

Decentralized Chat

1. Introduction and Goals

The development will consist of a WebApp whose objective is to be a decentralized chat, using SOLID technologies. This chat will allow users to exchange messages in different formats (audio, text, video), as well as other functions such as: share screen or video call; It will also allow you to save friends lists, show notifications, among other functions. It will be a web application developed at Angular, and an RDF library will be used to communicate and obtain information on the different PODs.

1.1. Requirements Overview

The application will mainly comply with the following:

- The system will be based on a decentralized architecture where data storage is separated from the app
- Users can store their chat data in their own pods
- The app will allow a user to share pictures, videos or other kinds of files with other friends through the chat
- A user can get notifications when some friend wants to chat with him
- Users can have groups of friends with whom they may want to chat
- It will be possible to have group chats where all members receive the messages
- Users can have live calls and videos
- Users can share their screens in the chat

1.2. Quality Goals

The main Stakeholders of this application are Inrupt and users, I will list the most important quality goals for them:

- Usability : Ease of use by non-technical people.
- Responsiveness : The application must send messages in real time.
- Privacy: The application must keep the data private (this is what solid is based on, each one owns their data).
- Security: The application must be secure, users must know who they are talking to and who has access to the chat.

1.3. Stakeholders

Stakeholders of the system:

- Developers
- Professor

- Users
- Inrupt

Role/Name	Contact	Expectations
Developer	Laura Sanchez	Have to work with the architecture or with code, documentation of the architecture, have to come up with decisions about the system or its development
Developer	Enrique Fernandez	Have to work with the architecture or with code, documentation of the architecture, have to come up with decisions about the system or its development
Developer	Jose Luis Bugallo	Have to work with the architecture or with code, documentation of the architecture, have to come up with decisions about the system or its development
Developer	Victor Manuel Chaves	Have to work with the architecture or with code, documentation of the architecture, have to come up with decisions about the system or its development
Developer	Carlos Gomez	Have to work with the architecture or with code, documentation of the architecture, have to come up with decisions about the system or its development
Developer	Daniel Fernandez	Have to work with the architecture or with code, documentation of the architecture, have to come up with decisions about the system or its development https://forum.solidproject.org/u/danielferromeral/activity
Professor	Jose Emilio Labra	Evaluate and guide the project
Users		Users can chat, they can have live calls and videos and they can share their screens in the chat
Inrupt	Inrupt	They has been proposed as a challenge

2. Architecture Constraints

2.1. Technical Constraints

Code	Restricction	Motive
TC001	Online independence: no central control of data	Linked-data are completely decentralized and fully under users' control rather than controlled by other entities.
TC002	Frameworks: Angular	We haven't worked with this framework before, so we will have to learn how to use it.
TC003	SOLID technology	app based on the solid specifications.
TC004	Data Storage	Users can store their chat data in their own pods.
TC005	Share files	The app will allow a user to share pictures, videos or other kinds of files with other friends through the chat.
TC006	Notifications	A user can get notifications when some friend wants to chat with him.
TC007	Groups	Users can have groups of friends with whom they may want to chat.
TC008	Program language: JavaScrip or TypeScript	We have chosen this language, but we don't have enough knowledge about this languages.

2.2. Organizational Constraints

Code	Restricction	Motive
OC001	About Version Control: Git, Tool: Github	Keep a version of the project after making changes
OC002	6 person group	We didn't know each other
OC003	Time schedule	We don't have a lot of time for developing the app. Furthermore, we are developing other proyects at the same time.
OC004	Documentation	Arc42 model .
CC005	Open source	The project, including source code and documentation.

Code	Restricction	Motive
CC005	Beta version	Limited time to develop the project maximum in May 2019.

