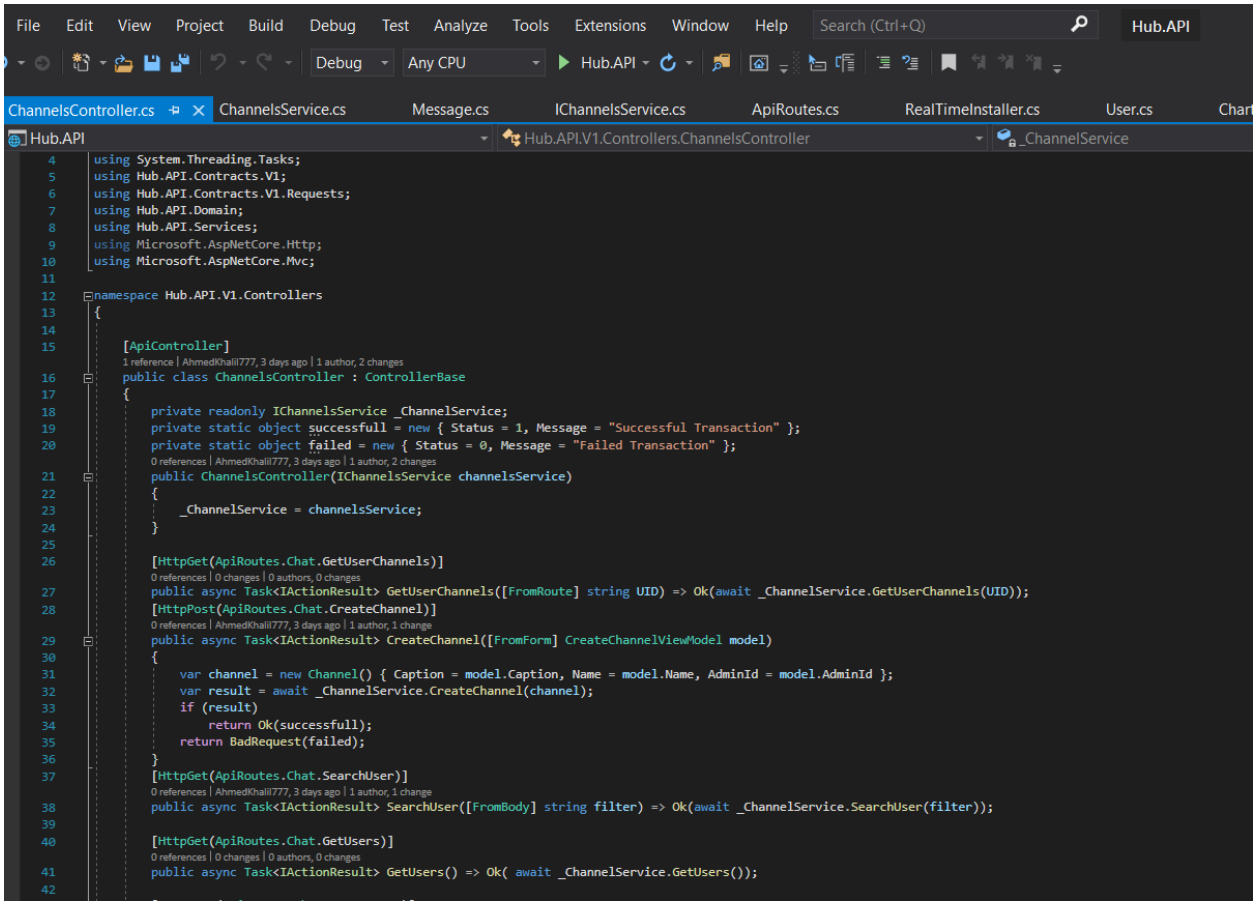


Figure 5-24 Controller to consume the Business logic dependencies

SWAGGER RESULT OF BACKEND DEVELOPMENT

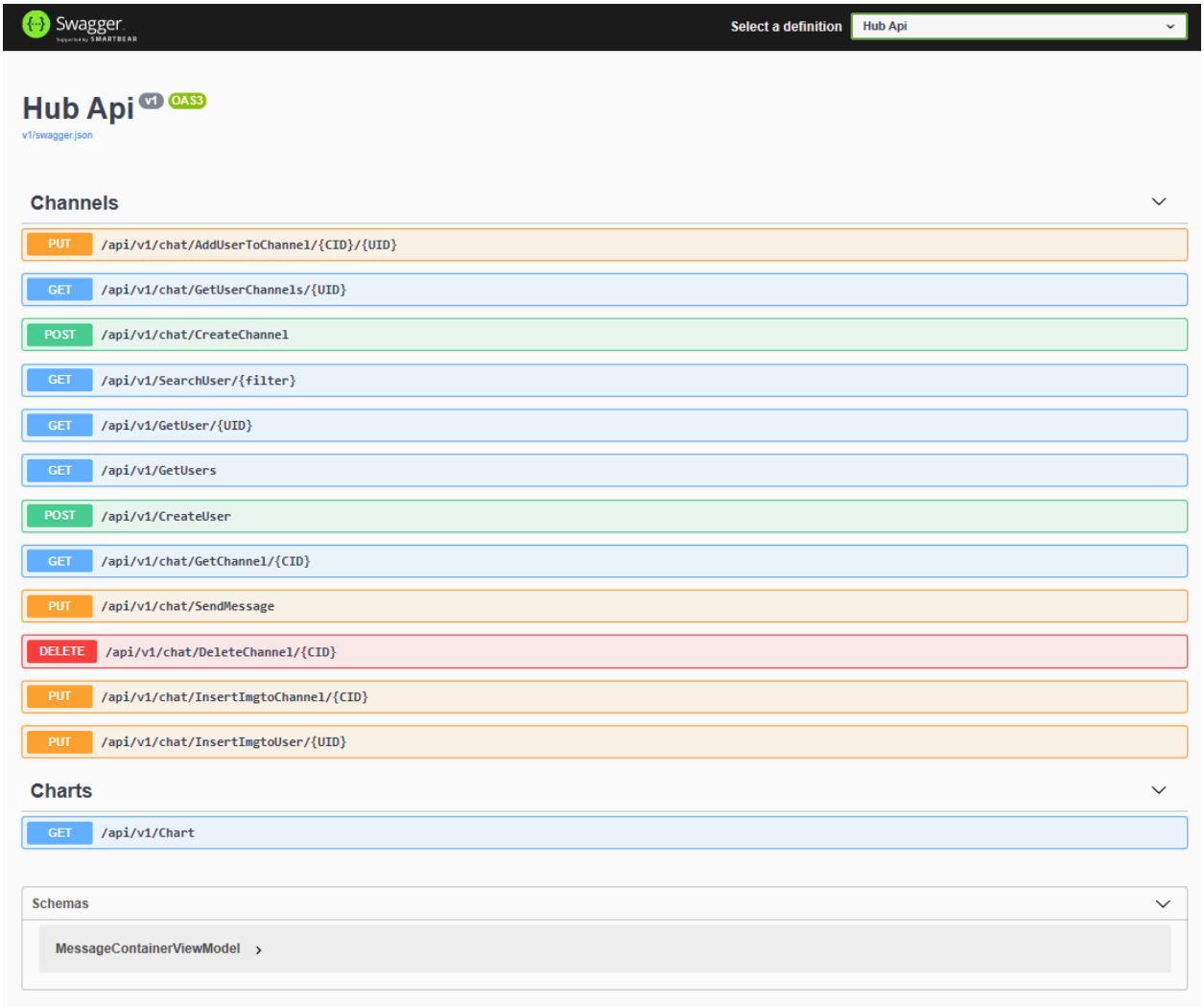


Figure 5-25 Swagger result of Rest API of RealTime App

By implementing the application, The Data can be added once the swagger working, using the Post Http Request to add Users and Channels the Results can be shown in figures 5-26: 5-28.

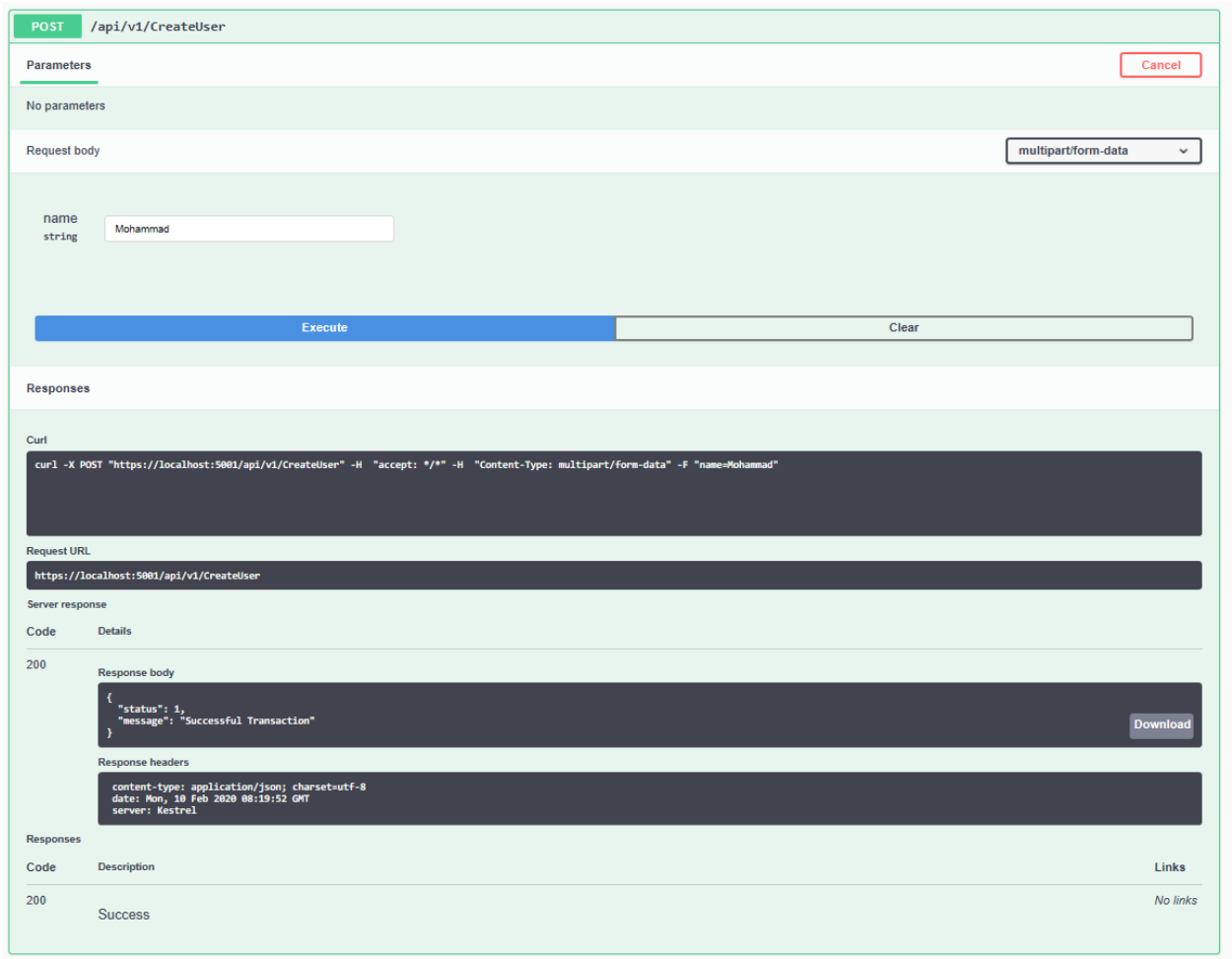


Figure 5-26Create User by Post Rest API and Saving the Data into Mongo DB

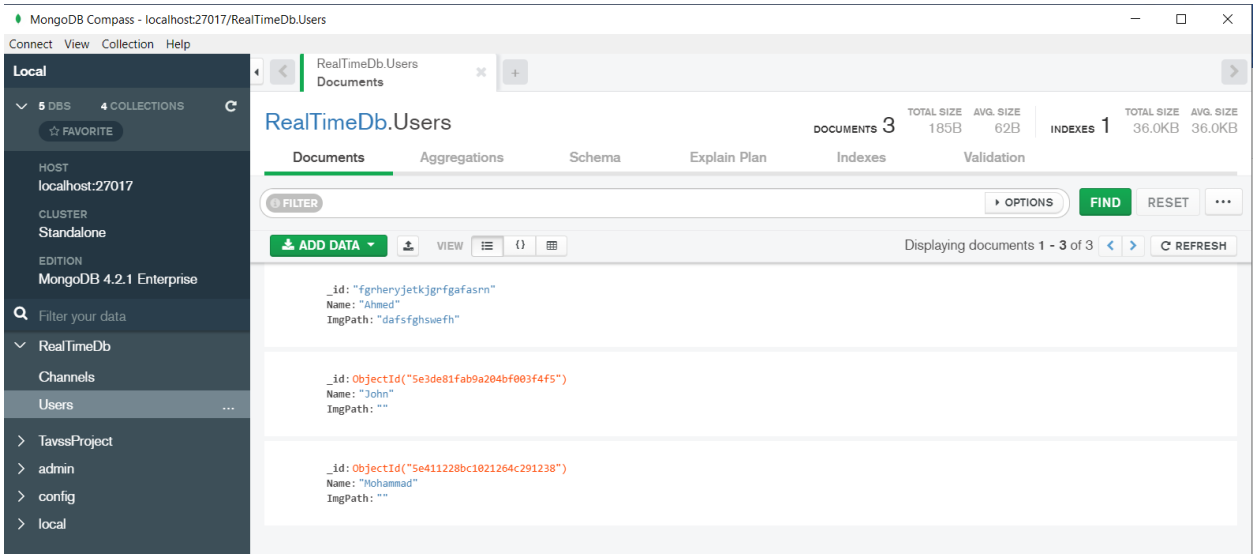


Figure 5-27 The Compass show The Changes of What data be entered

So, Let’s Get These Results

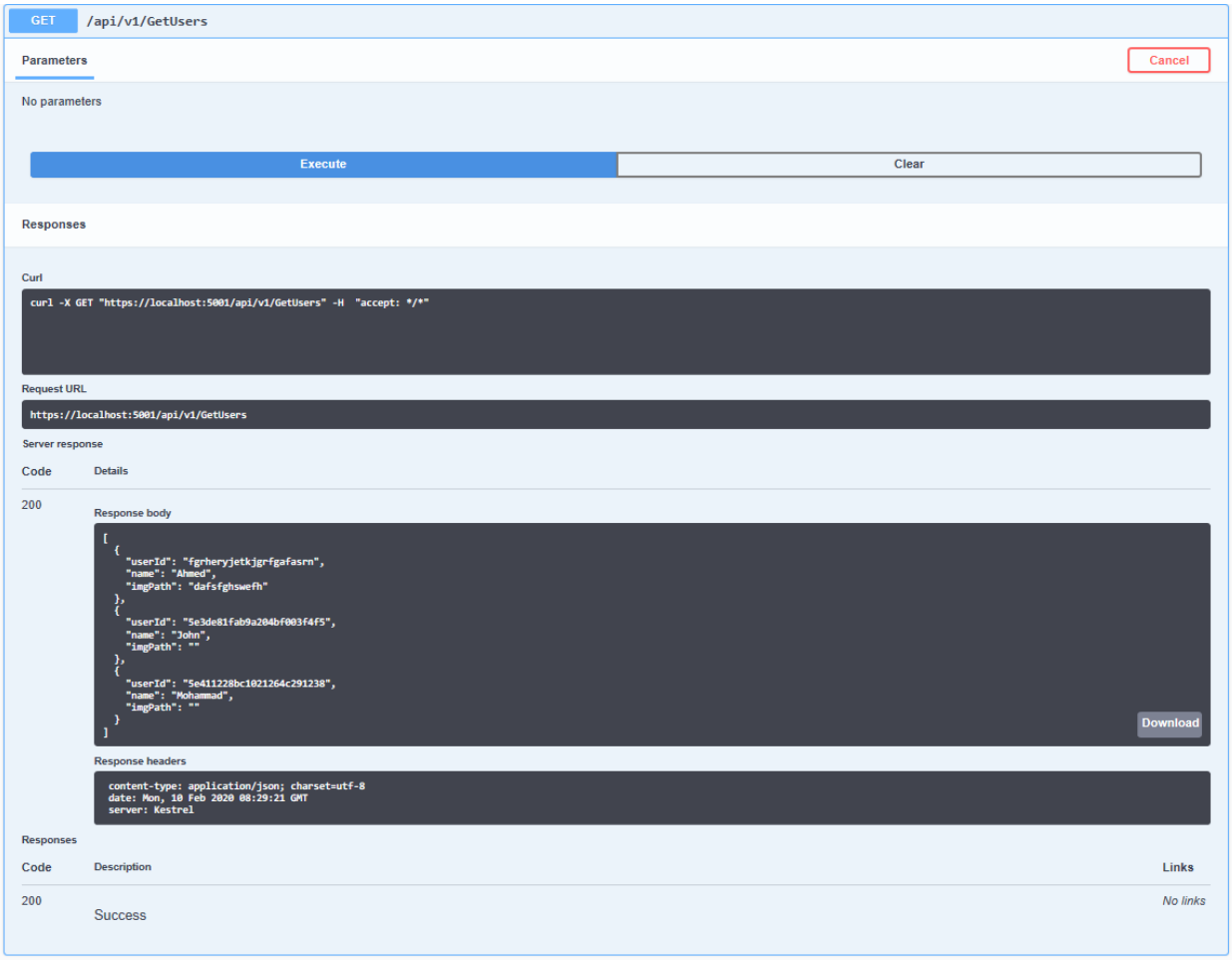


Figure 5-28 Getting the Data from Users Collection

It also works for all collections if you need to check them go to clone the github repos and run it:

https://github.com/AhmedKhalil777/TAVSSonContainers.Hub.API.GitHub

Now, The Consuming of the Rest Methods on hands, now let's work on image uploading and retrieving. It just a file uploading method technique to upload but contain many constraints:

- The files must be stored in wwwroot folder which is the global directory of hosting.
- It is like a hierarchal database where each folder contains specific files for a user or a group chat.
- The link of hosting must be a link of hosting environment not the local storage path.
    - Like this link which come from wwwroot folder: https://localhost:5001/userId/userImg.jpg

See the implementation of the Put Http Rest method and the result by implementing the Dependency Injection of IhostEnvironment interface, illustrated in figure

```
2 references | AhmedKhalil777, 5 days ago | 1 author, 1 change
public async Task<bool> InsertImgtoUser(string UID , IFormFile file)
{
     var User = await GetUser(UID);
    string m = User.UserId + User.Name;
    if (file.Length > 0)
    {
        try
        {

            if (!Directory.Exists(_hostEnvironment.ContentRootPath + "\\wwwroot\\" + "Images" + "\\" + m + "\\"))
            {
                Directory.CreateDirectory(_hostEnvironment.ContentRootPath + "\\wwwroot\\" + "Images" + "\\" + m + "\\");
            }
            string guid = Guid.NewGuid().ToString();
            using (FileStream fileStream = File.Create(_hostEnvironment.ContentRootPath + "\\wwwroot\\" + "Images" +
                "\\" + m + "\\" + guid + file.FileName.Replace("\\", "s").Replace(":", "s")))
            {
                file.CopyTo(fileStream);
                fileStream.Flush();
                User.ImgPath = "https://localhost:5001" + "\\" + "Images" + "\\" + m + "\\" + guid + file.FileName.Replace("\\", "s").Replace(":"
                    , "s");
                var result = await _user.ReplaceOneAsync(x => x.UserId == UID, User);
                return result.IsAcknowledged;
            }
        }
        catch
        {

            return false;
        }

    }

    return false;
}
```

Figure 5-29implementing the Business Logic of how to receive image and store it, in such a hierarchal db

Now, going to map this function to the Rest Controller illustrated in figure 5-30, then use it in swagger to upload an image shown in figure 5-31.

```
103
104         [HttpPut(ApiRoutes.Chat.InsertImgtoUser)]
            0 references | AhmedKhalil777, 5 days ago | 1 author, 1 change
105         public async Task<IActionResult> InsertImgtoUser([FromRoute] string UID, IFormFile file)
106         {
107             var result = await _ChannelService.InsertImgtoUser(UID, file);
108             if (result)
109             {
110                 return Ok(successfull);
111             }
112             return BadRequest(failed);
113
114         }
115
```

Figure 5-30 Implement the Rest Put function to request the File and send to BLL.