2.3. Conventions Constraints

Code	Restricction	Motive
CC001	Language	English. The project and the corresponding blog targets an international audience, so English should be used throughout the whole project.
CC002	6 person group	We didn't know each other
CC003	Time schedule	We don't have a lot of time for developing the app. Furthermore, we are developing other projects at the same time.
CC004	Non-technical	Every user should manage the app.
CC005	Security	Data must not be in touch by external devices
CC006	Privacy	Only own users can manage their own data.
CC007	Intuitive	Aesthetics and friendliness of the application.
CC008	Usability	Usability of technical documentation.
CC009	Originality	Originality of the solution
CC010	Documentation	We use AsciiDoc

3. System Scope and Context

The project that we are going to develop aims to communicate two people through different mechanisms:

- **Text messages.**
- **Images.**
- **Videos.**
- **Video calls.**

However, the approach that the application will take it's around permits. A user can not send a file of any kind or speak with a person if they do not have explicit permission from the recipient.

But the most important point of the chat is not the permissions, but the decentralization. We want only users to have access to the content of those conversations, so that they are the owners of their personal information.

To achieve this goal we will use SOLID. SOLID is a project that consists of a decentralized website. It deals with establishing a connection between several users, separating data application. To establish this connection, we will use what is known as POD. A POD is a unique profile of each user, which allows to store information on the web about it.

We will use these PODs to connect both users, but the data they exchange will be stored in the interlocutors' devices. In this way, we will create a private chat that will have the advantage of being isolated, reliable and safe.

3.1. Business Context

- Communication elements:
 - **Users:** Users are the main recipient of the application.
 - **Web:** Users will connect to the web through their PODs to establish secure communication.
- Communication process:
 - The partners create a POD.
 - The user adds as friend through the PODs to the second interlocutor.
 - The interlocutors log in with their POD in the chat.
 - Ready!

What data are exchanged with the environment? Through the website, users will enter some small data on the SOLID website to obtain their POD. Once established the connection between both interlocutors, they will be the only owners and holders of the information they exchange.

Communication Partner	Input	Output
User	Chat, video, images, POD information	Chat, video, images, POD information

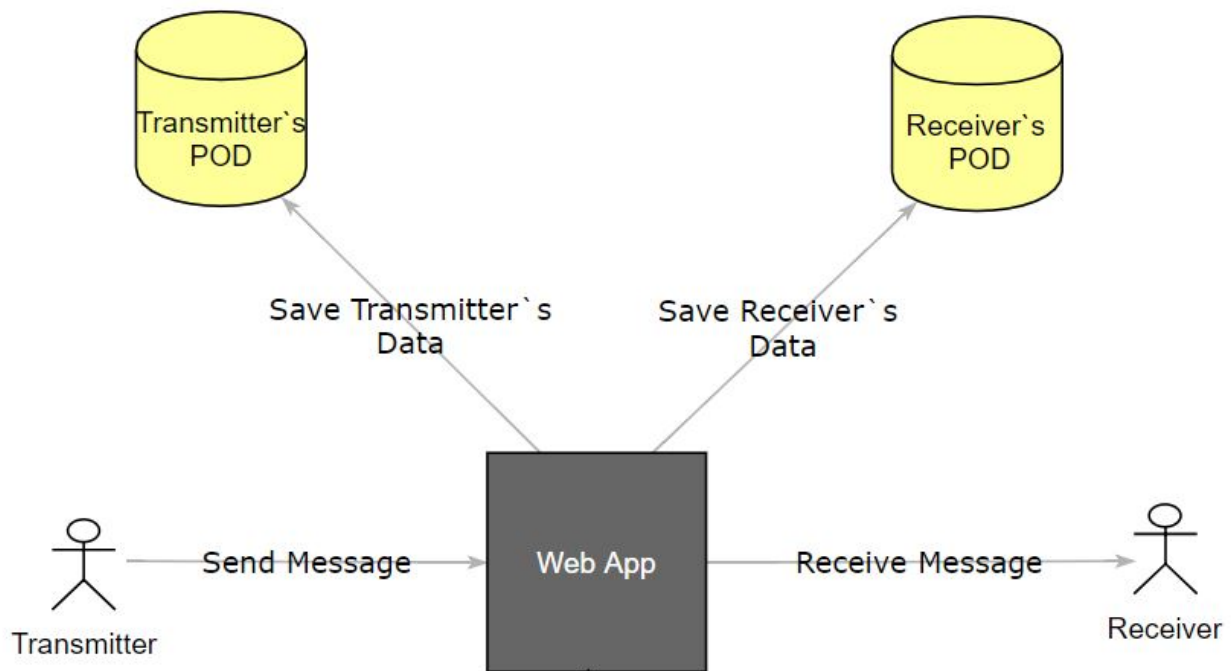
Communication Partner	Input	Output
Web		POD, Server Connection

3.2. Technical Context

As we have said before, we will use the so-called PODs provided by SOLID to connect to the server of the same, and through it, communicate with other people.

For the design of the connection we will use different mechanisms:

- **RDF:** This library allows us to establish the connection. Act as a communicator and thanks to it we can obtain the POD information necessary to establish communication.
- **Authenticator:** This tool receives the POD of a user and allows us to know if it is a valid POD.
- **Angular:** It is a JavaScript framework that will allow us to handle the language in a more comfortable way.



4. Solution Strategy

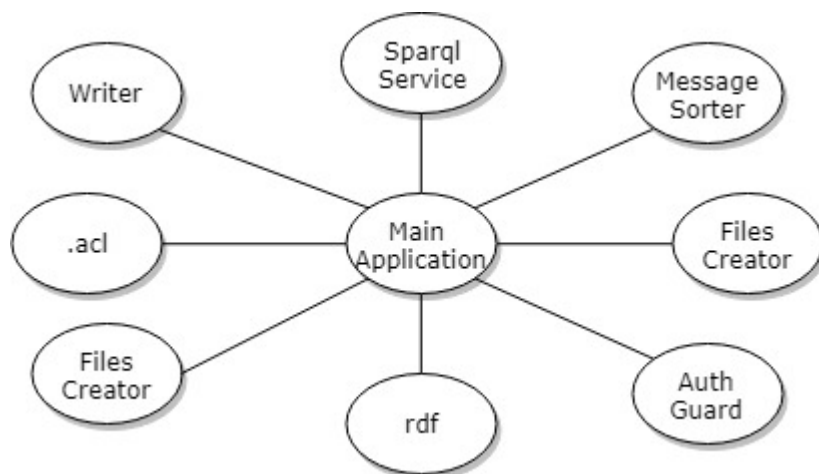
4.1. Technology and IDE

The team had to choose between new technologies for us and technologies already known but that did not have as much support to SOLID. Based on what we knew, our first option was to choose Java as programming language, but after reading the SOLID documentation, we decided to choose TypeScript, which is a JavaScript-based language, and, more specifically, the Angular Framework.

About the IDE, we choose WebStorm due to its power and the fact that, as students, we have a free payment license. In addition, some of the members of the group have used it in previous subjects. Although, another powerful tool like Visual Studio Code have been really helpful when developing our project.

4.2. Architectural pattern

The development of our architecture is based on a service system. The main class relies on these services to perform the different operations that it needs throughout the execution of the application.



4.3. Methodology of work

We will use Scrum to develop this project. Scrum can provide us an early software development, and more independence when programming. Our project will start implementing the basic functions of a chat and it will grow in complexity ([https://en.wikipedia.org/wiki/Scrum_\(software_development\)](https://en.wikipedia.org/wiki/Scrum_(software_development))).

5. Building Block View

Here is a simple scheme that explains the basic organizations of the application components:



Red: Components of the chat

Light Blue: Different Utilities

Turquoise: Coverage Tests

Orange: Services.

5.1. Whitebox Overall System

We will explain some of the application parts functionality:

5.1.1. Components

This are the different components that interact between them. Each one component is divided in some files, but the most important ones are:

- HTML: Is represents the interface layer.
- JS: This is the logic layer, it must contain all the useful logic.

5.1.2. Services

Services are the utilities that our components use to help them improving it's functionality.

5.1.3. Coverage

Represents the code testing. As we said before, tests are executed in Karma, with Jasmine framework. We use Google Chrome to execute the tests.