Now, by building and running the swagger open API. Let's See what is result:

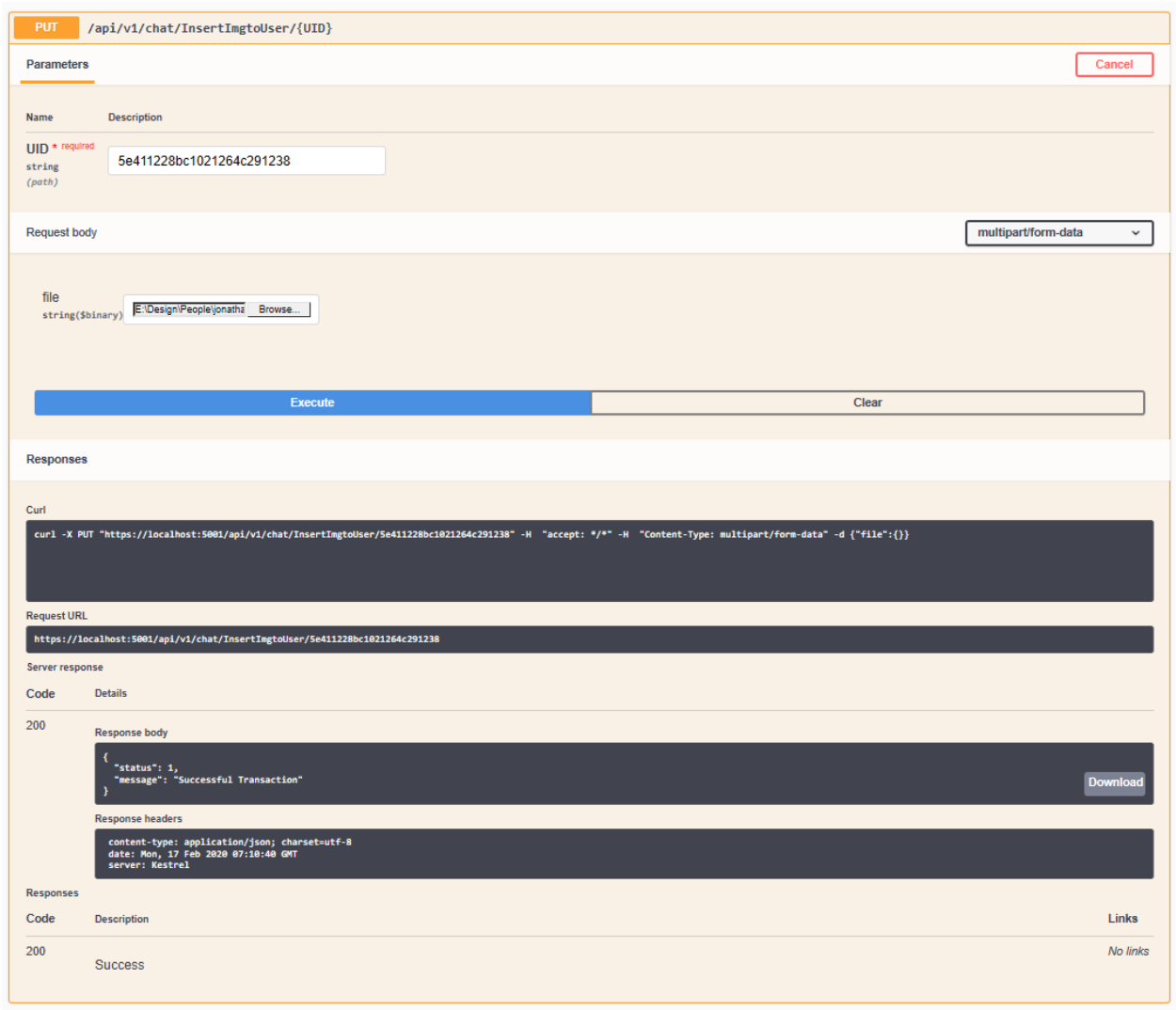


Figure 5-31 Swagger Result of Uploading an image

Opening the Client App chat to check if it works shown in figure 5-32.

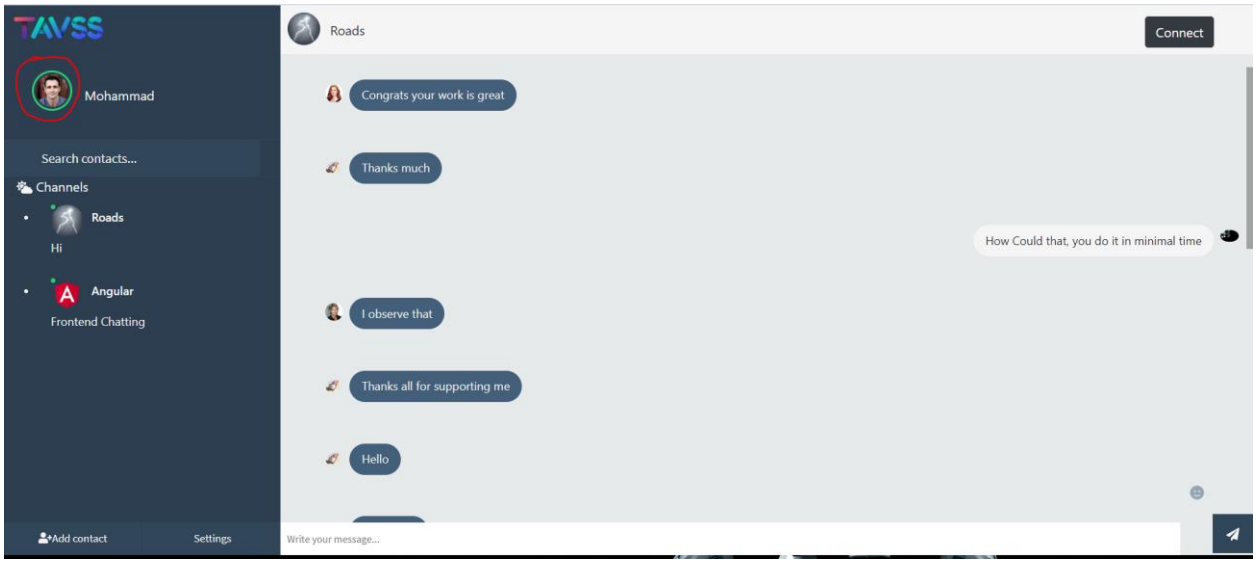


Figure 5-32 The Client App display images successfully

IMPLEMENTING THE GROUPS ON THE FRONTEND LAYERS

It must implement the Signalr packages by the Dependency injection using a new service shown in figure 5-33.

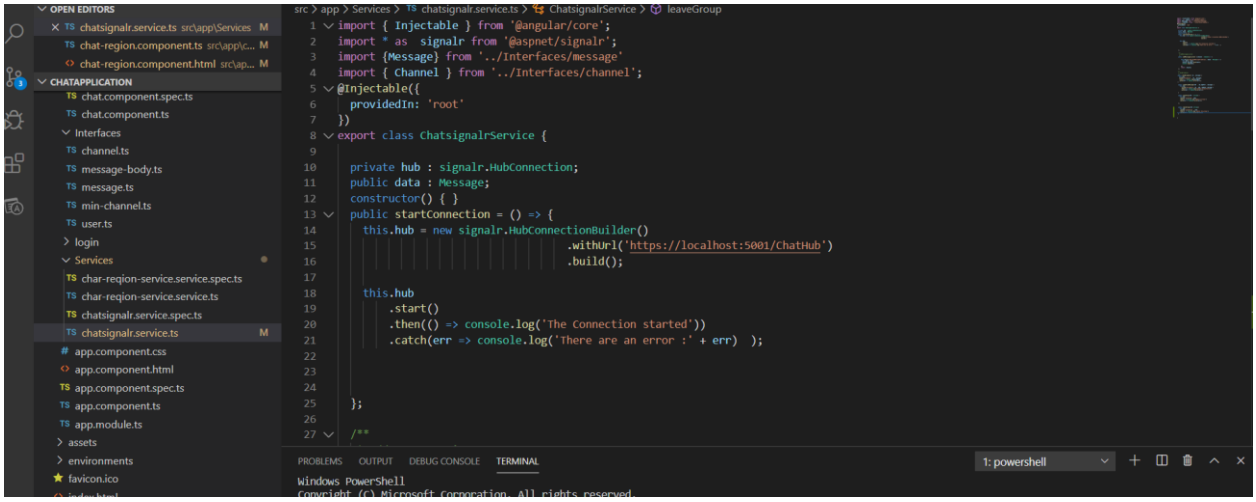


Figure 5-33 Creating a new service to inject the signalr packages

$ ng new service Services/chatSignalr

5.3 SIGNALR NOTIFICATIONS DEVELOPMENT

5.4 SIGNALR CHARTS DEVELOPMENT

The Charts is a channel to a user that contain large data and preview these data into a graph, make it easy for reports, ease access.

5.4.1 IMPLEMENTING CHARTS UNIDIRECTIONAL CHANNEL

First, creating a model that describe the data to be previewed illustrated in figure 5.34.

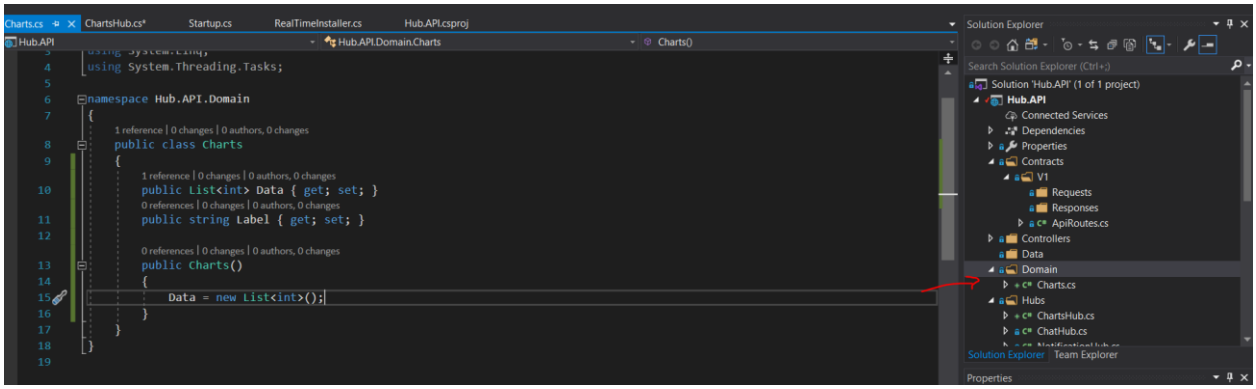


Figure 5-34 The Domain Model of the Charts Simulations

This form of data is expected by the Angular Charts library (which is yet to be installed), thus the model properties **Data and Label**.

Let's move to create the Hub where the connection initiated and used by creating a Hub for shown in figure 5-35.

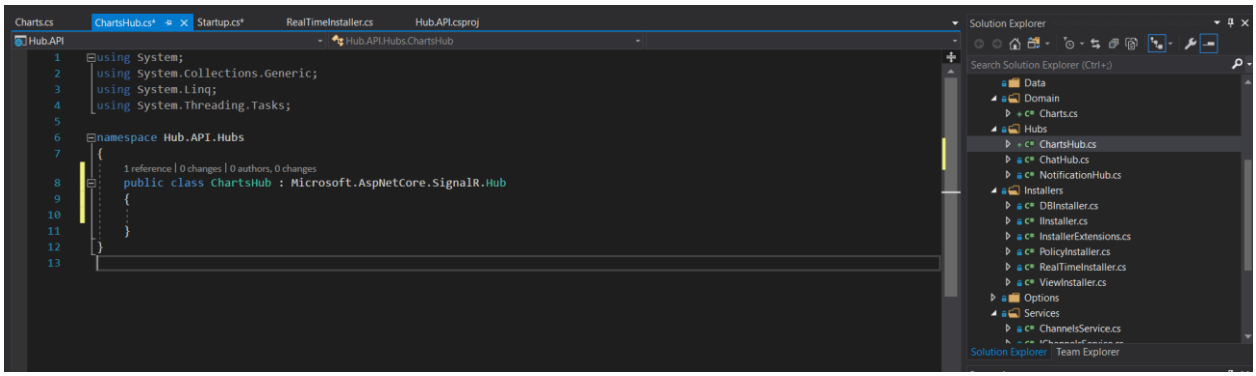


Figure 5-35 Implementing the Hub of Charts using the Signalr.Hub to Inherit

Then Mapping ChartsHub as endpoint and create its pipeline showing in figure 5.36

Figure 5-36 add a link to app that map the real-time sockets.

5.4.2 IMPLEMENTING TIMERMANAGER

To simulate a real-time data flow from the server, by implementing a Timer class from the **System.Threading** namespace. Let's create a new folder **TimerFeatures** and inside it a new class **TimerManager** illustrated in figure 5-37.

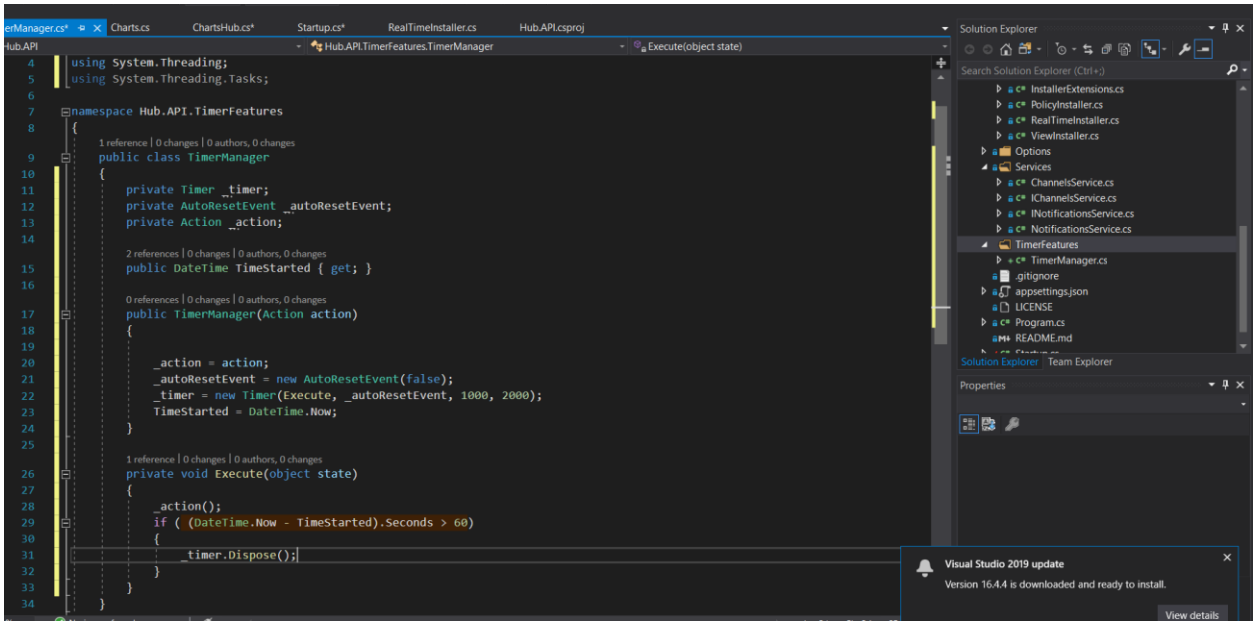


Figure 5-37 The TimerManager Class create a simulation technique of a time to check the real time

using an Action delegate to execute the passed callback function every two seconds. The timer will make a one-second pause before the first execution. Finally, just creating a sixty seconds time slot for execution, to avoid limitless timer loop. If learning more about delegates was needed and how to use them to write better C# code, you can visit Delegates in C# article.

It is important to have a method that has one object parameter and returns a void result. The Timer class expects that kind of method in its constructor.

5.5 FRONTEND ANGULAR SIGNALR CHARTS DEVELOPMENT

After creating The Real Time API, this API must serve the user in real-time mode and to Begin, Let's launch Angular application as SPA (Single Page Application) that consume all real-time services.

5.5.1 INSTALLING REQUIRED PACKAGES OF ANGULAR FROM NPM

Install the SignalR library for the client side. To do that, opening the Angular project in the Visual Studio Code and type the following command in the terminal window:

```
$ npm install -g @aspnet/signalr --save
```

Figure 5-38 installing java script aspnet signalr packages

Then installing the charts of Angular application, a package of responsive charts.

Angular Charts & Graphs for Web Applications

Angular Charts & Graphs for your Web Applications. Charts are Responsive & support animation, zooming, panning, events, exporting chart as image, drilldown & real-time updates. AngularJS Application including line, column, bar, pie, doughnut, range charts, stacked charts, stock charts, etc. To top it all off, it can render thousands of data-points without any performance lag.

More information: https://canvasjs.com/angular-charts/

Executing now the command to install this package from Node JS Package Manager

$ npm install ng2-charts --save

Figure 5-39 Solve Warnings about JS Modules

It seems that the application has some of warnings and starting to solve these warnings, first solving the problem of Karma-jasmine package by install its dependencies

$ npm install jasmine-core@>=3.5 –save

Second installing dependencies of Angular charts using following command:

$ npm install chart.js@^2.7.3 –save

5.5.2 CONFIGURING THE APLLICATION TO WORK WITH NEW PACKAGES

Adding the JS package to the configuration of angular in file of Angular.json in scripts Array

Then importing the module to app.modules.ts to start to consume them

```
"tsConfig": "tsconfig.app.json",
"aot": false,
"assets": [
  "src/favicon.ico",
  "src/assets"
],
"styles": [
  "src/styles.css"
],
"scripts": [
  "./node_modules/chart.js/dist/Chart.js"
]
},
"configurations": {
  "production": {
    "fileReplacements": [
      {
        "replace": "src/environments/environment.ts",
        "with": "src/environments/environment.prod.ts"
      }
    ],
```

Figure 5-40 Append the Chart JS to the Scripts

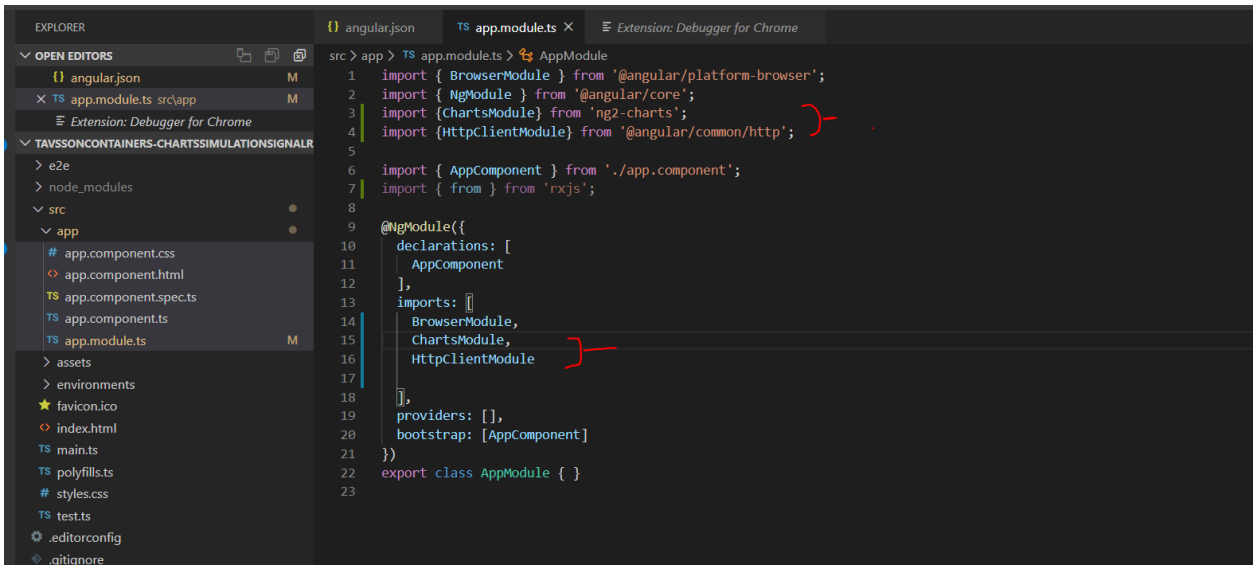


Figure 5.41 importing modules of charts and the client of rest

Of course, the HttpClientModule is not required for the charts to work, but the HTTP request will be send towards the server, so it is needed.