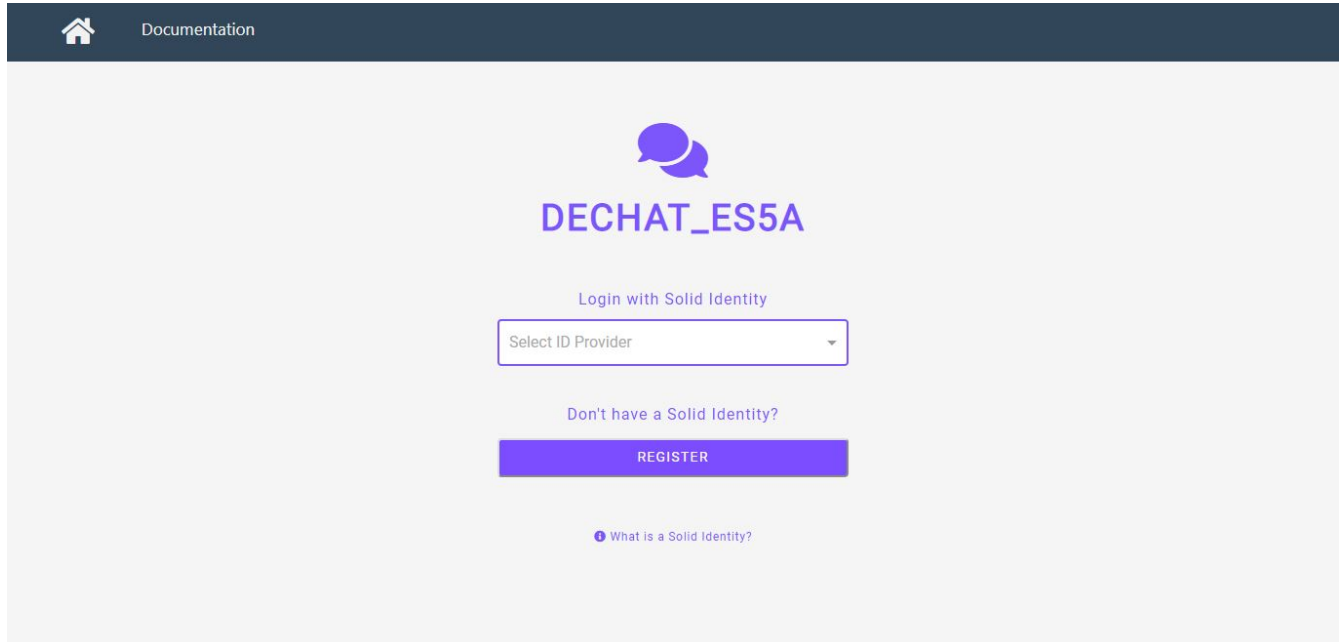
5.1.4. Utilities

It is all the useful resources. In this case, we've used a core that allows us to interact with some libraries. It contains some useful methods.

6. Runtime View

The architecture of the application is very simple:

Once you launch the application, you'll see a login view. That login view will redirect you to the official solid login page.

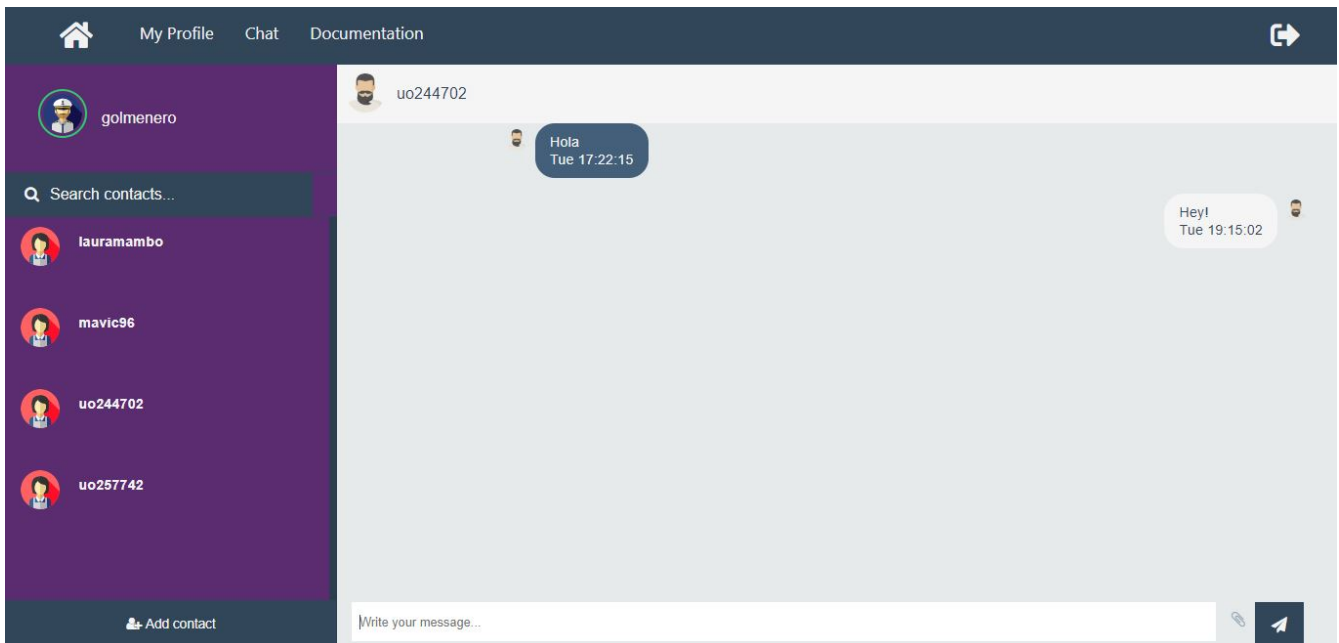


In the solid login page, you'll introduce your solid credentials. If your data is correct, you'll login into your profile and see your solid profile page.

In the navigation bar of the application, you will see 4 labels:

- Profile: The same page. In there you can edit your profile information
- Chat: The chat page. We'll introduce about it later.
- Documentation: A documentation page.
- A logout icon: It will redirect to the application login.