5.5.3 IMPLEMENTING THE SIGNALR LOGIC

Let's Create a service for the sole purpose to wrap the SignalR logic

$ ng g service services/signal-r --spec false

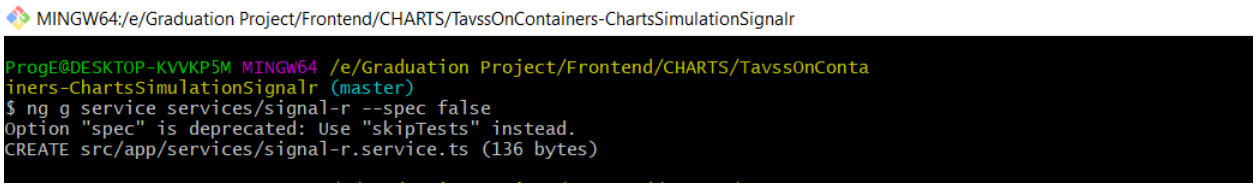


Figure 5-42 creating the service of SIGNALR

Then generate an interface (ChartModel) to map the resources of the backend logic and implement the 2 properties the Data as Array and The Label as String

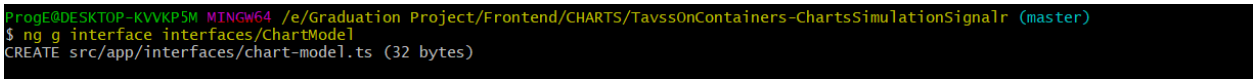


Figure 5-43 creating an interface for the charts receiving the models

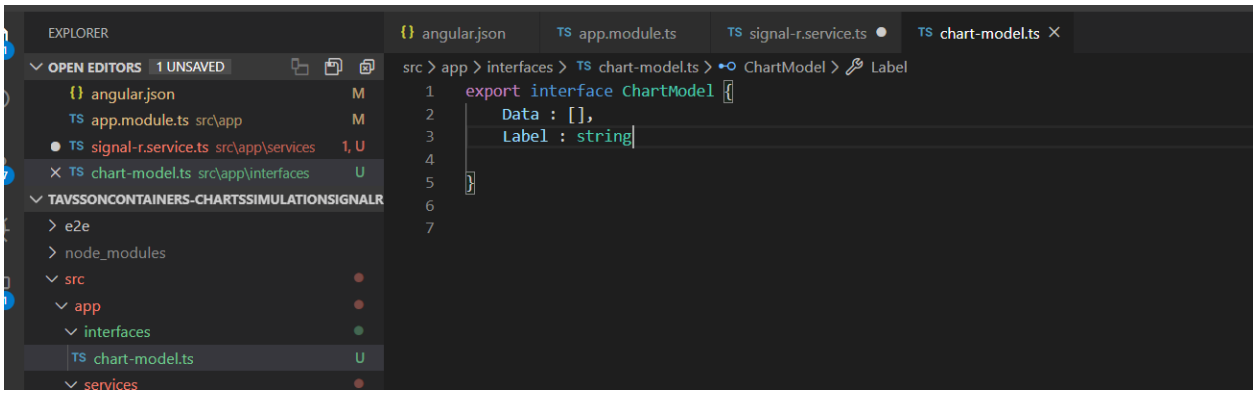


Figure 5-44 implementing the interface

By creating 2 folders:

- The first for Interfaces to map data from the server
- The Second is Services to contain the consumed modules logic like (Signalr , HttpContext)

5.5.4 CONSUMING THE SIGNALR SERVICES

First, the module must be imported to its service call it from the node_modules packages:

```
import * as  signalr from '@aspnet/signalr';
```

figure5.45

the signalr property now containing all SignalR's modules that can be consumed over application. Then importing the interface ChartModel to map the data into an object created from it.

```
import { ChartModel } from '../interfaces/chart-model';
```

figure5.46

Defining Prosperities to consume these modules into class. Making an array of data as ChartModel array and using a hubConnection object that can manipulate the functionality of Signalr.

```
  public data : ChartModel[];
  private hubConnection : signalr.HubConnection
```

figure5.47

Starting by configure the connection by the server, declaring what is the IP and which Route can be the Socket in then building in the hubConnection object

```
    this.hubConnection = new signalr.HubConnectionBuilder()
                                    .withUrl('https://localhost:5001/Charts')
                                    .build();
```

figure5.48

Now after configuration, Starting the connection and maintain the connection if it's lost, the log message created.

```
    this.hubConnection
        .start()
        .then(() => console.log('The Connection started'))
        .catch(err => console.log('There are an error :' + err)  );
```

figure5.49

Then in ON mode the server sent events data so, Application must capture these data from its pipe using listener to a server, it is strange that a client app using listeners but the rule is one, have the same name of the pipe in the server declared in section 5.4.

```
  public addTransferChartDataListner =() => {
    this.hubConnection.on('TransferCharts', (data) => {
      this.data = data;
      console.log(data);
    });
```

figure5.50

The whole service is implemented in figure 5.51

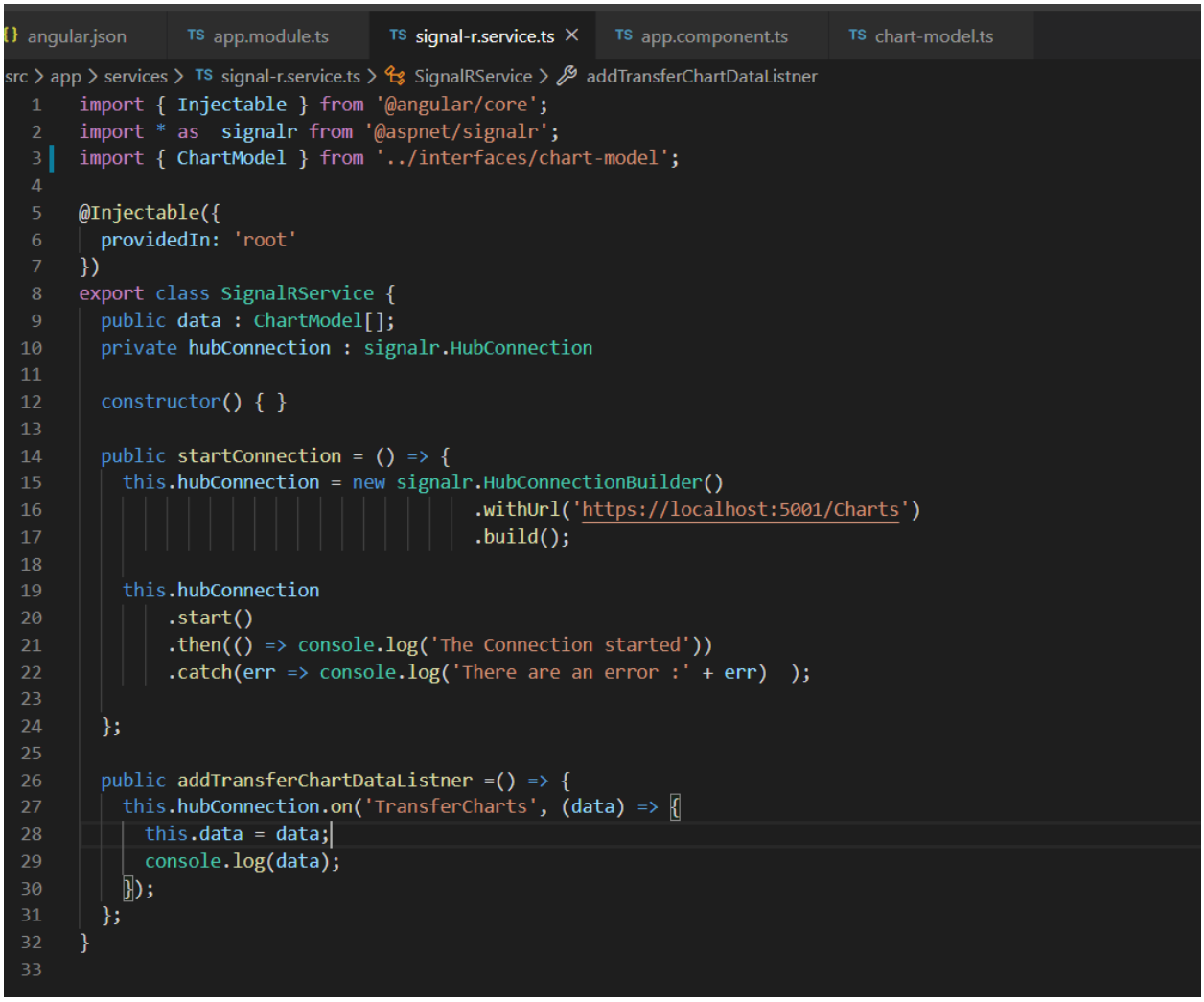


figure5.51

5.5.5 CONSUMING SERVICES AND RESTFUL APP AS A UI

Using now the Dependency Injection to create a separate object that consume these modules of The Service (Siganal-r) and the HttpClient to maintain CRUD vs REST operations.

In the start or The ngOnInit() calling the Initiation and Listening methods then log all responses to console as messages to check illustrated in figure 5-52.

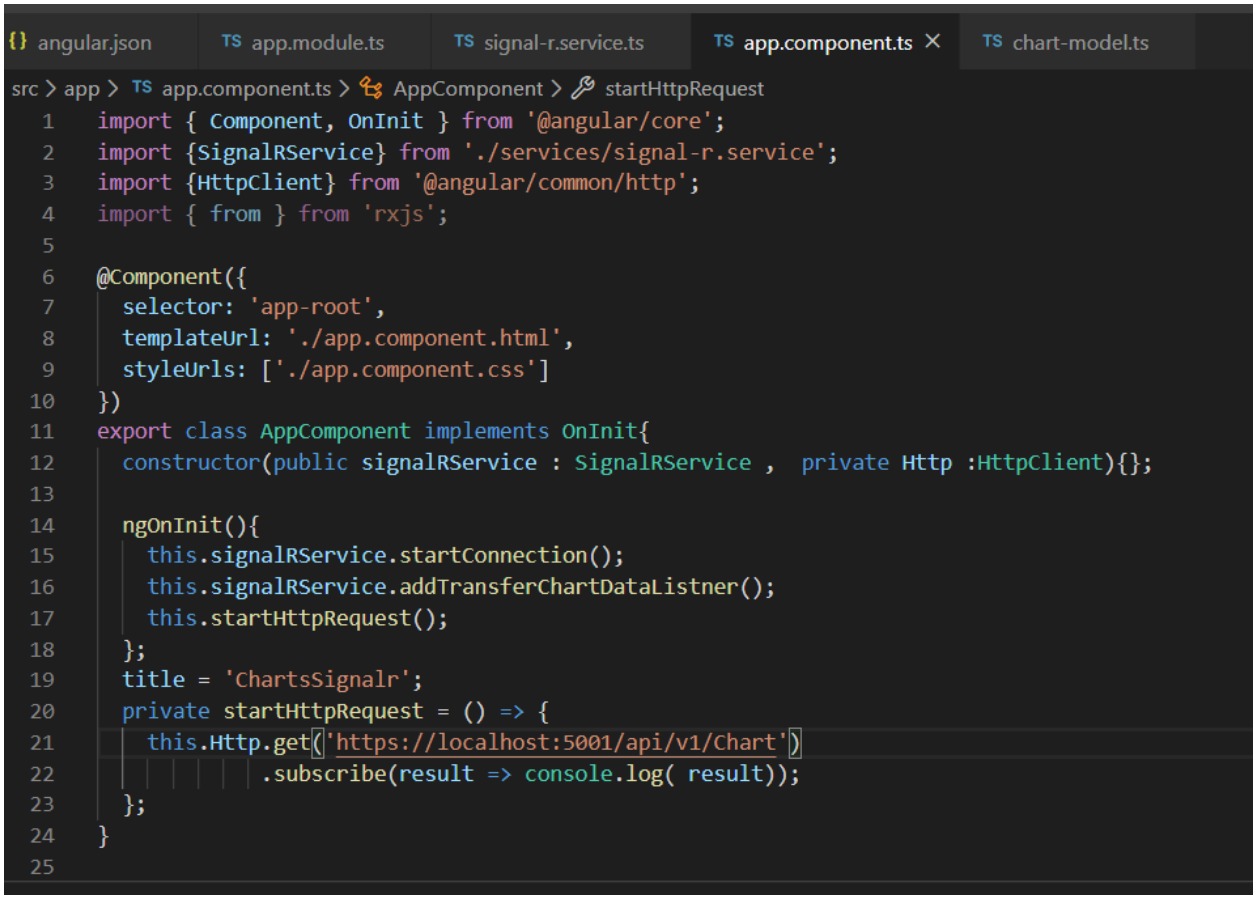


Figure 5-52 implement the REST API client service

5.5.6 BUILDING AND TESTING THE RESULTS OF SERVER

First run the Hub.API for a server and the Angular App to check the results shown in figure 5-53.

```
ProgE@DESKTOP-KVVKP5M MINGW64 /e/Graduation Project/Frontend/CHARTS/TavssOnContainers-ChartsSimulationSignalr (master)
$ ng serve
i ｢wds｣: Project is running at http://localhost:4200/webpack-dev-server/
i ｢wds｣: webpack output is served from /
i ｢wds｣: 404s will fallback to //index.html

chunk {main} main.js, main.js.map (main) 64.6 kB [initial] [rendered]
chunk {polyfills} polyfills.js, polyfills.js.map (polyfills) 268 kB [initial] [rendered]
chunk {runtime} runtime.js, runtime.js.map (runtime) 6.15 kB [entry] [rendered]
chunk {scripts} scripts.js, scripts.js.map (scripts) 393 kB [entry] [rendered]
chunk {styles} styles.js, styles.js.map (styles) 9.75 kB [initial] [rendered]
chunk {vendor} vendor.js, vendor.js.map (vendor) 5.62 MB [initial] [rendered]
Date: 2020-02-05T01:11:17.437Z - Hash: a9e8bdc2dddf01374b98 - Time: 12404ms
** Angular Live Development Server is listening on localhost:4200, open your browser on http://localhost:4200/ **
i ｢wdm｣: Compiled successfully.
i ｢wdm｣: Compiling...

Date: 2020-02-05T01:36:59.264Z - Hash: a48f316bc7fd4e5305f5
5 unchanged chunks
chunk {main} main.js, main.js.map (main) 64.6 kB [initial] [rendered]
Time: 2405ms
i ｢wdm｣: Compiled successfully.
i ｢wdm｣: Compiling...

Date: 2020-02-05T01:58:39.139Z - Hash: a48f316bc7fd4e5305f5
6 unchanged chunks

Time: 1491ms
i ｢wdm｣: Compiled successfully.
i ｢wdm｣: Compiling...

Date: 2020-02-05T02:25:30.418Z - Hash: 733bd68daafe858e90cf
5 unchanged chunks
chunk {main} main.js, main.js.map (main) 64.6 kB [initial] [rendered]
Time: 1063ms
i ｢wdm｣: Compiled successfully.
i ｢wdm｣: Compiling...

Date: 2020-02-05T03:58:17.077Z - Hash: 733bd68daafe858e90cf
6 unchanged chunks

Time: 2738ms
i ｢wdm｣: Compiled successfully.
```

Figure 5-53 running the angular app

Now by checking results the Get Method worked successfully and the results is real-time by it changed every 2 seconds declared in the TimerManager => see the last section of the server illustrated in figure 5-54.

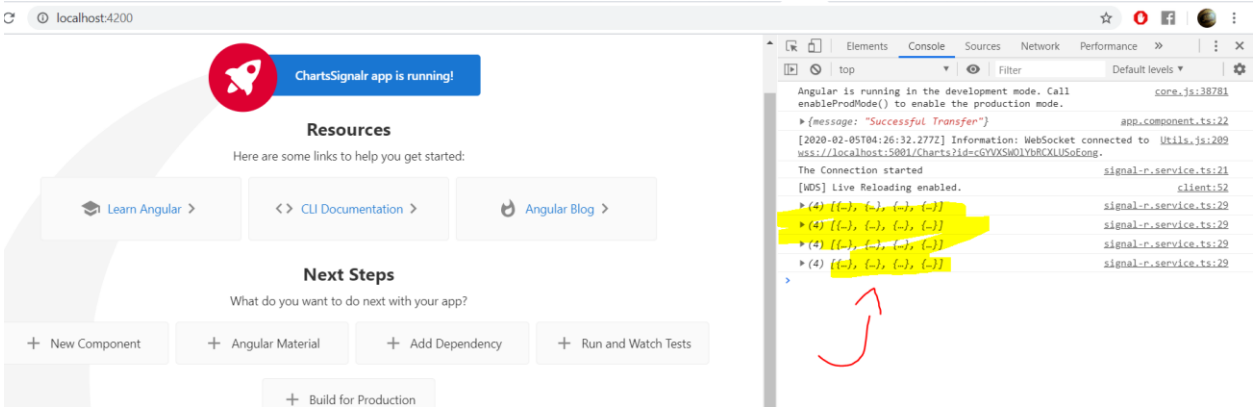


Figure 5-54 results of real-time models.

5.5.7 DESIGN THE CHARTS UI AS CANVAS TO SHOW RESULTS

Implementing the UIs is a good practice when the Developer practice the Real-Time Services, Now going to consume the Charts Modules of Angular and to consume it, it's just a canvas of JS and contain some configurations first.

So, beginning to configure the canvas from the TypeScript component it has:

- chartOptions that contain several params like scaling and the point of drawing

```
public chartOptions: any ={
  scaleShowVerticalLines: true,
  responsive: true,
  scales: {
    yAxes: [{
      ticks: {
        beginAtZero: true
      }
    }]
  }
};
```

figure5.55

- chartLabels is a string array that contain the Labels over x axis required from server

```
public chartLabels : string[] = ["Real Time Data for The Chart"];
```

figure5.56

- chartLegend is a Boolean determine if the chart need a legend section or not.

```
public chartLegend :boolean = false;
```

figure5.57

- chartType is a string determine the chart type, so implementing as bars.

```
public chartType : string = 'bar';
```

figure5.58

- The Colors of every bar determined by colors as array of CSS elements

```
public colors : any[] =[{backgroundColor : '#5491DA' }, { backgroundColor: '
#E74C3C' },{ backgroundColor: '#82E0AA' }, { backgroundColor: '#E5E7E9' }];
```

figure5.59

showing the modification in figure 5.60

```
src > app > app.component.ts > AppComponent > chartType
import {HttpClient} from '@angular/common/http';
import { from } from 'rxjs';

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.css']
})
export class AppComponent implements OnInit{

  public chartOptions: any ={
    scaleShowVerticalLines: true,
    responsive: true,
    scales: {
      yAxes: [{
        ticks: {
          beginAtZero: true
        }
      }]
    }
  };
  public chartLabels : string[] = ["Real Time Data for The Chart"];
  public chartType : string = 'bar';
  public chartLegend :boolean = false;
  public colors : any[] =[{backgroundColor : '#5491DA' }, { backgroundColor: '#E74C3C' },
   { backgroundColor: '#82E0AA' }, { backgroundColor: '#E5E7E9' }];

  constructor(public signalRService : SignalRService ,  private Http :HttpClient){};

  ngOnInit(){
    this.signalRService.startConnection();
    this.signalRService.addTransferChartDataListner();
    this.startHttpRequest();
  };
```

figure5.60

Now creating the Html content to consume the canvas chart showing in figure.5.61

```
src > app > app.component.html > ...
<div style="display: block;" *ngIf="signalRService.data">
  <canvas baseChart
          [datasets] = 'signalRService.data'
          [labels] = 'chartLabels'
          [options] = 'chartOptions'
          [legend] = 'chartLegend'
          [chartType] = 'chartType'
          [colors]= 'colors'
          >

  </canvas>

</div>
```

figure5.61

And here are the results of running the server and the Angular app representing the real-time changing of data illustrated in figure 5.62

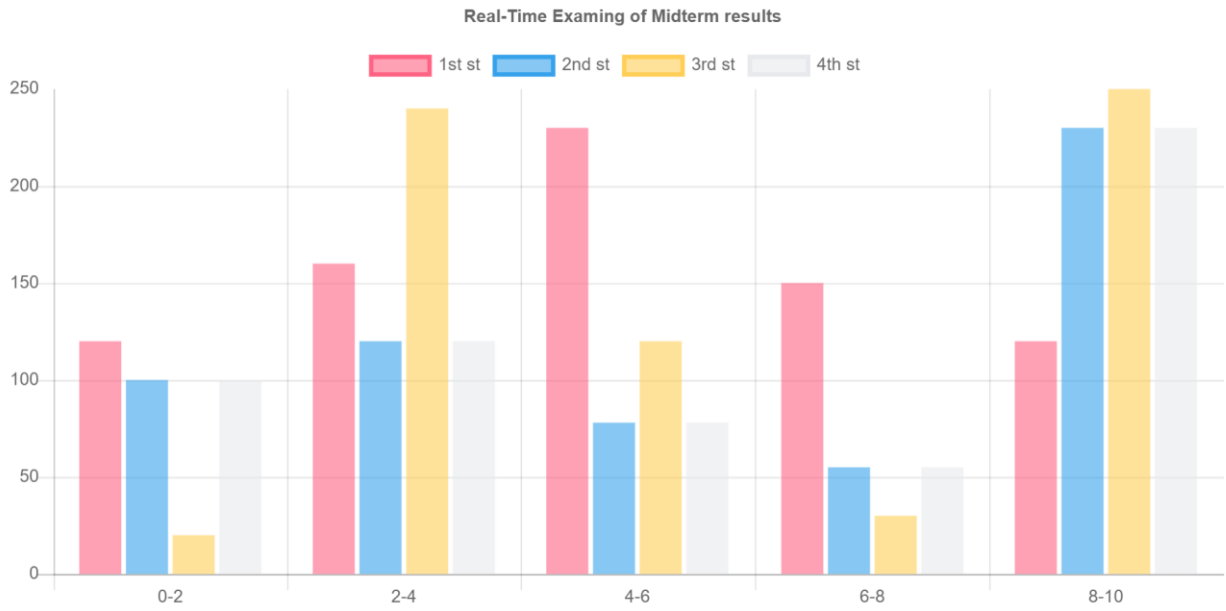


figure5.62

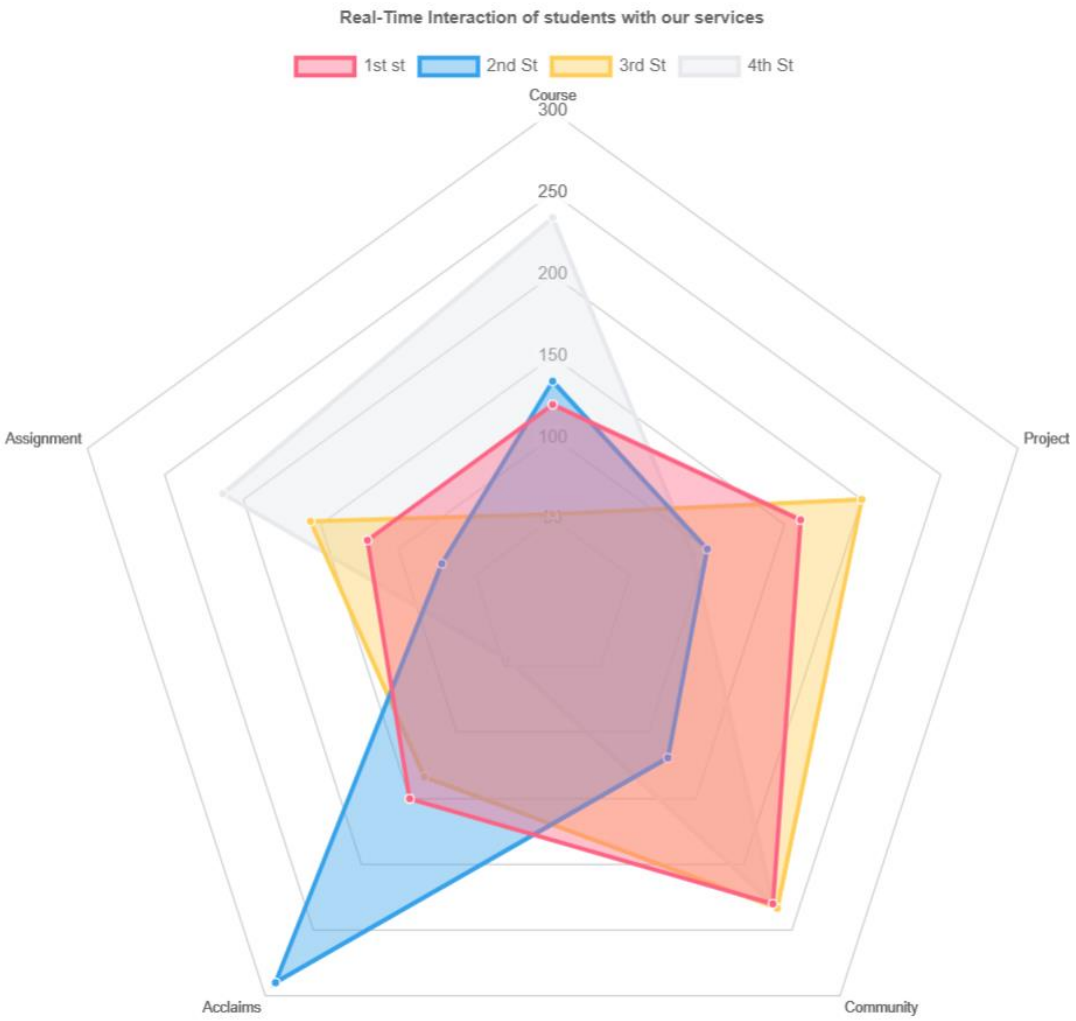

Real-Time Interaction of students with our services
1st st
2nd St
3rd St
4th St
Course
300
250
200
150
100
Assignment
Project
Acclaims
Community

figure5.63

CHAPTER 6: DEPLOYMENT OF MICROSERVICES

There are a variety of techniques to deploy new applications to production, so choosing the right strategy is an important decision, weighing the options in terms of the impact of change on the system, and on the end-users.