The chat page

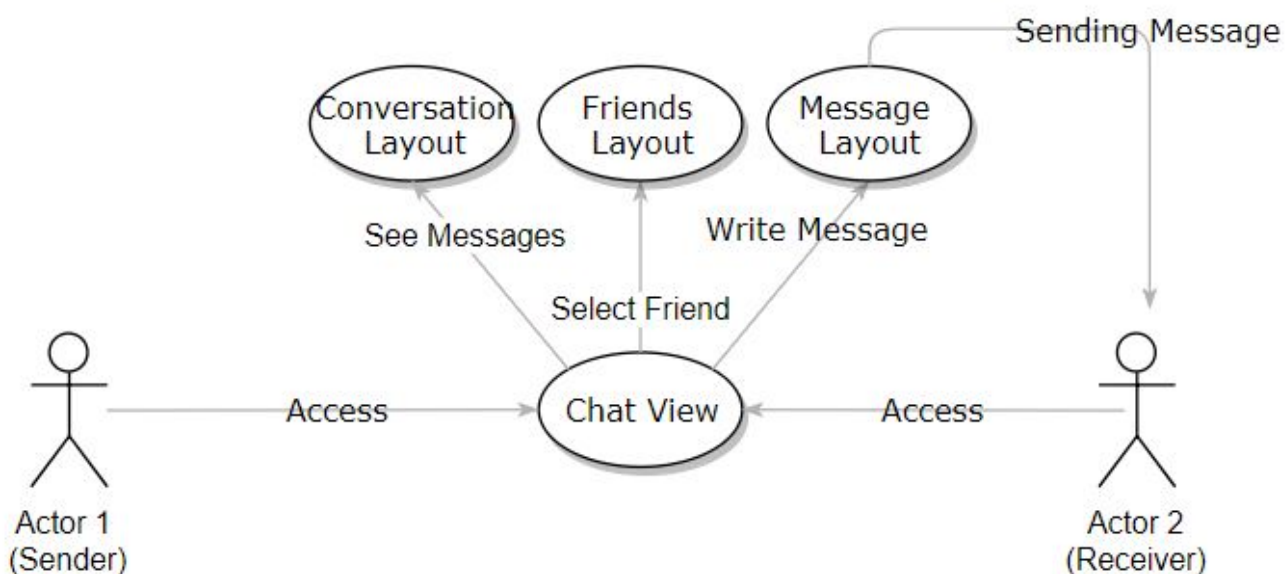


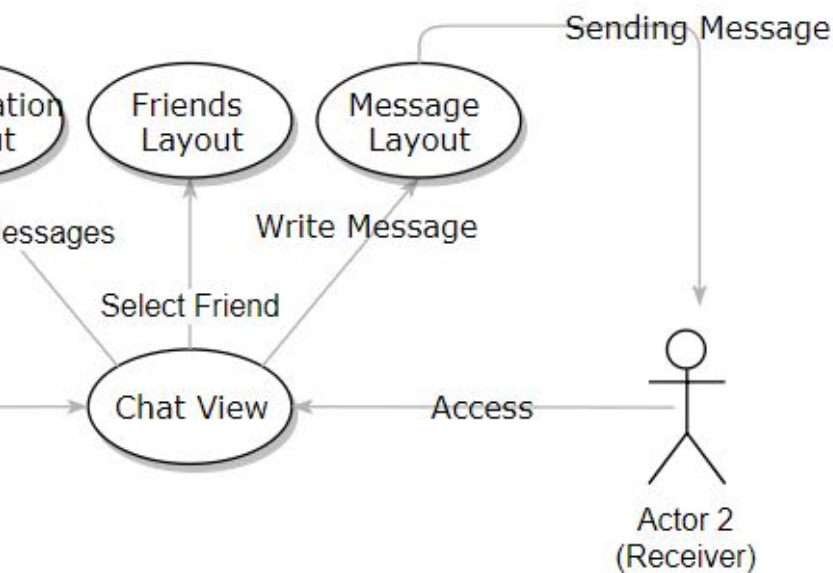
As you can see, the chat page is divided in three layers:

- Friends layer: In this layer you can search between your friends (for those you should add in solid), and start a conversation.
- Conversation layer: Here it will show the different conversations. Your own messages will appear in white colour, and your friends' will be black.
- Message layer: There you can send a message to your friend. Once you write you can press the button or simply the Enter key to send it. This message will appear as yours in the conversation layer and will be sent to your partner. Now you can choose to send emojis.