It will be good to explain these approaches before work:

6.1 TRADITIONAL DEPLOYMENT VS MODERN APPROACHES

Let's imagine that the version A is going to be changed with version B and the approaches and techniques will develop a way to execute the deployment phase these approaches can be:

- **Recreate**: Version A is terminated then version B is rolled out.
- **Ramped (also known as rolling-update or incremental)**: Version B is slowly rolled out and replacing version A.
- **Blue/Green**: Version B is released alongside version A, then the traffic is switched to version B.
- **Canary**: Version B is released to a subset of users, then proceed to a full rollout.
- **A/B testing**: Version B is released to a subset of users under specific condition.
- **Shadow**: Version B receives real-world traffic alongside version A and doesn't impact the response.

6.1.1 RECREATE APPROACH {TRADITIONAL AND NON-CONSISTENT}

The recreate strategy is a dummy deployment which consists of shutting down version A then deploying version B after version A is turned off. This technique implies downtime of the service that depends on both shutdown and boot duration of the application as illustrated in figure 6-1.[17]

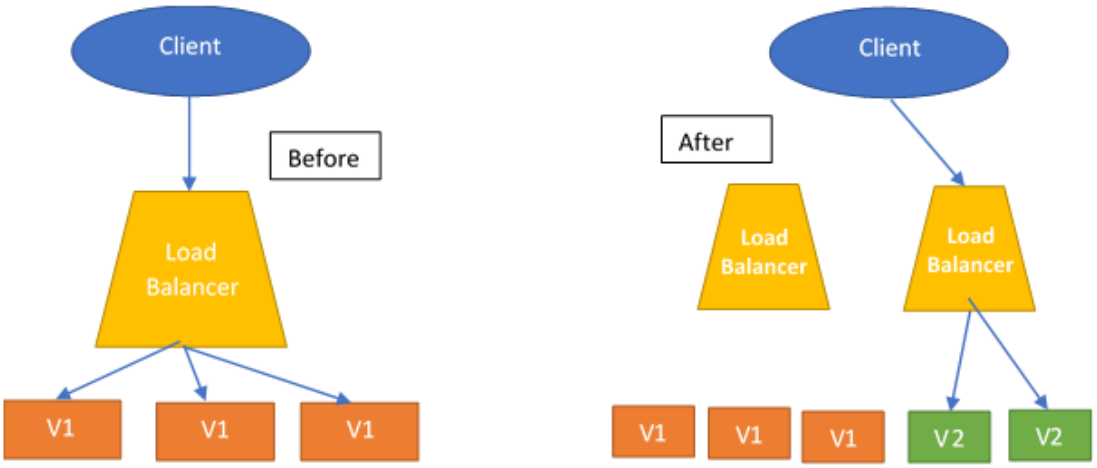


Figure 6.1 Shutdown the V1 and release V2 {The Recreation Approach}

Pros:

- Easy to setup.
- Application state entirely renewed.

Cons:

- High impact on the user, expect downtime that depends on both shutdown and boot duration of the application.

6.1.2 RAMPED APPROACH {INCREMENTAL MODEL}

The ramped deployment strategy consists of slowly rolling out a version of an application by replacing instances one after the other until all the instances are rolled out. It usually follows the following process: with a pool of version A behind a load balancer, one instance of version B is deployed. When the service is ready to accept traffic, the instance is added to the pool. Then, one instance of version A is removed from the pool and shut down. [17]

Depending on the system taking care of the ramped deployment, the enterprise can tweak the following parameters to increase the deployment time:

- **Parallelism, max batch size**: Number of concurrent instances to roll out.
- **Max surge**: How many instances to add in addition of the current amount.
- **Max unavailable**: Number of unavailable instances during the rolling update procedure.

Pros:

- Easy to set up.

- Version is slowly released across instances.
- Convenient for stateful applications that can handle rebalancing of the data.

Cons:

- Rollout/rollback can take time.
- Supporting multiple APIs is hard.
- No control over traffic.

This process begins when alternate the modular inside the project with the new version of modular project incremental deployment the new version and decremental as shutdowns in the old version as illustrated in figure 6-1-2.

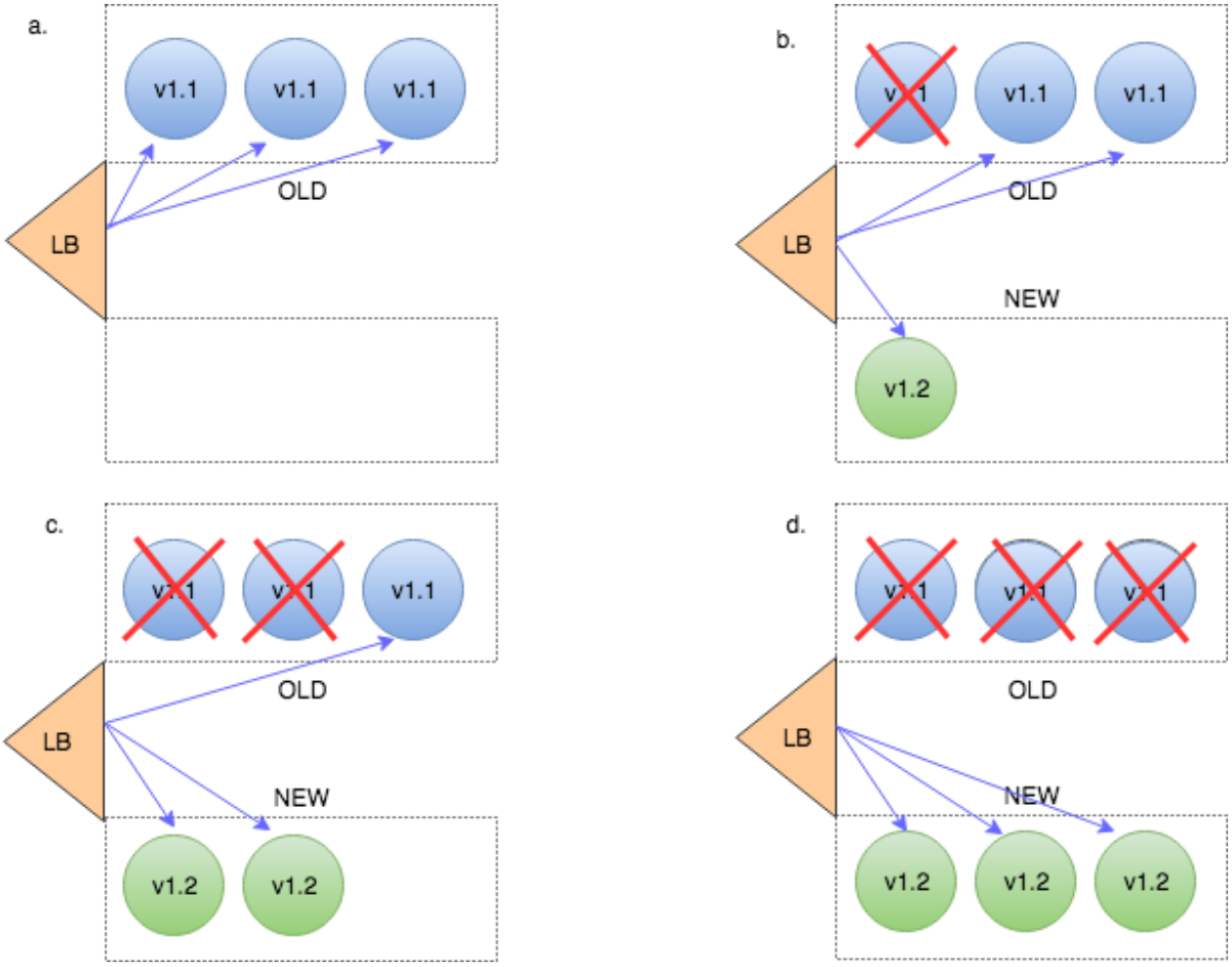


Figure 6-2 The Incremental approach of deployment

6.1.3 BLUE/GREEN APPROACH OR A/B APPROACH {PARALLEL APROACH}

The blue/green deployment strategy differs from a ramped deployment, version B (green) is deployed alongside version A (blue) with exactly the same number of instances.

After testing that the new version meets all the requirements the traffic is switched from version A to version B at the load balancer level shown in figure 6-3.

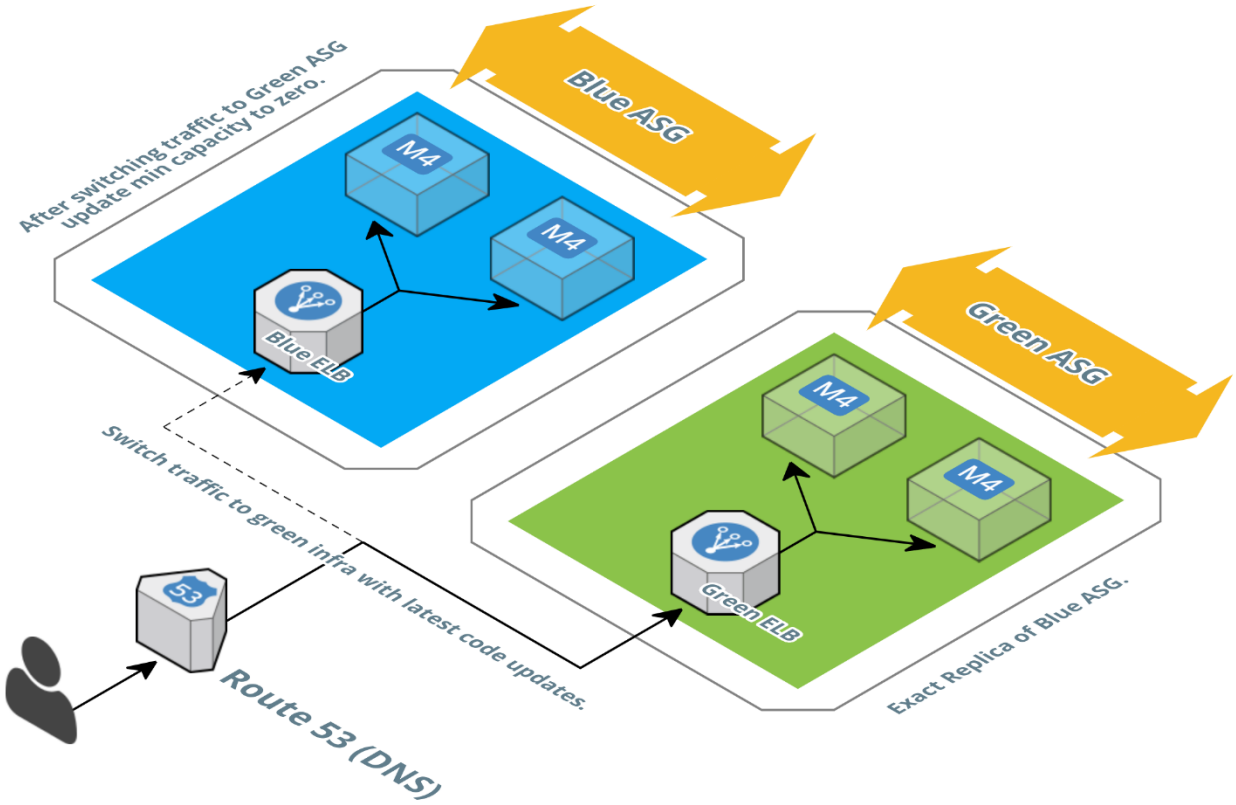


Figure 6-3 The Blue/Green Approach, switching the traffic to green infra.

This is another fail-safe process. In this method, two identical production environments work in parallel.

One is the currently-running production environment receiving all user traffic (depicted as Blue). The other is a clone of it, but idle (Green). Both use the same database back-end and app configuration showing in figure 6-4.

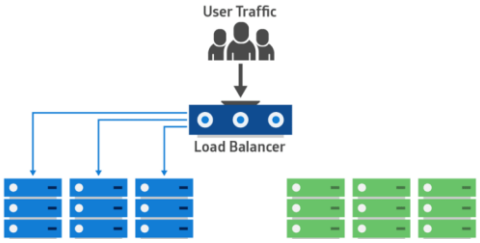


Figure 6-4 tow versions, load balancer manipulate blue's

The new version of the application is deployed in the green environment and tested for functionality and performance. Once the testing results are successful, application traffic is routed from blue to green. Green then becomes the new production illustrated in figure 6-5.[18]

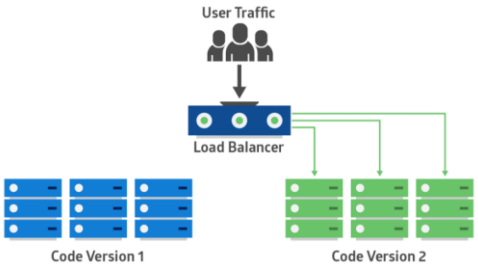


Figure 6-5 routing the traffic to the new version deployed

6.1.4 CANARY DEPLOYMENT

A canary deployment consists of gradually shifting production traffic from version A to version B. Usually the traffic is split based on weight. For example, 90 percent of the requests go to version A, 10 percent go to version B.

This technique is mostly used when the tests are lacking or not reliable or if there is little confidence about the stability of the new release on the platform.

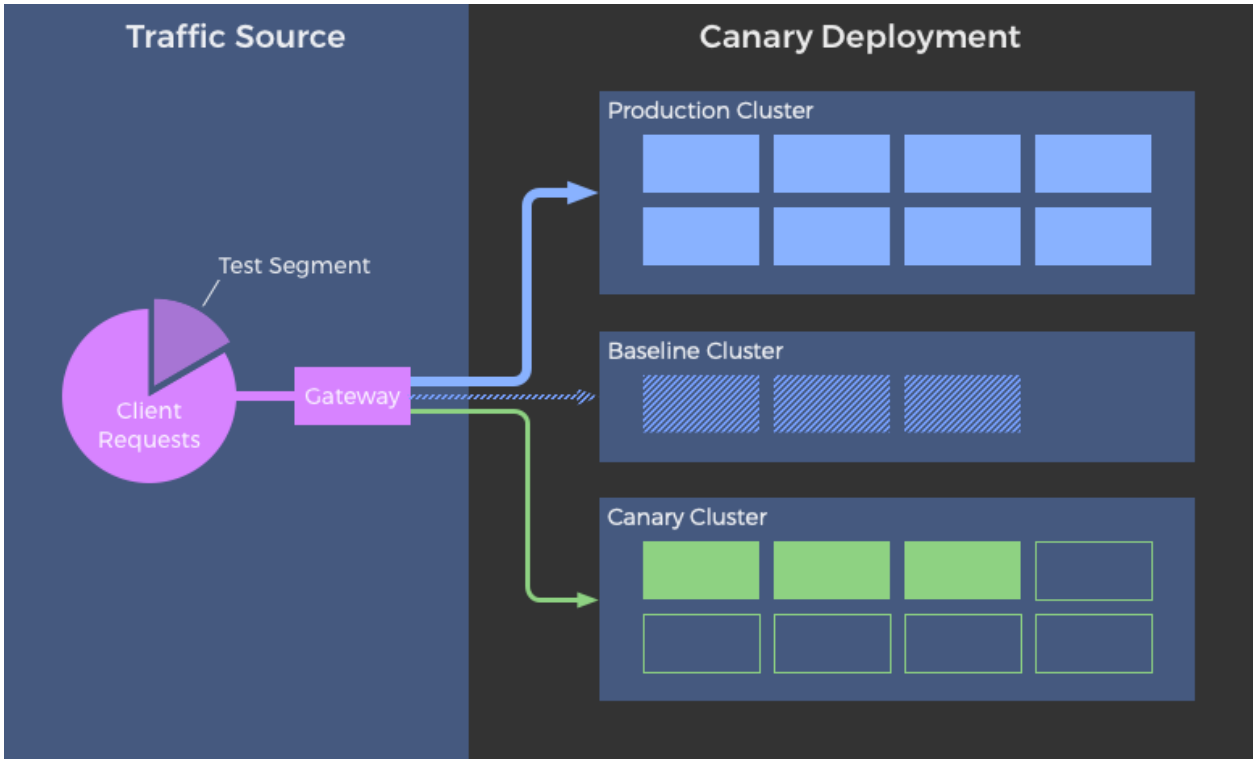


Figure 6-6 Canary deployment good way to test it incrementally

Pros:

- Version released for a subset of users.
- Convenient for error rate and performance monitoring.
- Fast rollback.

Con:

- Slow rollout.

6.1.5 A/B TESTING

A/B testing deployments consists of routing a subset of users to a new functionality under specific conditions. It is usually a technique for making business decisions based on statistics, rather than a deployment strategy. However, it is related and can be implemented by adding extra functionality to a canary deployment so we will briefly discuss it here.

This technique is widely used to test conversion of a given feature and only roll-out the version that converts the most.

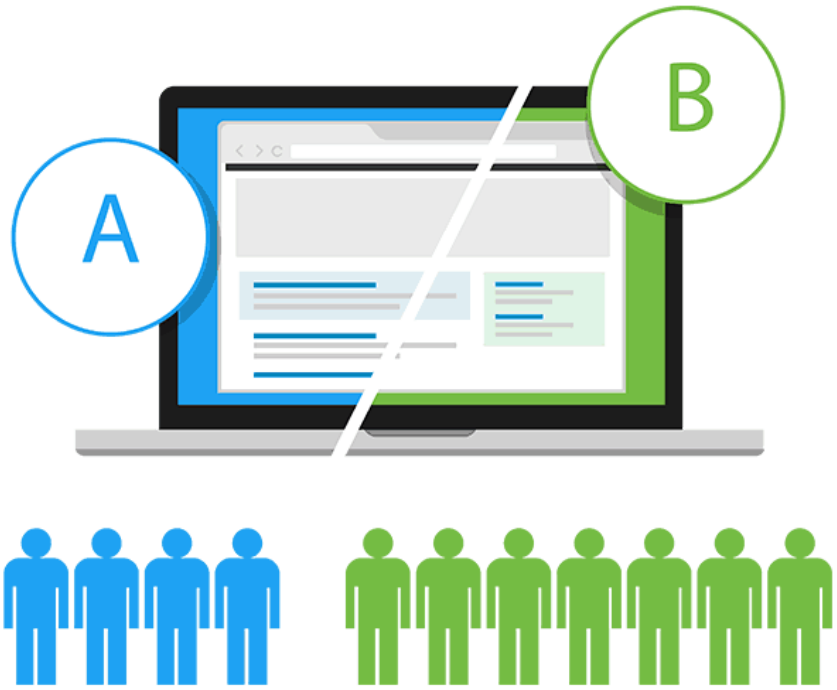


Figure 6-7 Divide the versions between chosen segments to test it before rolling out

Here is a list of conditions that can be used to distribute traffic amongst the versions:

- By browser cookie
- Query parameters
- Geo-localization
- Technology support: browser version, screen size, operating system, etc.
- Language

Pros:

- Several versions run in parallel.
- Full control over the traffic distribution.

Cons:

- Requires intelligent load balancer.
- Hard to troubleshoot errors for a given session, distributed tracing becomes mandatory.

6.1.6 SHADOW

A shadow deployment consists of releasing version B alongside version A, fork version A's incoming requests and send them to version B as well without impacting production traffic. This is particularly useful to test production load on a new feature. A rollout of the application is triggered when stability and performance meet the requirements.

This technique is fairly complex to setup and needs special requirements, especially with egress traffic. For example, given a shopping cart platform, if you want to shadow test the payment service you can end-up having customers paying twice for their order. In this case, you can solve it by creating a mocking service that replicates the response from the provider.