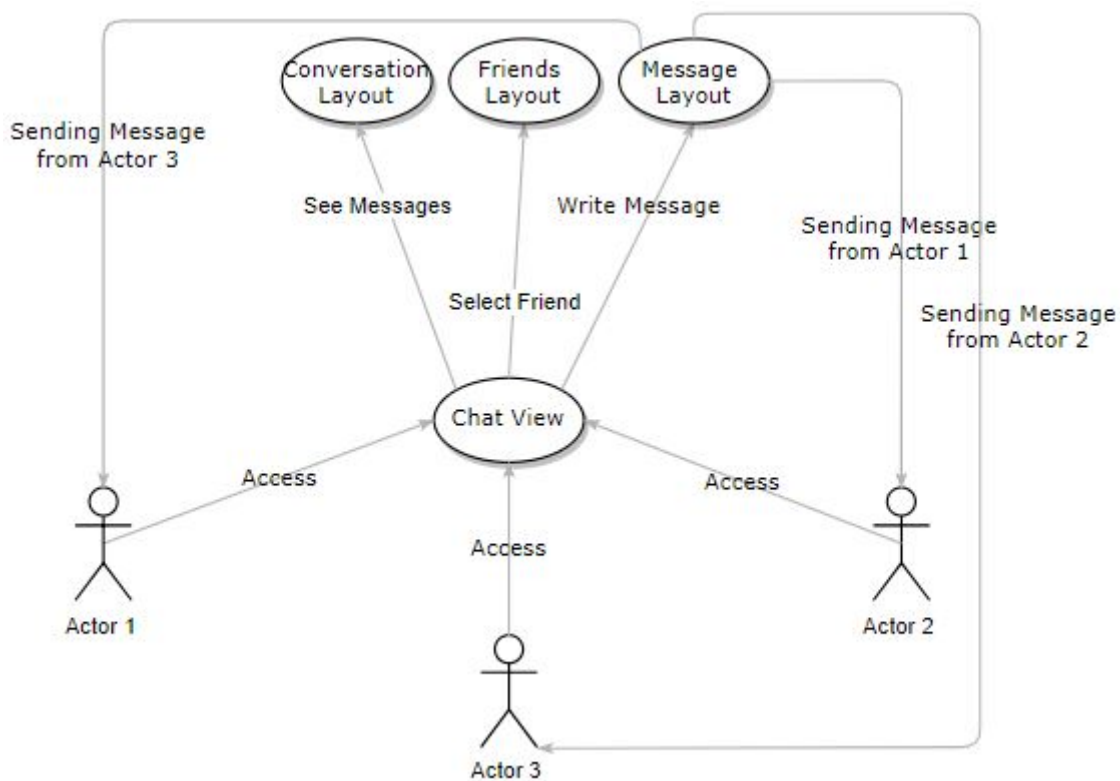
Lets see a couple runtimes scenarios

Scenario 1 Actor 1 wants to send a message to one of his friends, after login in successfully, his runtime would be like this:





Scenario 2 Actor 1 wants to send a message to Actor 2, Actor 2 sends a message to Actor 3 and Actor 3 sends a message to Actor 1:



Scenario 3 Actor 1 log in the app and modify its profile. Pod info will be upload.

7. Deployment View

¿What hardware do you need to use the application?

Fortunately, to use the application you just need one computer connected to Internet. You can also use a mobile phone to chat with your friends, but we haven't developed the app specifically to be used on it, so there will be some problems. We are working hard to try to make it more comfortable for mobile users.

At this point of the development, there is no need for geographical permissions or others like that, so the only thing you need is a computer and an Internet connection.

Although, this is an early version of the project, and it hasn't been optimized yet, so you'll need some available RAM in your computer, but not too much for worrying about it.

We developed this app mostly in Google Chrome and Firefox, so we recommend this browser.

Mapping of relationship between hardware and software

The relationship between software and hardware is very simple, there are three main components that need special attention:

- Computer.
- Browser: As we said before, we recommend Google Chrome and Firefox. Browser connects to the application.
- Application: It connects to server.
- Server: Automatically synchronizes with solid server.

It is important to notice that talking about resources **the application consumes the same resources as another app**, because it is launched in a browser.

There are other ways of deploying our app. We can deploy it using docker. For that there are 8 files we have to take a look into it.

- In Dockerfile we choose how our image will be and how to create the docker container. To run a file type "docker-compose -f Dockerfile.XXX up" and "docker-compose -f Dockerfile.XXX down"
- Dockerfile.dev and docker-compose.dev: those files make our application run in a container during develop phase, we can access to the container through 4200 port.
- Dockerfile.test and docker-compose.test: those files allow karma and e2e tests run inside container. To make this possible we had to configure ChromeHeadless.
- Dockerfile.prod and docker-compose.prod: those files allow running the app on a server. An important feature is that the app run in a Nginx server web, unlike running our app in other server(github project). To make this possible we need other files
- nginx.conf: this file allow us to configure the web server. It is a standard file that we need even we are not running it on a web server.
- entrypoint.sh: this script is needed because we are going to deploy it on Heroku and we don't

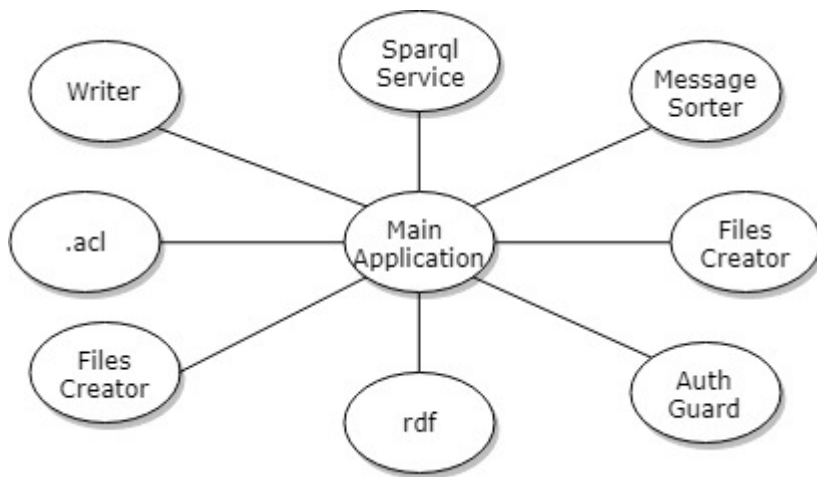
know which port will be assigned so this allow us to communicate the container with the outere.