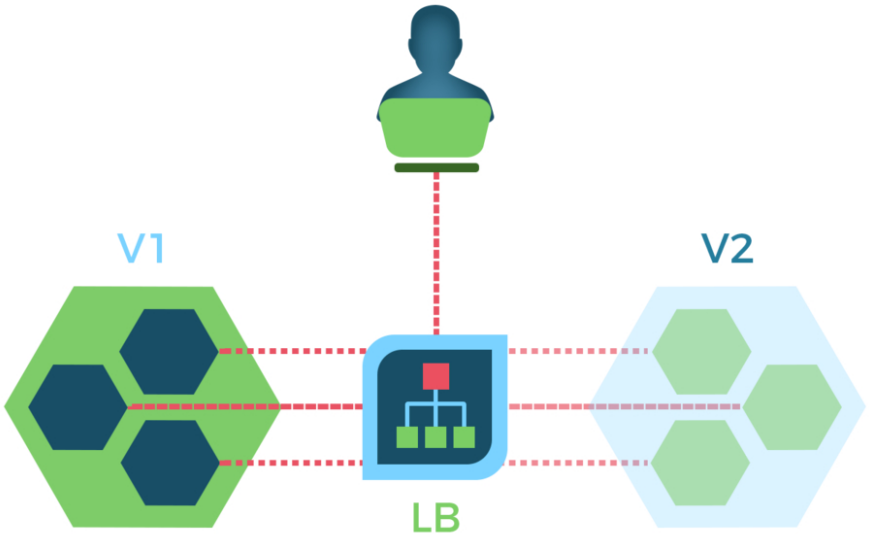


Figure 6-8 the LB need to send the request twice for the two versions

Pros:

- Performance testing of the application with production traffic.
- No impact on the user.
- No rollout until the stability and performance of the application meet the requirements.

Cons:

- Expensive as it requires double the resources.
- Not a true user test and can be misleading.
- Complex to setup.
- Requires mocking service for certain cases.

6.1.7 SUM UP

There are multiple ways to deploy a new version of an application and it really depends on the needs and budget. When releasing to development/staging environments, a recreate or ramped deployment is usually a good choice. When it comes to production, a ramped or blue/green deployment is usually a good fit, but proper testing of the new platform is necessary.

Blue/green and shadow strategies have more impact on the budget as it requires double resource capacity. If the application lacks in tests or if there is little confidence about the impact/stability of the software, then a canary, a/ b testing or shadow release can be used. If the business requires testing of a new feature amongst a specific pool of users that can be filtered depending on some parameters like geolocation, language, operating system or browser features, then the a/b testing technique may be used.

Last but not least, a shadow release is complex and requires extra work to mock egress traffic which is mandatory when calling external dependencies with mutable actions (email, bank, etc.). However, this technique can be useful when migrating to a new database technology and use shadow traffic to monitor system performance under load.

To more explaining the diagram in figure 6-9from container solutions website:

Figure 6.9 The Development Strategies

DEPLOYMENT STRATEGIES

When it comes to production, a ramped or blue/green deployment is usually a good fit, but proper testing of the new platform is necessary.

Blue/green and shadow strategies have more impact on the budget as it requires double resource capacity. If the application lacks in tests or if there is little confidence about the impact/stability of the software, then a canary, a/b testing or shadow release can be used.

If your business requires testing of a new feature amongst a specific pool of users that can be filtered depending on some parameters like geolocation, language, operating system or browser features, then you may want to use the a/b testing technique.

Container Solutions

Strategy	ZERO DOWNTIME	REAL TRAFFIC TESTING	TARGETED USERS	CLOUD COST	ROLLBACK DURATION	NEGATIVE IMPACT ON USER	COMPLEXITY OF SETUP
RECREATE version A is terminated then version B is rolled out	✗	✗	✗	■□□	■■■	■■■	□□□
RAMPED version B is slowly rolled out and replacing version A	✓	✗	✗	■□□	■■■	■□□	■□□
BLUE/GREEN version B is released alongside version A, then the traffic is switched to version B	✓	✗	✗	■■■	□□□	■■□	■■□
CANARY version B is released to a subset of users, then proceed to a full rollout	✓	✓	✗	■□□	■□□	■□□	■■□
A/B TESTING version B is released to a subset of users under specific condition	✓	✓	✓	■□□	■□□	■□□	■■■
SHADOW version B receives real world traffic alongside version A and doesn't impact the response	✓	✓	✗	■■■	□□□	□□□	■■■

TAVSS

6.2 WHY DOCKER TO DEPLOY

Getting down to the nuts and bolts, Docker allows applications to be isolated into containers with instructions for exactly what they need to survive that can be easily ported from machine to machine. Virtual machines also allow the exact same thing, and numerous other tools like Chef and Puppet already exist to make rebuilding these configurations portable and reproducible.

While Docker has a more simplified structure compared to both of these, the real area where it causes disruption is resource efficiency.

6.3 DOCKER APPLICATIONS

6.3.1 DOCKER SWARM AND COMPOSE

A Docker Swarm is a group of either physical or virtual machines that are running the Docker application and that have been configured to join in a cluster. Once a group of machines have been clustered together, it can still run the Docker commands that it used to, but they will now be carried out by the machines in your cluster. The activities of the cluster are controlled by a swarm manager, and machines that have joined the cluster are referred to as nodes.

Compose is a tool for defining and running multi-container Docker applications. With Compose, you use a YAML file to configure your application's services. Then, with a single command, creating and starting all the services from the configuration.

Now, Beginnings of create the docker compose file is some how can be confused as there have many configurations and orders to complete

6.3.2 AZURE SERVICE FABRIC

Focus on building applications and business logic, and let Azure solve the hard distributed systems problems such as reliability, scalability, management, and latency. Service Fabric is an open source project and it powers core Azure infrastructure as well as other Microsoft services such as Skype for Business, Intune, Azure Event Hubs, Azure Data Factory, Azure Cosmos DB, Azure SQL Database, Dynamics 365, and Cortana. Designed to deliver highly available and durable services at cloud-scale, Azure Service Fabric intrinsically understands the available infrastructure and resource needs of applications, enabling automatic scale, rolling upgrades, and self-healing from faults when they occur.

The Azure Service Fabric nodes can run on Azure ore on Premises or on other clouds illustrated in 6-10.

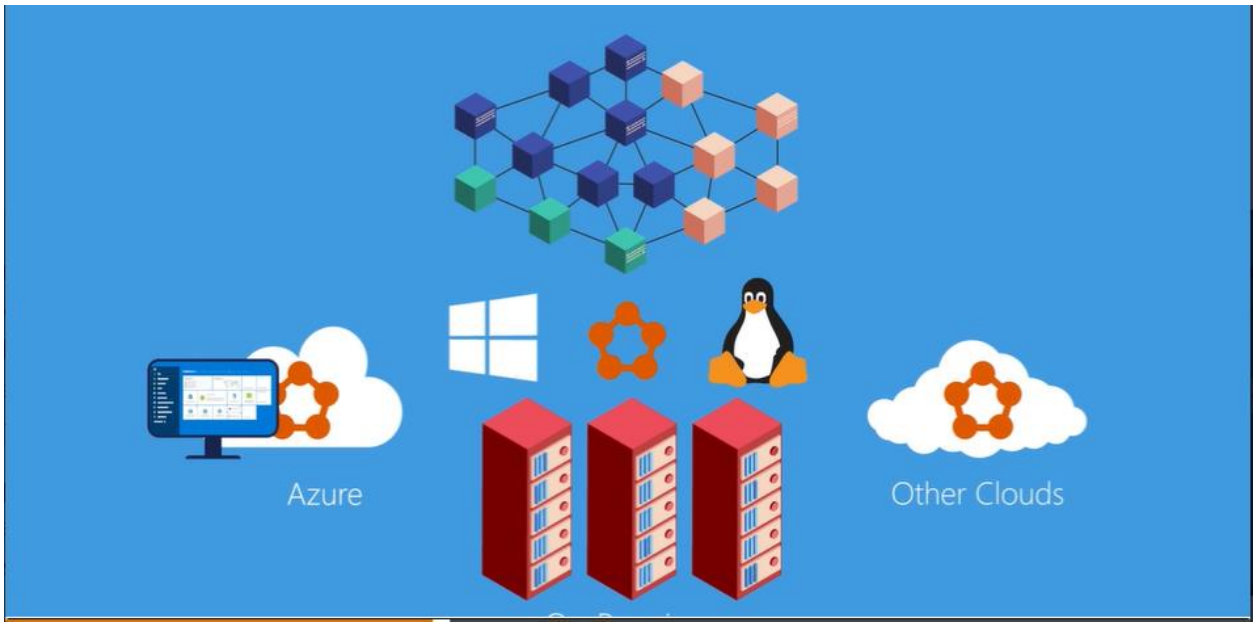


Figure 6-10 Install Azure Service Fabric in different hosting environments

6.3.3 KUBERNETES

Kubernetes (K8s) is an open-source system for automating deployment, scaling, and management of containerized applications.

- Kubectl:
  - a CLI tool for Kubernetes
- Master Node:
  - The main machine that controls the nodes
  - Main entrypoint for all administrative tasks
  - It handles the orchestration of the worker nodes

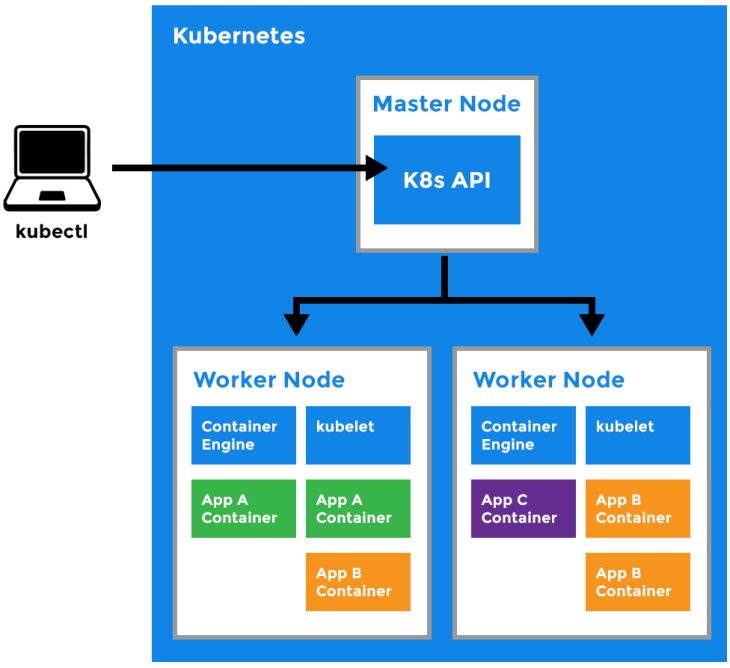


Figure 6-11

- **Worker Node:**

    - It is a worker machine in Kubernetes (used to be known as minion)
    - This machine performs the requested tasks. Each Node is controlled by the Master Node
    - Runs containers inside pods
    - This is where the Docker engine runs and takes care of downloading images and starting containers

6.4 IMPLEMENT DOCKER COMPOSE

IMPLEMENT THE COMPOSE FOR OUR APPLICATIONS AND SERVICES

The Docker Compose file written in YAML, compose the services:

- Identity
- Courses
- Projects
- Communities
- Acclaims

to run them together and databases:

- SQL Server
- MongoDb

And other API Gateways:

- Students.Bff.Web
- Doctor.Bff.web
- ….

Illustrated in figure 6-12.

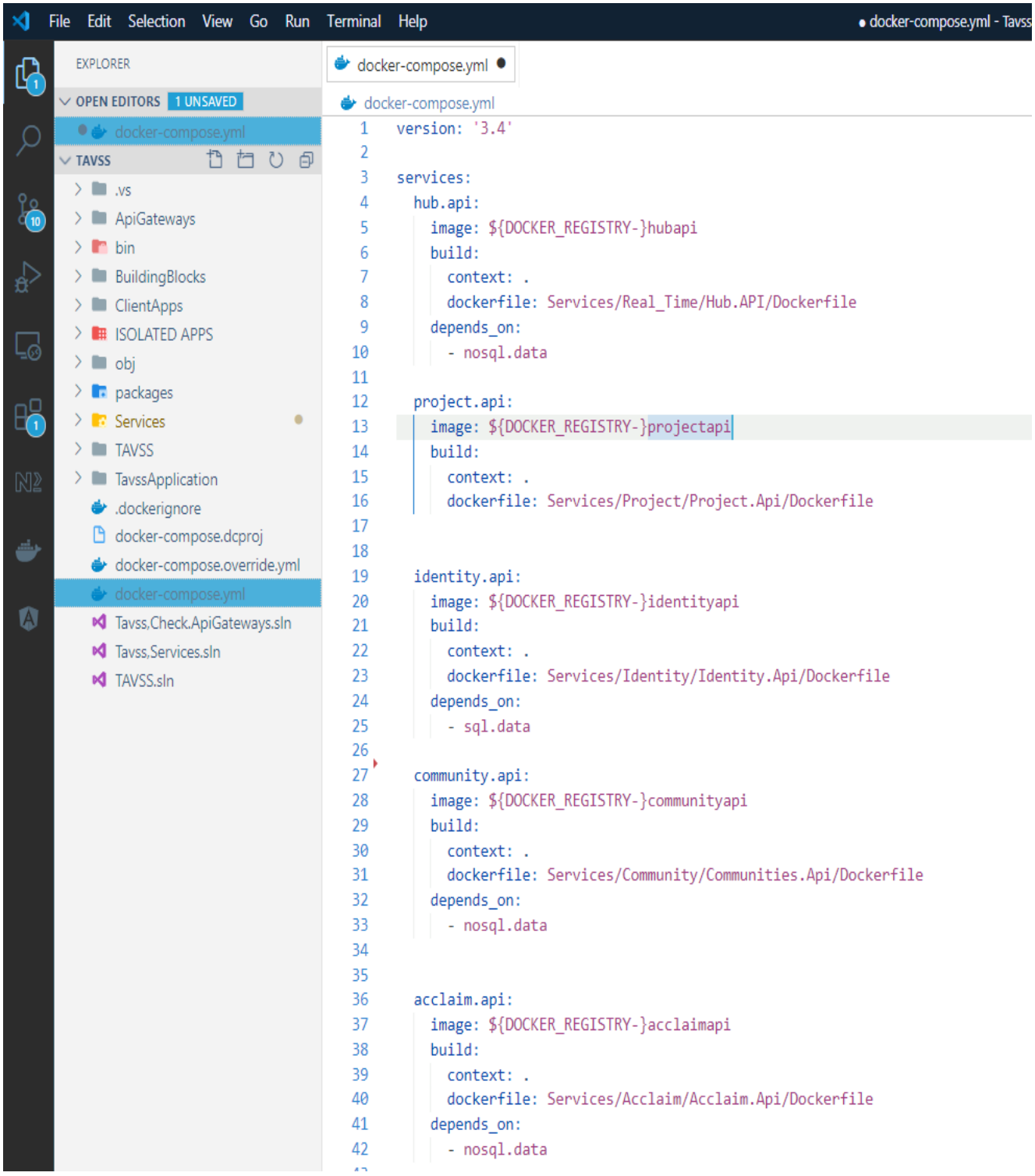


Figure 6-12 Implementing docker compose over apps

```
43
44      web.bff.student:
45        image: ${DOCKER_REGISTRY-}webbffstudent
46        build:
47          context: .
48          dockerfile: ApiGateways/Web.Bff.Student/Dockerfile
49
50      sql.data:
51        image: microsoft/mssql-server-linux:2017-latest
52
53      nosql.data:
54        image: mongo
55
56
57      course.api:
58        image: ${DOCKER_REGISTRY-}courseapi
59        build:
60          context: .
61          dockerfile: Services/Course/Course.Api/Dockerfile
62        depends_on:
63          - nosql.data
64
```

As a structure to Auto Deployment, it has many sides to implement, and because of the many level of software development modes, the compose file can be overridden many times to

- Production stage
- Development stage
- Testing Stage
- Releasing stage

Nice to implement them that way but in our project, we just override it to network stage illustrated in figure 6-13,6-14:

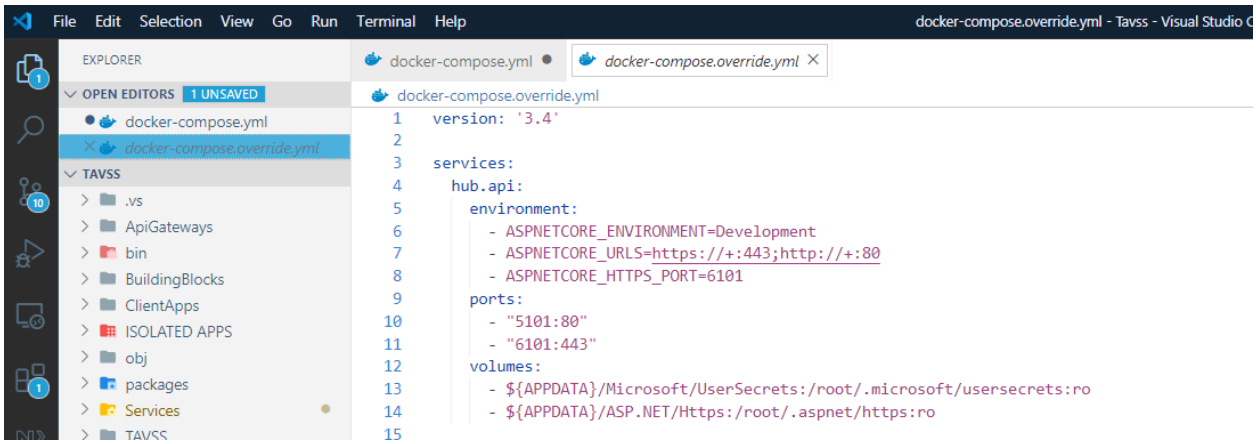


Figure 6-13 Overriding the Compose file

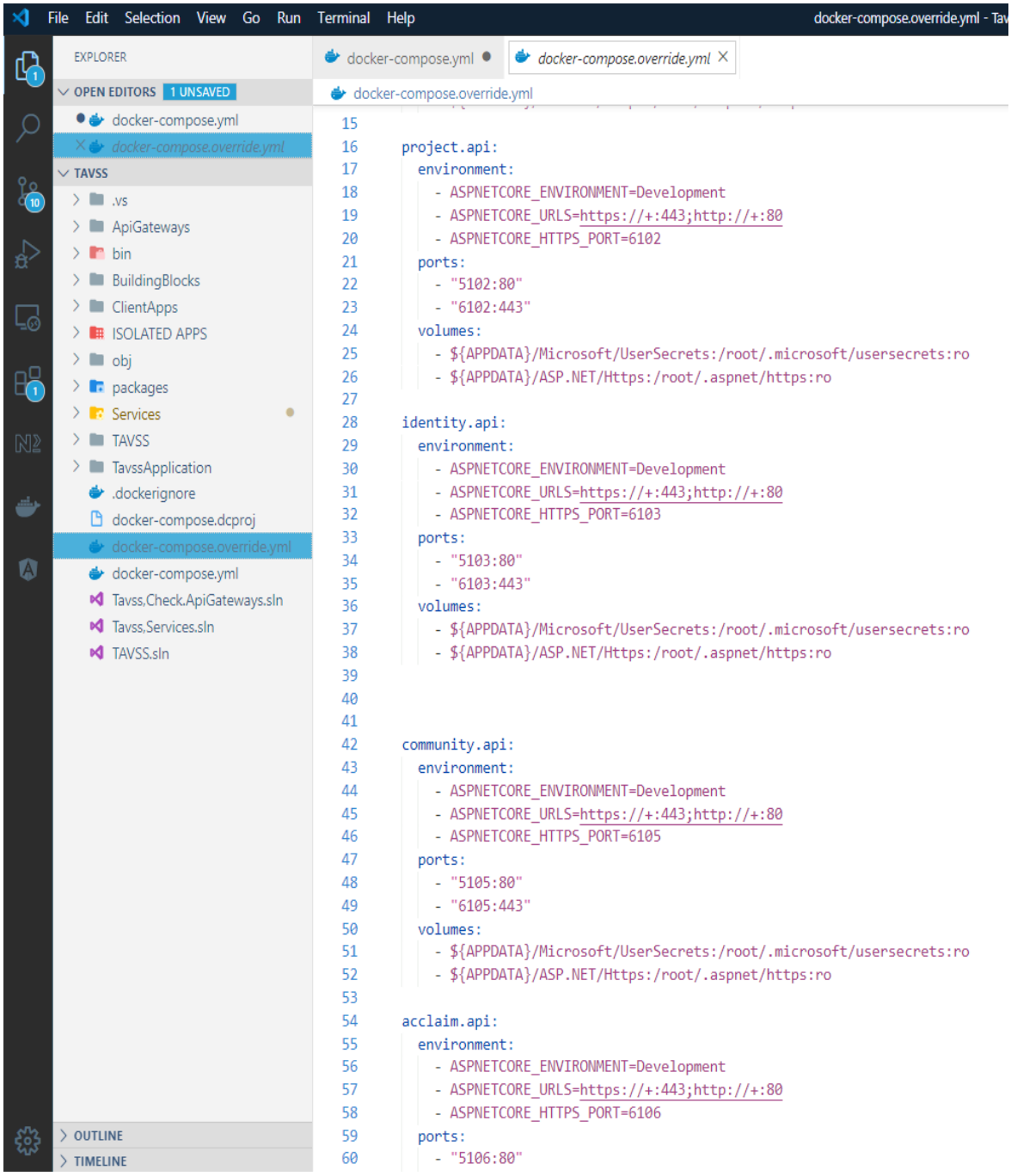


Figure 6-14 Overriding the Compose file

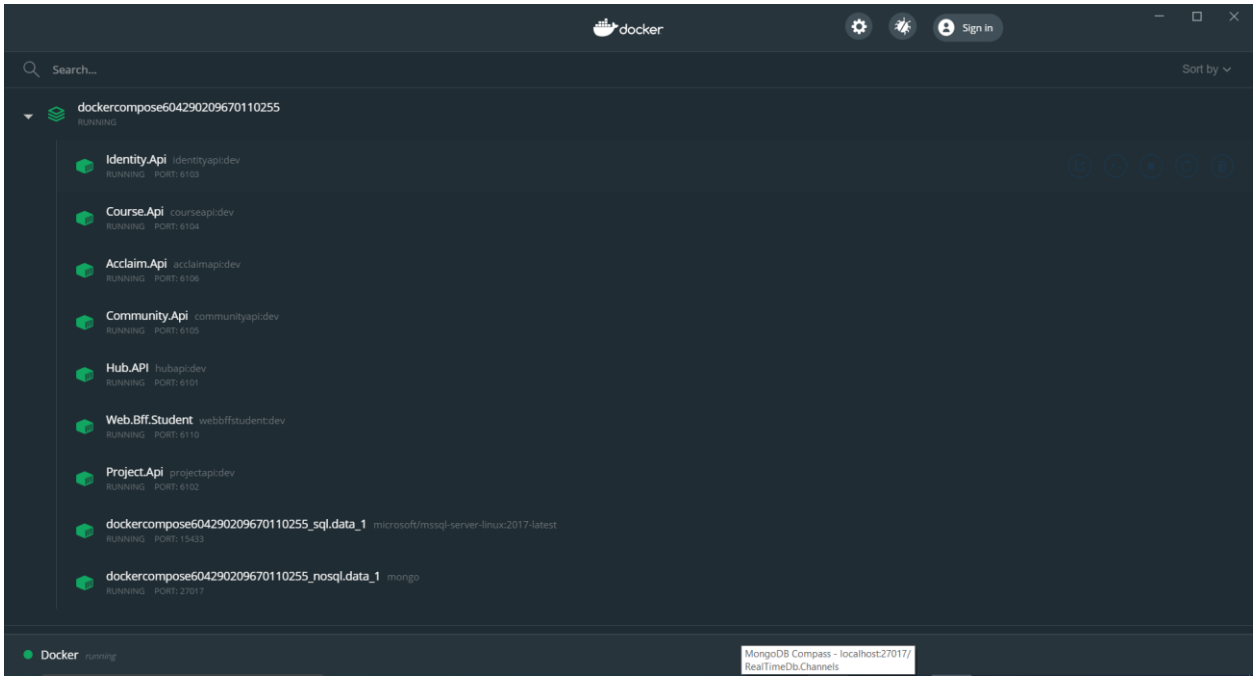

docker
Sign in
Search...
Sort by
dockercompose604290209670110255
RUNNING
Identity.Api identityapi:dev
RUNNING PORT: 6103
Course.Api courseapi:dev
RUNNING PORT: 6104
Acclaim.Api acclaimapi:dev
RUNNING PORT: 6106
Community.Api communityapi:dev
RUNNING PORT: 6105
Hub.API hubapi:dev
RUNNING PORT: 6101
Web.Bff.Student webbffstudent:dev
RUNNING PORT: 6110
Project.Api projectapi:dev
RUNNING PORT: 6102
dockercompose604290209670110255_sql.data_1 microsoft/mssql-server-linux:2017-latest
RUNNING PORT: 15433
dockercompose604290209670110255_nosql.data_1 mongo
RUNNING PORT: 27017
Docker running
MongoDB Compass - localhost:27017/RealTimeDb.Channels

Figure 6-15

CHAPTER 7: GATEWAY DESIGN PATTERN {BFF : OCELOT}

Let's Imagine The need to develop many UIs for many platforms, like implementing the courses microservices for FCIS faculty and the Commerce Faculty, means many UIs for different users, or to append the Microservices for each platform {IOS, Android, Angular}, seems they need different types of views, as IOS and Android have limitations on processing either the UI capabilities than the Angular web SPA.

7.1 WAYS OF CLIENT-MICROSERVICES COMMUNICATION

There are 2 ways to client communicate to microservices:

- Direct Client-to-Microservices Communication.
- Indirect Client-Gateway-Microservices communication

7.1.1 DIRECT CLIENT-TO-MICROSERVICES COMMUNICATION

A possible approach is to use a direct client-to-microservice communication architecture. In this approach, a client app can make requests directly to some of the microservices [4], as shown in figure 7-1

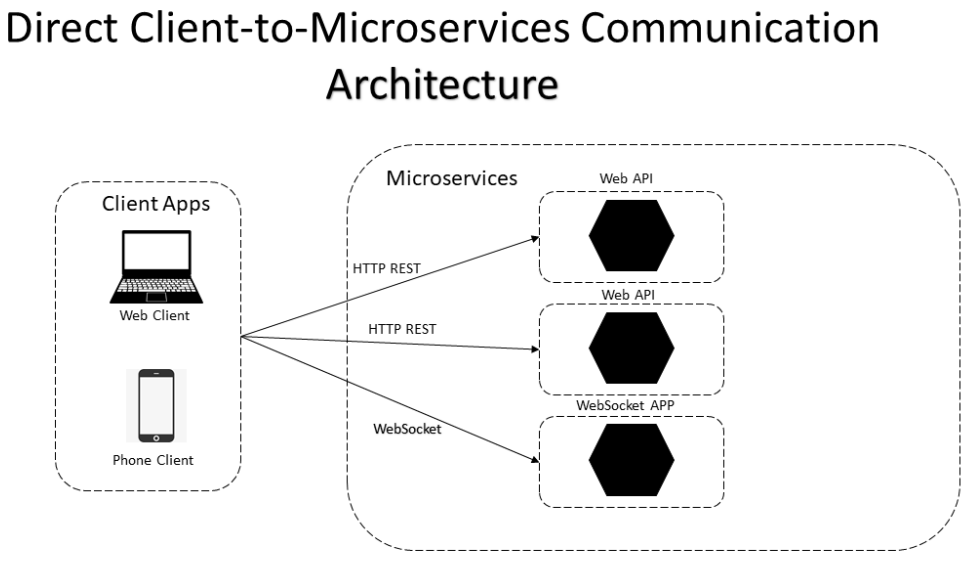


Figure 7-1 Direct Client-to-Microservices Communication

In this approach, each microservice has a public endpoint, sometimes with a different TCP port for each microservice. An example of a URL for a particular service could be the following URL in localhost:

- https://localhost:6103/ => Identity Microservices in TAVSS Development Mode
    - Dotnet Core 2.2 implementation illustrated in figure 7-2
- https://localhost:6101/ => Real-Time Microservices in TAVSS Development Mode
    - Dotent Core 3.1 implementation illustrated in figure 7-3

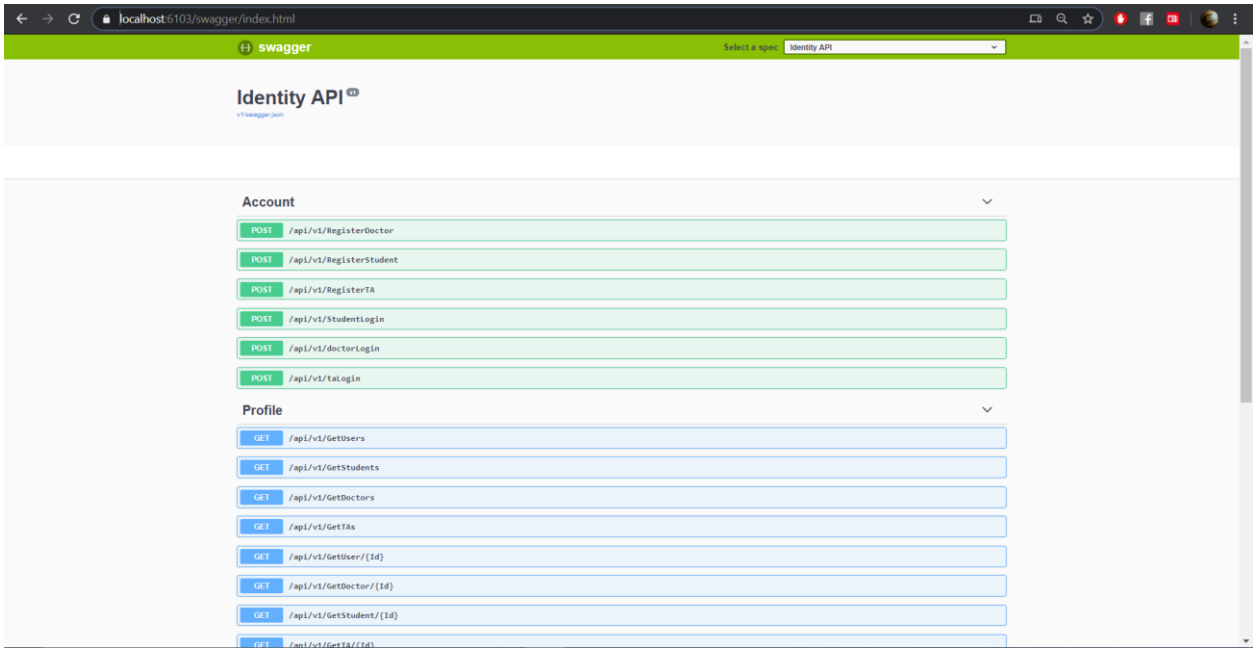


Figure 7-2 Identity API Microservice swagger result

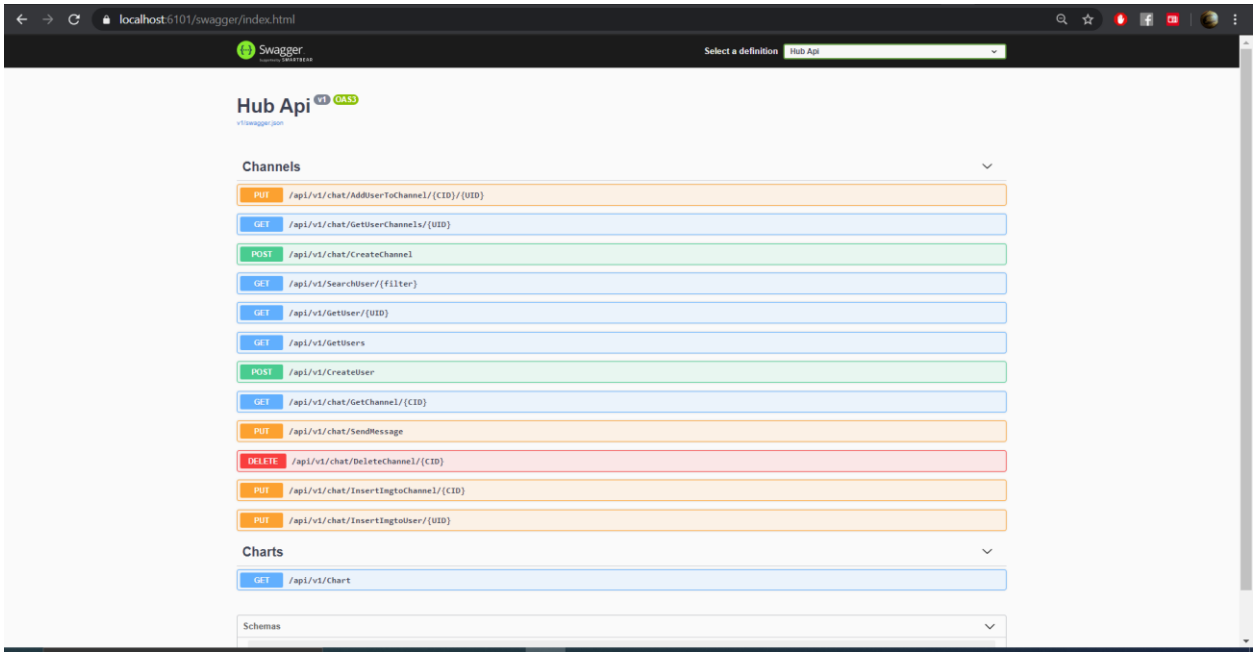


Figure 7-3 Hub API Microservice swagger result

In a production environment based on a cluster, that URL would map to the load balancer used in the cluster, which in turn distributes the requests across the microservices. In production environments, the enterprise could have an Application Delivery Controller (ADC) like Azure Application Gateway between enterprise microservices and the Internet.

This acts as a transparent tier that not only performs load balancing but secures enterprise services by offering SSL termination. This improves the load of enterprise hosts by offloading CPU-intensive SSL termination and other routing duties to the Azure Application Gateway. In any case, a load balancer and ADC are transparent from a logical application architecture point of view.[4]

A direct client-to-microservice communication architecture could be good enough for a small microservice-based application, especially if the client app is a server-side web application like an MVC app. However, when enterprise build large and complex microservice-based applications (for example, when handling dozens of microservice types), and especially when the client apps are remote mobile apps or SPA web applications, that approach faces a few issues.

Let’s Ask some questions when building such large apps as ISSUES:

How can client apps minimize the number of requests to the back end and reduce chatty communication to multiple microservices?

- Interacting with multiple microservices to build a single UI screen increases the number of round trips across the Internet. This increases latency and complexity on the UI side. Ideally, responses should be efficiently aggregated in the server side. This reduces latency, since multiple pieces of data come back in parallel and some UI can show data as soon as it's ready.

How can enterprise handle cross-cutting concerns such as authorization, data transformations, and dynamic request dispatching?

- Implementing security and cross-cutting concerns like security and authorization on every microservice can require significant development effort. A possible approach is to have those services within the Docker host or internal cluster to restrict direct access to them from the outside, and to implement those cross-cutting concerns in a centralized place, like an API Gateway.

How can client apps communicate with services that use non-Internet-friendly protocols?

- Protocols used on the server side (like AMQP or binary protocols) are usually not supported in client apps. Therefore, requests must be performed through protocols like HTTP/HTTPS and translated to the other protocols afterwards. A man-in-the-middle approach can help in this situation.

How can you shape a facade especially made for mobile apps?

- The API of multiple microservices might not be well designed for the needs of different client applications. For instance, the needs of a mobile app might be different than the needs of a web app. For mobile apps, you might need to optimize even further so that data responses can be more efficient. You might do this by aggregating data from multiple microservices and returning a single set of data, and sometimes eliminating any data in the response that isn't needed by the mobile app. And, of course, you might compress that data. Again, a facade or API in between the mobile app and the microservices can be convenient for this scenario.

7.1.2 CONSIDERING THE 2 APPROACHES API GATEWAY AND DIRECT CTM

In a microservices architecture, the client apps usually need to consume functionality from more than one microservice. If that consumption is performed directly, the client needs to handle multiple calls to microservice endpoints. What happens when the application evolves and new microservices are introduced or existing microservices are updated? If your application has many microservices, handling so many endpoints from the client apps can be a nightmare. Since the client app would be coupled to those internal endpoints, evolving the microservices in the future can cause high impact for the client apps.[4]

And this approach helps to solve the pre-issues like:

- Coupling

- As there are changes and maintenance must be achieved for apps, makes it badly concern when use many microservice to show something.

- Too many Round Trips
  - The Client app that need to consume many microservices need a huge time to aggregate the required data
- Security Issues
  - Like Chemistry lab of Particles vs Cubes dissolving Like Attacker vs Many Microservices or Attacker vs A gateway illustrated in figure 7-4

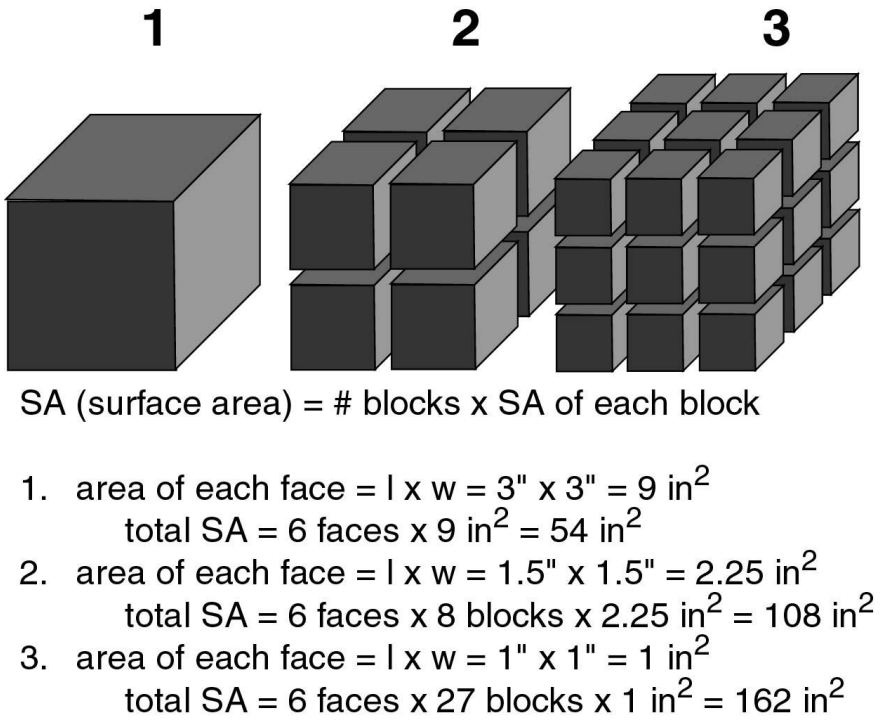


Figure 7-4 Like Chemistry dissolving the attacking probability

- Cross-Cutting Issues
  - Seems Geometric area Cross-Cutting: means the Module use the same concern in decision can take like Authorization, SSL and many concerns like those, imagine these concerns like what you see in figure 7-5.

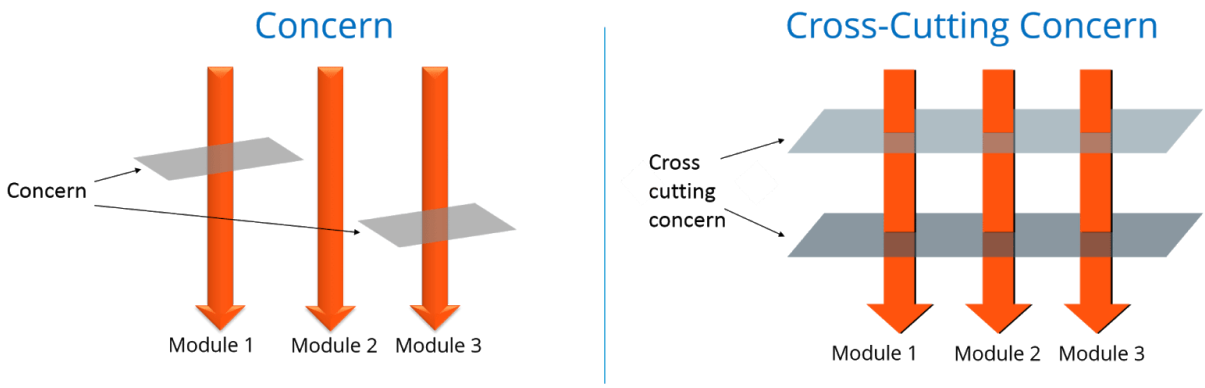


Figure 7-5 Cross-Cutting Concerns over modules

All these issues can be solved by using the API Gateways design pattern.

7.2 PROBLEM AGINEST USERS

How do the clients of a Microservices-based application access the individual services?

This question had been asked in Microservices.IO website and the answer is a design pattern called “API Gateways”, since using agile methodologies to contain the user in development environment, the user didn’t has any knowledge of backend environment or { Domain-Driven-Design }, he has the ability of imagine how the UI can be, but many users with many points of view plus the different platforms of work illustrated in figure 7-6.

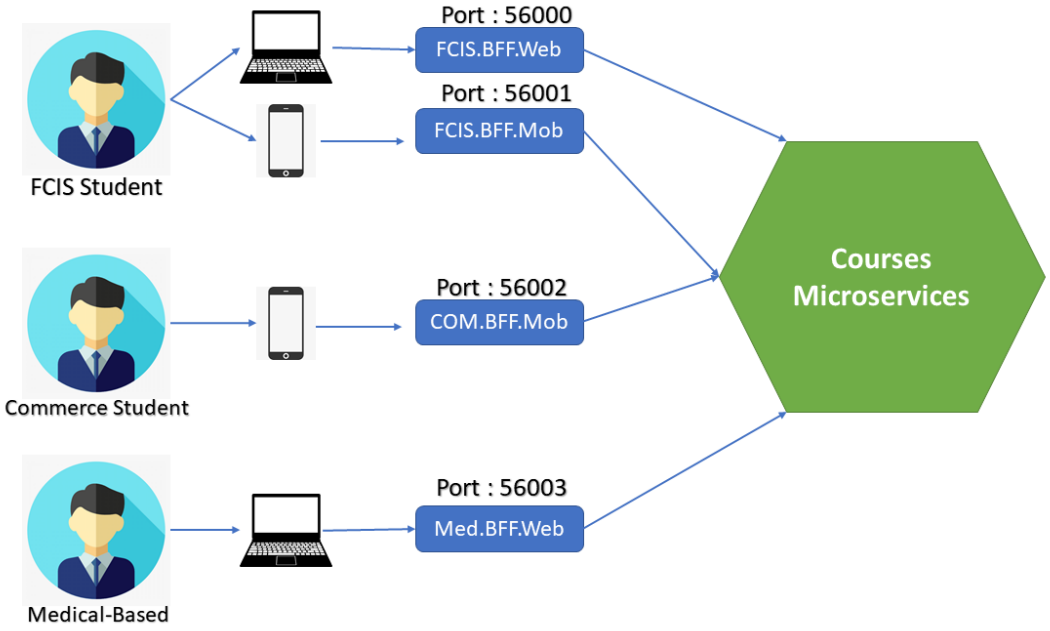


Figure 7-6 Every type of user need a good relation with the Microservices

7.2.1 A LOOK INTO THE E-LEARNING SYSTEMS

A Courses details UI can display a lot of information about a course. For example, the TAVSSOnContainers details page for displays:

- Basic information about the course such as title, lecturer, price, etc.
- Your purchase history for the course
- Availability
- reservation options
- Other courses that are related to the courses
- Other courses reviews for who reserve this course
- Student reviews
- Students ranking

Since the online Learning Systems uses the Microservice architecture pattern the courses details data is spread over multiple services. For example:

- Real-Time Services
- Acclaims services
- Assignment Services
- Project Services

Consequently, the code that displays the course details needs to fetch information from all of these services.

7.2.2 FORCES THAT CONTROL THE UNIT OF DISPLAYING

- The granularity of APIs provided by microservices is often different than what a client needs.
- Microservices typically provide fine-grained APIs, which means that clients need to interact with multiple services. For example, as described above, a client needing the details for a product needs to fetch data from numerous services.
- Different clients need different data. For example, the desktop browser version of a product details page desktop is typically more elaborate then the mobile version.
- Network performance is different for different types of clients. For example, a mobile network is typically much slower and has much higher latency than a non-mobile network. And, of course, any WAN is much slower than a LAN. This means that a native mobile client uses a network that has very difference performance characteristics than a LAN used by a server-side web application.
- The server-side web application can make multiple requests to backend services without impacting the user experience where as a mobile client can only make a few.
- The number of service instances and their locations (host+port) changes dynamically
- Partitioning into services can change over time and should be hidden from clients
- Services might use a diverse set of protocols, some of which might not be web friendly

7.2.3 WHAT IS AN API GATEWAY?

An API gateway takes all API calls from clients, then routes them to the appropriate microservice with request routing, composition, and protocol translation.[15]

Typically, it handles a request by invoking multiple microservices and aggregating the results, to determine the best path. It can translate between web protocols and web-unfriendly protocols that are used internally.[15]

This video can explain why and how enterprises use them:

- NGNIX (What is an API Gateway?)
- How Adobe Powers Its API Gateway

7.3 ARCHITECTING THE GATEWAYS

To make it simple enough in this project, the project will have importance on its users {Student, Doctor, TA, Company, Admin} and platforms {IOS, Android, Web}.

7.3.1 WHO USE WHAT

Essentially, the project must provide the what platform for who is use, making an agile concept {Who Use What?} let's solve this question by analysis team:

- Admin use the Web platform to manage the system
- Student can use the web portals in home or faculty
- Student can use the phone portals.
- TA can use the web portals in home or faculty
- TA can use the phone portals.
- Doctor can use the phone portals.
- Doctor can use the web portals in home or faculty.

So, these different cases mean many gateways, and there are more, but just the project simulate a simple dividing, to control a unit of users, project use a standard like {Platform.BFF.USER} so the API Gateways can be like these units:

- Web.Bff.Student
- Web.Bff.Admin
- Web.Bff.TA
- Web.Bff.Doctor
- Phone.Bff.Student
- Phone.Bff.TA
- Phone.Bff.Doctor

This can illustrate as analytics in figure 7-7.

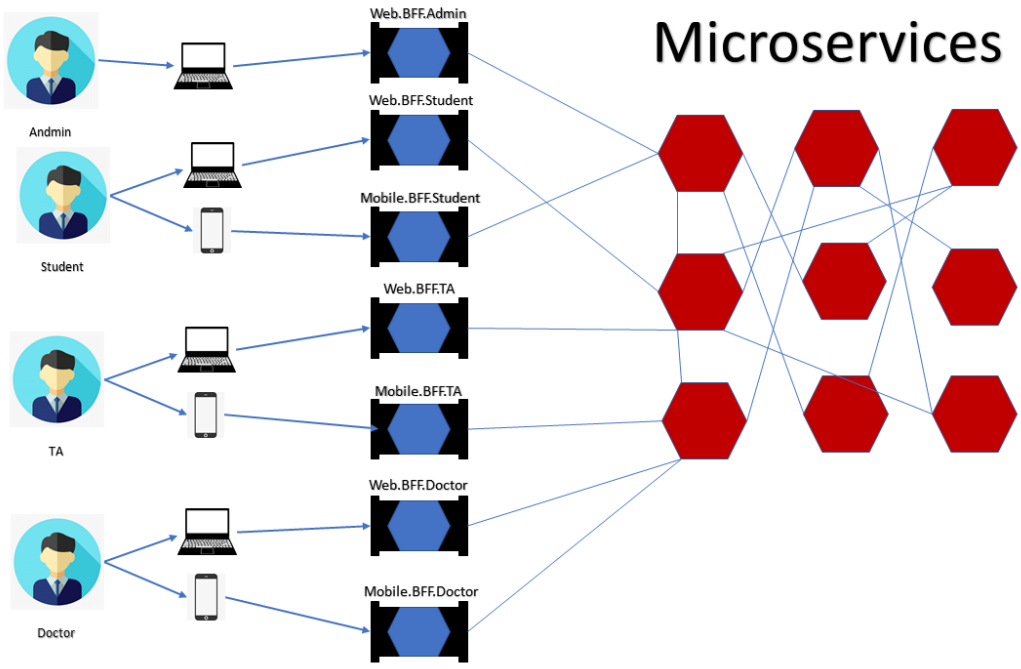


Figure 7-7 Who Use What TAVSS Model.

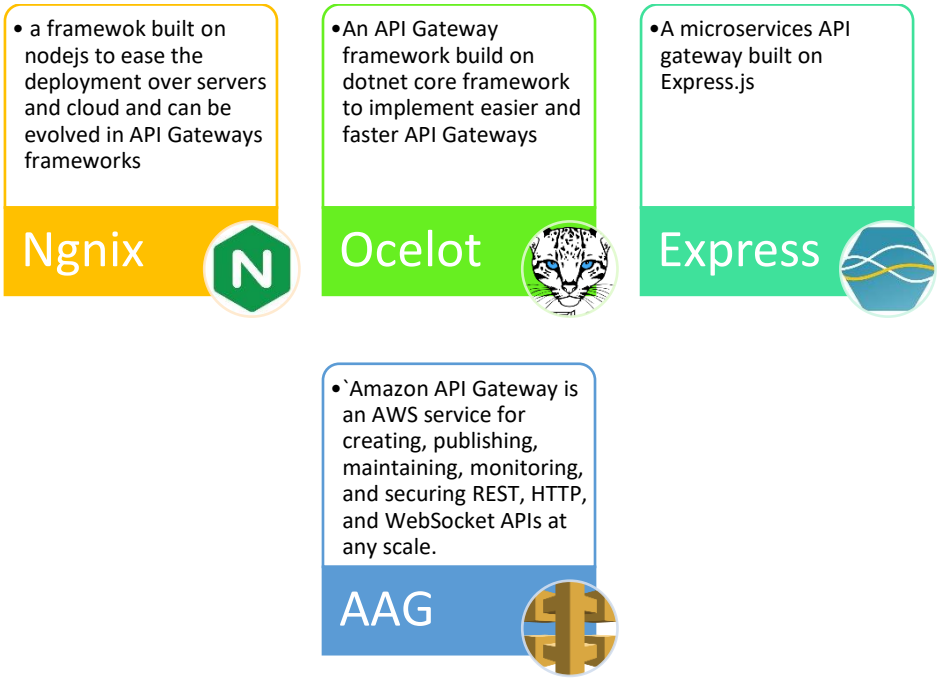
7.3.2 BENEFITS AND DRAWBACKS

When talking about benefits of API gateways, it has many benefits when the organization systems achieve microservices pattern otherwise its drawbacks will open the system the hell door, as the complexity and manipulating, the benefits are:

- Many gateways mean **No Single Point of Failure**
- Additional security layers can be added before using microservices
- Abstraction for the frontend team when consuming microservices.
- Help to understand for who microservices will work
- Control unit of REST-API Technology
- Aggregation layer for many microservices.
- No direct communication with business logic

7.4 IMPLEMENTATION OF API GATEWAYS

Gateways offers a unified access to microservices as a link with whole app, but how can the developers implement them, there are many frameworks and programming languages able to make them:



TavssOnContainers uses Ocelot as the technology framework build on .Net Core Apps that Ocelot is aimed at people using .NET running a micro services / service orientated architecture that need a unified point of entry into their system.[16]

Ocelot is a bunch of middlewares in a specific order.

Ocelot manipulates the HttpRequest object into a state specified by its configuration until it reaches a request builder middleware where it creates a HttpRequestMessage object which is used to make a request to a downstream service. The middleware that makes the request is the last thing in the Ocelot pipeline. It does not call the next middleware. The response from the downstream service is stored in a per request scoped repository and retrieved as the requests goes back up the Ocelot pipeline. There is a piece of middleware that maps the HttpResponseMessage onto the HttpResponse object and that is returned to the client. That is basically it with a bunch of other features.

There are types of configuration when using ocelot:

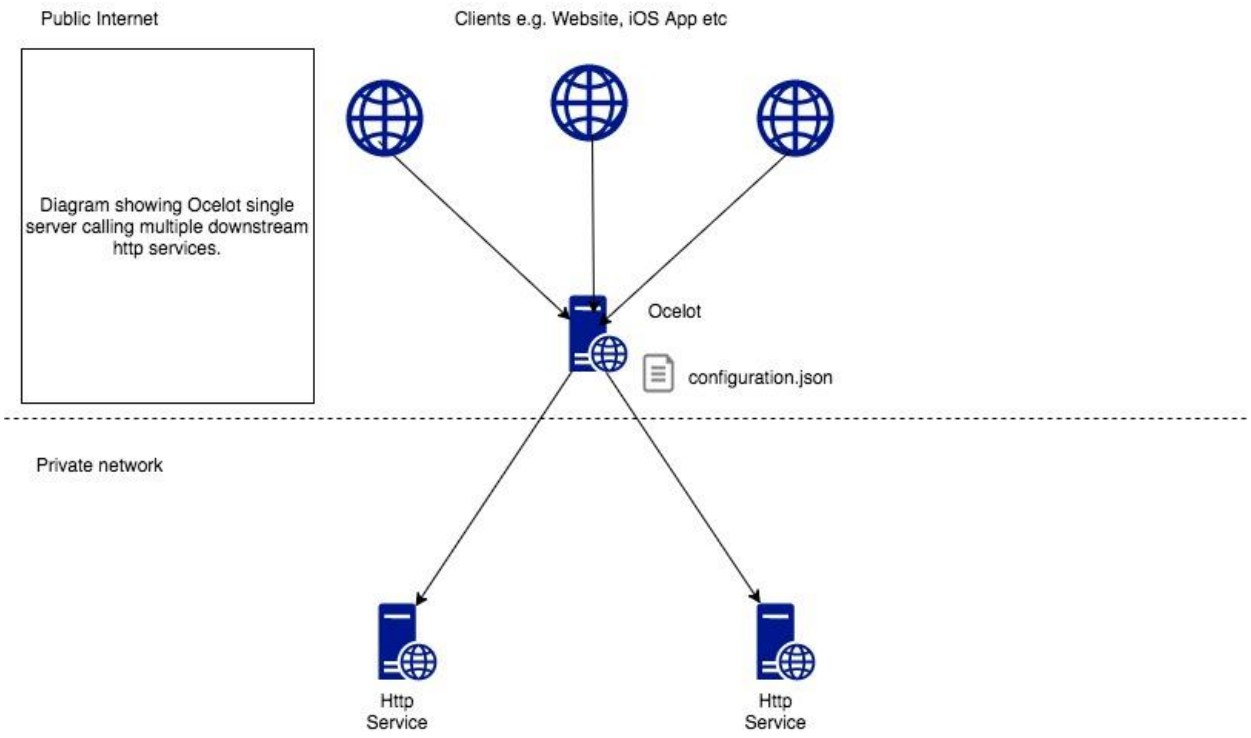


Figure 7-8 The Basic configuration of ocelot many downstreams as Http services using the private network

TavssOnContainers uses this type to handle the requests and the responses but this configuration doesn't achieve the cross-cutting concerns, round trips and to achieve them, it must be like the next architecture illustrated in figure 7-9.

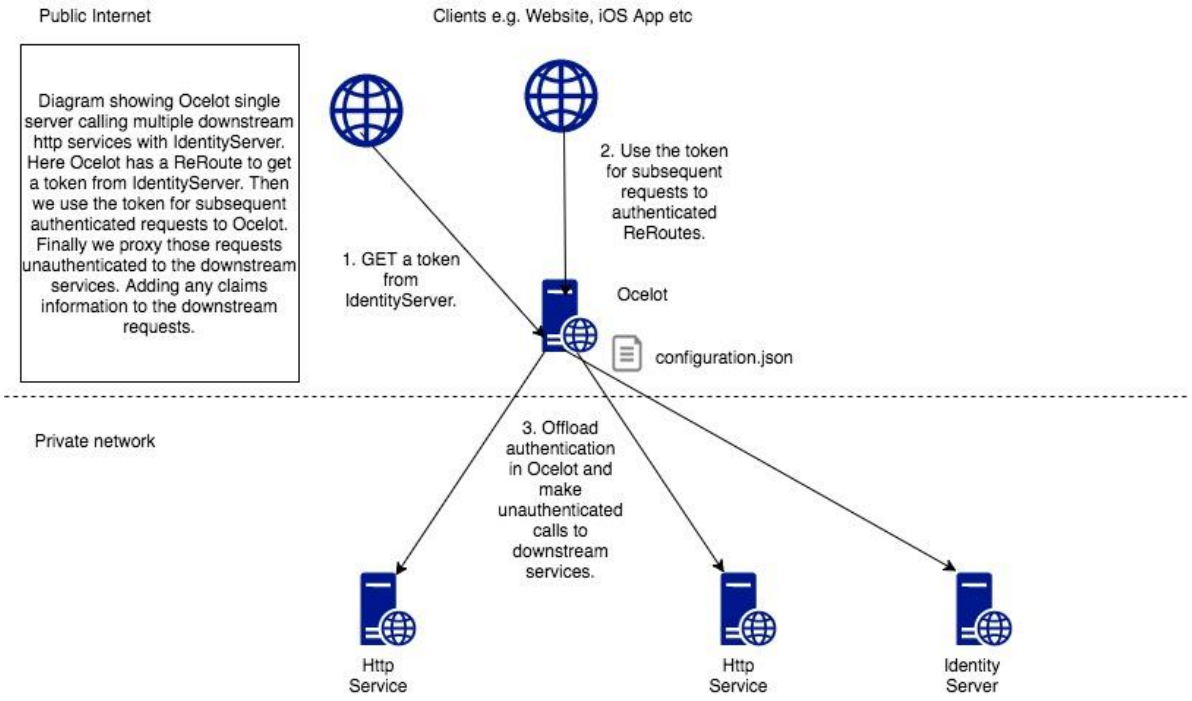


Figure 7-9 using the identity services to contain the cross-cutting concerns

CHAPTER 8: DEVOPS MANAGEMENT

DevOps is a set of practices that combines software development (Dev) and information-technology operations (Ops) which aims to shorten the systems development life cycle and provide continuous delivery with high software quality.

8.1 AZURE DEVOPS INTRODUCTION

Azure DevOps provides developer services to support teams to plan work, collaborate on code development, and build and deploy applications. Developers can work in the cloud using Azure DevOps Services or on-premises using Azure DevOps Server. Azure DevOps Server was formerly named Visual Studio Team Foundation Server (TFS).[25]

Azure DevOps provides integrated features that you can access through your web browser or IDE client. That can use one or more of the following services based on business needs:

- **Azure Repos** provides Git repositories or Team Foundation Version Control (TFVC) for source control of your code
- **Azure Pipelines** provides build and release services to support continuous integration and delivery of your apps
- **Azure Boards** delivers a suite of Agile tools to support planning and tracking work, code defects, and issues using Kanban and Scrum methods
- **Azure Test** Plans provides several tools to test your apps, including manual/exploratory testing and continuous testing
- **Azure Artifacts** allows teams to share Maven, npm, and NuGet packages from public and private sources and integrate package sharing into your CI/CD pipelines

You can also use collaboration tools such as:

- Customizable team dashboards with configurable widgets to share information, progress, and trends
- Built-in wikis for sharing information
- Configurable notifications

Azure DevOps supports adding extensions and integrating with other popular services, such as: Campfire, Slack, Trello, UserVoice, and more, and developing your own custom extensions.

8.2 WORKING WITH AZURE DEVOPS

With azure devops, managing all development to operations of Tavss Project

- Overview has the Readme Section of Architecture illustrated in figure 8-1

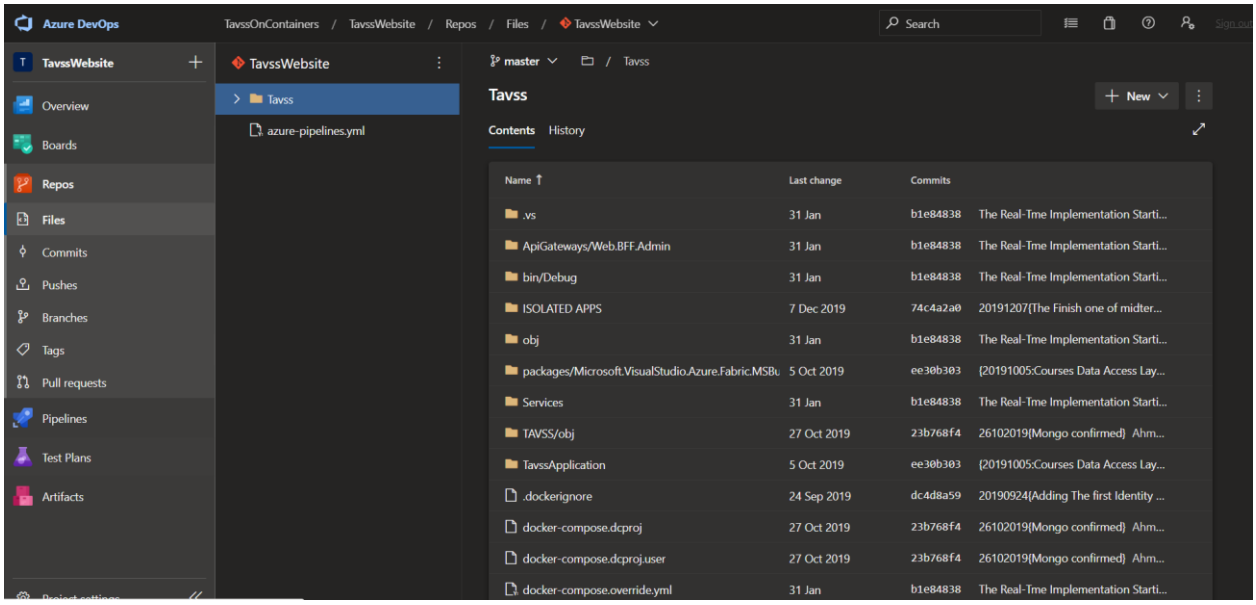
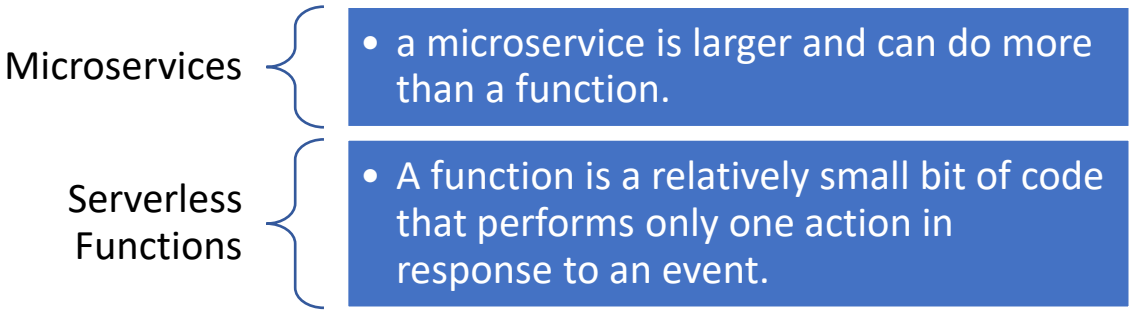


Figure 8.1 The Repository in The VCS

CHAPTER 9: MERGING SERVERLESS FUNCTIONS

What are serverless microservices? How does a serverless microservices architecture work?

Serverless microservices are deployed within a serverless vendor's infrastructure and only run when they are needed by the application. Depending on the size of a microservice, it may also be broken up into even smaller functions. To learn more about how serverless computing works.



This distinction is still being defined by the technology community, but typically, depending on how developers have divided up an application, a microservice may be equivalent to a function (meaning it performs only one action), or it may be made up of multiple functions.[19]

The serverless function app of some cloud doesn't do work until something tells it to execute. {trigger}, A trigger is an object that defines how a serverless computing function is invoked. For example, if a function wants to be executed every 10 minutes, that could use a timer trigger.[20]

9.1 TRIGGERS AND BINDING

9.1.1 WHAT IS TRIGGERS?

trigger types. Here are some of the most common types:

Table 9.1 The common types of triggers that can be executed

Time trigger	Execute a function at a set interval.

HTTP	Execute a function when an HTTP request is received.
Blob	Execute a function when a file is uploaded or updated in Azure Blob storage.
Queue	Execute a function when a message is added to an Azure Storage queue.
Cloud DB	Execute a function when a document changes in a collection.
Event Hub	Execute a function when an event hub receives a new event.

9.1.2 WHAT IS A BINDING?

A binding is a connection to data within the function. Bindings are optional and come in the form of input and output bindings. An input binding is the data that function receives. An output binding is the data that function sends.

Unlike a trigger, a function can have multiple input and output bindings.

9.2 WORKING WITH CLOUD {AZURE SERVERLESS FUNCTIONS}

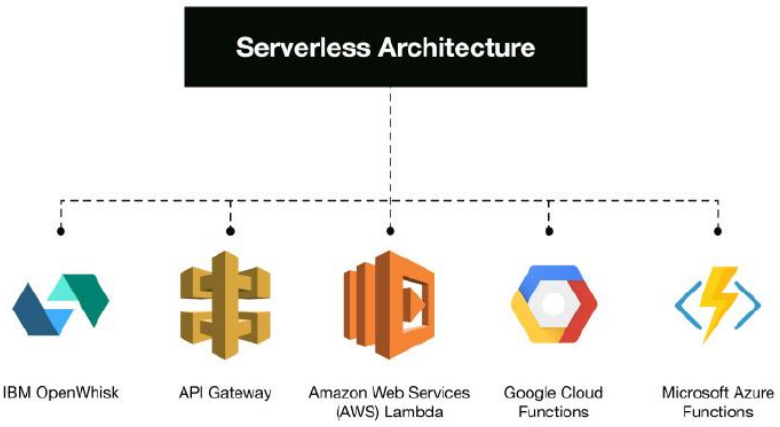


Figure 9-2Lots of vendors to create serverless functions

9.2.1 RUN AN AZURE FUNCTION ON A SCHEDULE

It's common to execute a piece of logic at a set interval. Imagine a blog owner notice that his subscribers aren't reading his most recent posts. he decides that the best action is

to send an email once a week to remind them to check his blog. he implements this logic using an Azure function app with a *timer trigger* to invoke your function weekly.

WHAT IS A TIMER TRIGGER?

A timer trigger is a trigger that executes a function at a consistent interval. To create a timer trigger, that needs to supply two pieces of information.

- A *Timestamp parameter name*, which is simply an identifier to access the trigger in code.
- A *Schedule*, which is a CRON expression that sets the interval for the timer.

WHAT IS A CRON EXPRESSION?

A CRON expression is a string that consists of six fields that represent a set of times.

The order of the six fields in Azure is: {second} {minute} {hour} {day} {month} {day of the week}.

To more understanding about CRON Expression:

Table 9.1 The CORN Syntax

Special character	**Meaning**	**Example**
*****	Selects every value in a field	An asterisk "*" in the day of the week field means EVERY day.
,	Separates items in a list	A comma "1,3" in the day of the week field means just Mondays (day 1) and Wednesdays (day 3).
-	Specifies a range	A hyphen "10-12" in the hour field means a range that includes the hours 10, 11, and 12.
/	Specifies an increment	A slash "*/10" in the minutes field means an increment of every 10 minutes.

Table 9.3

For example, a CRON expression to create a trigger that executes every five minutes looks like:

LOG

```
0 */5 * * * *
```

The **first field represents seconds.** This field supports the values 0-59. Because the field contains a zero, it selects the first possible value, which is one second.

The **second field represents minutes.** The value "*/5" contains two special characters. First, the asterisk (*) means "select every value within the field." Because this field represents minutes, the possible values are 0-59. The second special character is the slash (/), which represents an increment. When combining these characters together, it means for all values 0-59, select every fifth value. An easier way to say that is simply "every five minutes."

The **remaining four fields represent the hour, day, month, and weekday of the week.** An asterisk for these fields means to select every possible value. In this example, selecting "every hour of every day of every month."

When the code joins all the fields together, the expression is read as **"on the first second, of every fifth minute of every hour, of every day, of every month".**

9.2.2 CREATING THE FUNCTION APP

Just a tutorial to know how it is work

1. Open the Azure portal https://portal.azure.com/#home

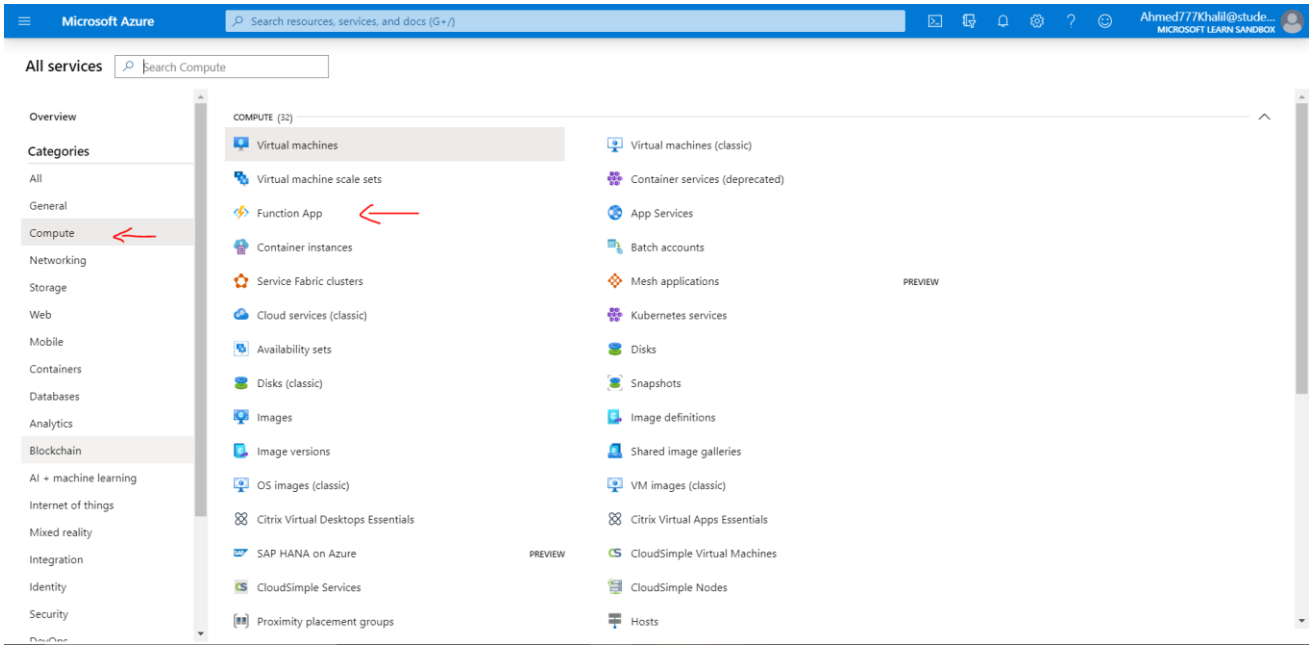


Figure 9.4

By learning Microsoft have a good practice for student to learn without deprecation, a sandbox version to learn for 4 hours, that is finished and eliminated after this time.

2. Enter a globally unique **App name**.
3. Select the **Concierge Subscription**.
4. Select the existing **Resource group** learn-a89e9ab5-e679-4d46-a1f7-ee98a4f0e31a.
5. Choose **Windows** as your **OS**.
6. Choose **Consumption Plan** for your **Hosting Plan**. When using the Consumption Plan type you're charged for each execution of your function and resources are automatically allocated based on your application workload.
7. Select a **Location** close to you.
8. For **Runtime Stack**, select **PowerShell Core (Preview)**, which is the language in which we implement the function examples in this exercise.
9. Create a new **Storage** account, you can change the name if you like - it will default to a variation of the App name.
10. Select **Create**. Once the function app is deployed, go to **All resources** in the portal. The function app will be listed with type **App Service** and has the name you gave it.

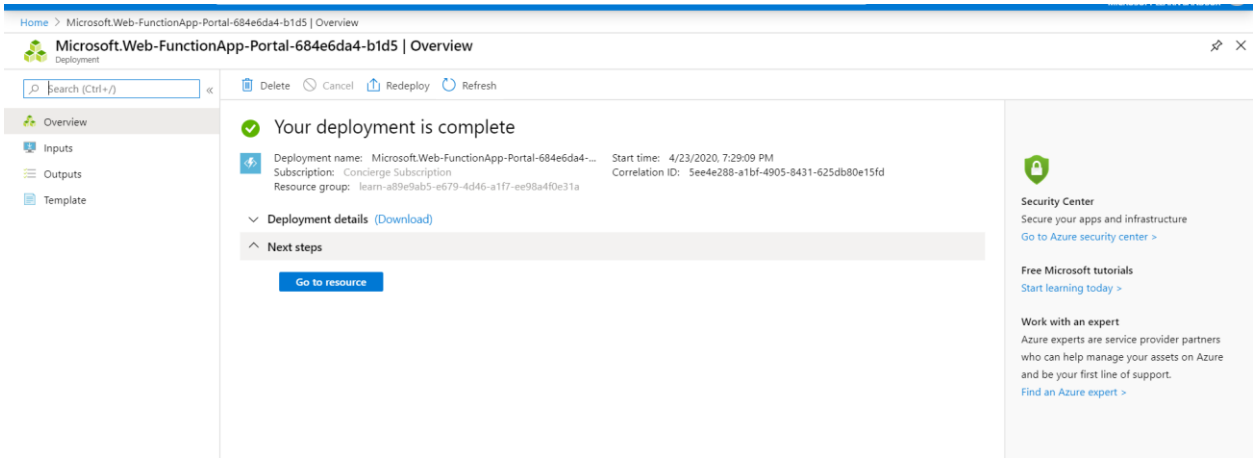


Figure 9.5

CREATE A TIMER-TRIGGERED FUNCTION

Now timer trigger will be created inside our function.

1. Select the Add (+) button next to Functions. This action starts the function creation process.
2. On the Azure Functions for PowerShell - getting started page, select In-portal and then select Continue.
3. In the list of quick start templates, select Timer and then select Create illustrated in figure 9.6.

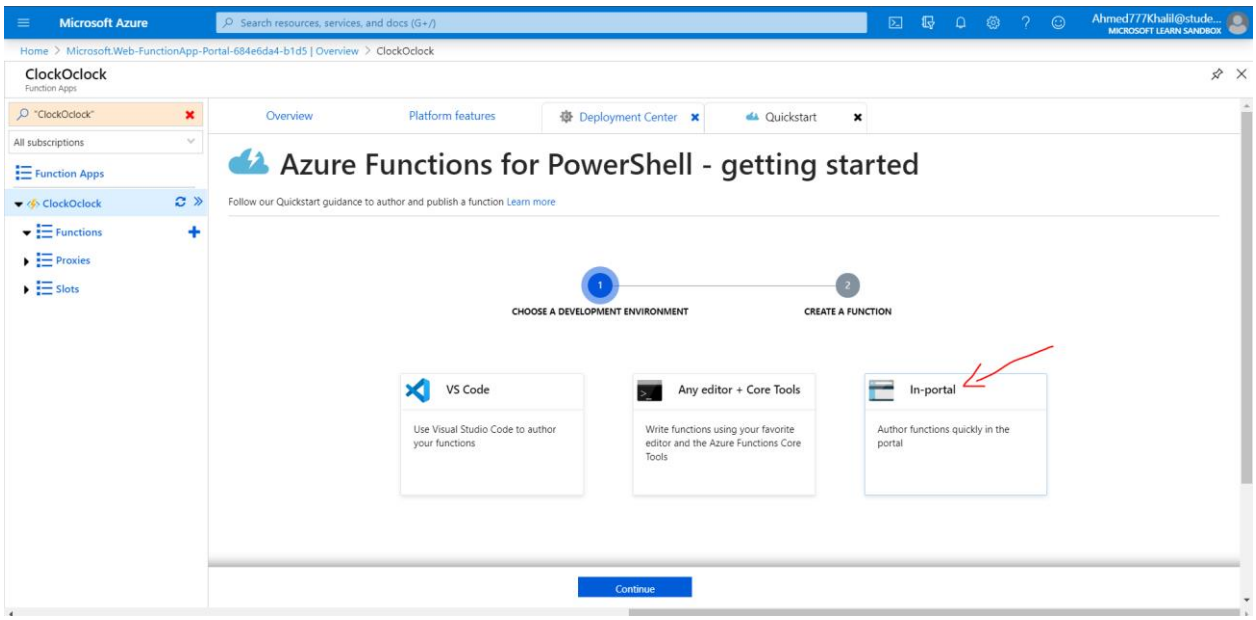


Figure 9.6

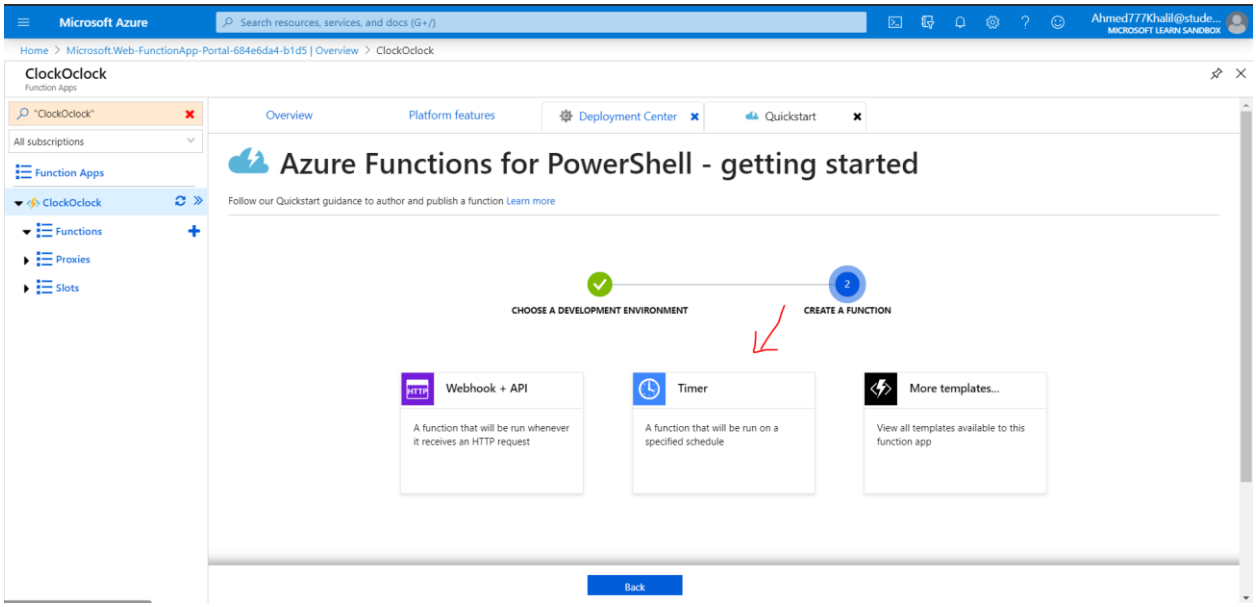


Figure 9.7 get in the Timer Implementations

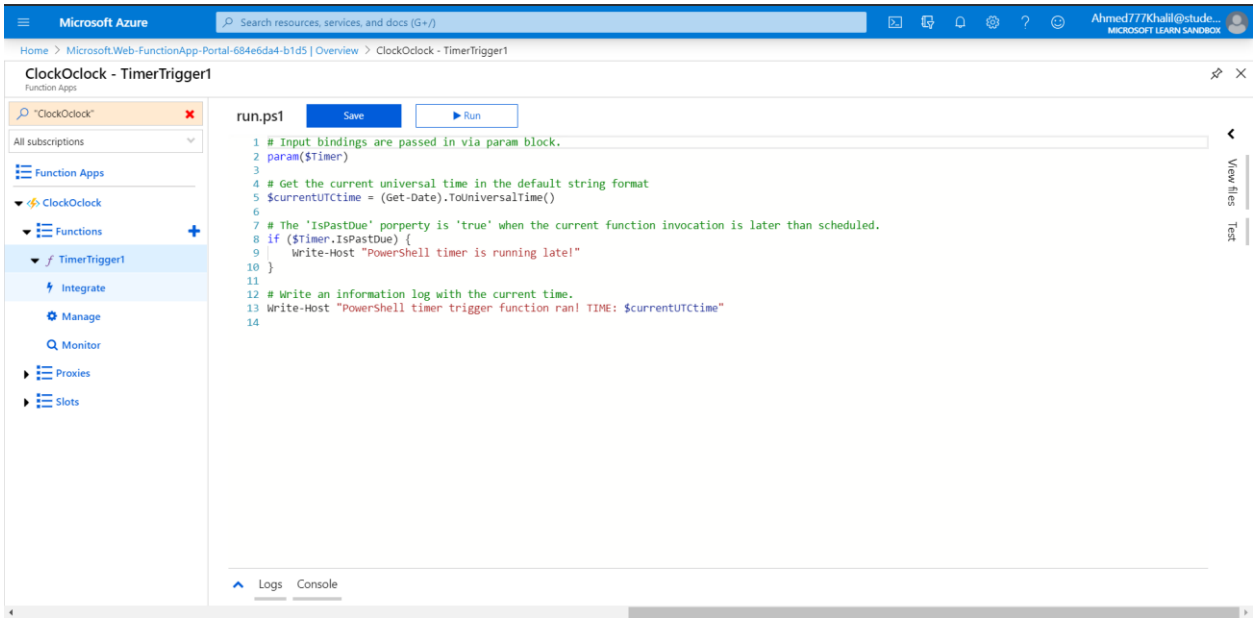


Figure 9.8 Implement a time trigger function

CONFIGURE THE TIMER TRIGGER

We have an Azure function app with logic to print a message to the log window. We're going to set the schedule of the timer to execute every 20 seconds.

1. Select Integrate.

2. Enter the following value into the Schedule box:

```
LOG
```

```
*/20 * * * * *
```

3. Select **Save**.

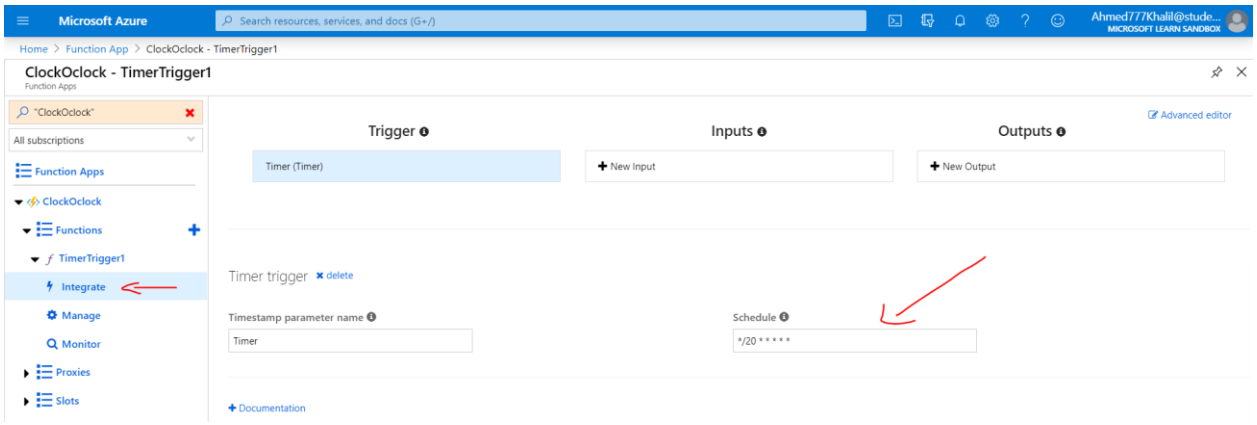


Figure 9.9

TEST THE TIMER

Now that we've configured the timer, it will invoke the function on the interval we defined.

1. Select TimerTrigger1.

TimerTrigger1 is a default name. It's automatically selected when you create the trigger.

2. Open the Logs panel at the bottom of the screen.
3. Observe new messages arrive every 20 seconds in the log window. You may not see any log messages for a few minutes as the function app warms up for the first time.

To stop the function from running, select Manage and then switch Function State to Disabled.

The process now is successes and it logging every 20 seconds, the message as shown as

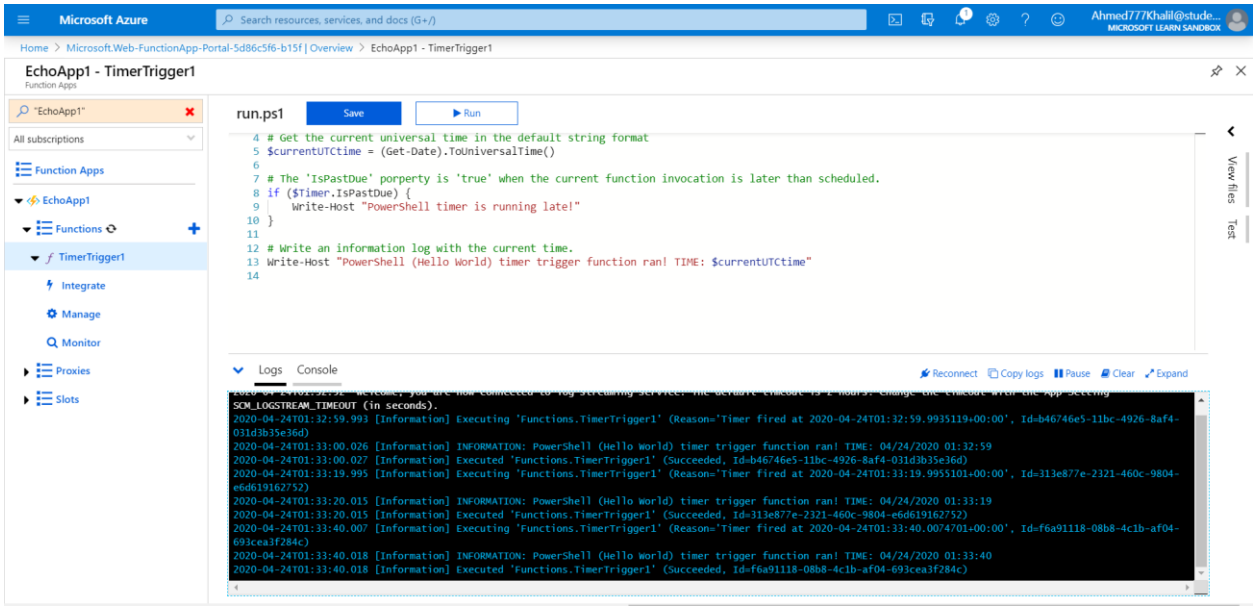


Figure 9.10 Running The Triggers of terminal corn

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