Another way of deploying the app is cloning the github repository and running it as localhost

8. Cross-cutting Concepts

8.1. Important modules

As we saw before, the architecture of the application is based on services, like printers, creators and another useful ones.



It is important to remember that for the application we are using npm, working (obviously) in Node.js, which is a package administrator that allows you to easily manage your resources.

- Testing * To test our application, we are using karma testing, with the Jasmine framework.

Jasmine is an easy OpenSource framework that allows you to test JavaScript functionality developed in Angular. More information here:

[https://en.wikipedia.org/wiki/Jasmine_\(JavaScript_testing_framework\)](https://en.wikipedia.org/wiki/Jasmine_(JavaScript_testing_framework))

8.2. Directory Structure and Required Files

This is the directory structure of the source folder:


```
|-----app
|       |-----card
|       |-----dashboard
|       |-----fragments
|       |   |-----footer
|       |   |-----header
|       |   |-----navbar
|       |-----friends
|       |-----login
|       |-----login-popup
|       |-----models
|       |-----register
|       |-----services
|       |   |-----creators
|       |   |-----printers
|       |   |-----query
|       |   |-----sorters
|       |   |-----utils
|-----assets
|       |-----images
|       |-----js
|       |   |-----libs
|       |-----types
|       |   |-----rdflib
|-----coverage
|       |-----Chrome 73.0.3683 (Windows 10 0.0.0)
|-----environments
```

9. Design Decisions

- First decision is that we are using Git as version control system instead of using mercurial, vsn, etc. and GitHub as source code management instead of using Bitbucket, this decision was imposed by the teachers of the subject.
- The advantages of GitHub is that this platform allows us to easily share and deploy our code.
- One important feature of GitHub is the control versions. If we lose our code, we`ll be able to retrieve it easily.
- We are using javascript family language(javascript, typescript, node.js, angular, etc) to build the application as the main programming language. As we understand, javascript is the easiest way to make a SOLID application.
- The concrete language we are using is TypeScript. It is synchronized with Angular framework, and it`s usage is the same as if we were working with JavaScript. We are also using basic languages for the web such as html, css, etc as complements for the TypeScript code. When working with Angular, and you create a chat component, this tool will generate automatically a new folder with the component`s name, with a personalized css, ts and html.
- Social linked data(SOLID) based application. A must decision we have to follow if we want to make a decentralized application. This means following several important constraints to build the application. One of them is storing data in PODS, so the user is the owner of their data.
- Using a Service architecture that helps us to easily separate responsibilities. These services are used from the main app to obtain extra-functionality. There is a lot of different services, such as writers, sorters and queries services.
- Following Angular components structure, so we can build a high cohesion and low coupling app. Our main component is FriendComponent and it represents the chat page where we can select chats and send messages to our Solid friends. We decided to have all chat functionality in the same page because we thought it was better for the final user as it will be able to move in our app with just a few clicks. The most important feature of Angular is that you can build Single Pages Applications.
- Single pages applications means that the whole application works on a single page. This page updates itself dynamically, and allows you to exchange information between the app parts easily and faster.
- We use the known Karma-Jasmine framework for implementing unit test, a tool that allows us to easily test code on Angular, it helps us separating test code from the application code, it is also useful and easy to learn how to test. We thought about using Mocha.js for tests but we had a few tests done yet so we decide to keep on with Karma-Jasmine.
- At the beginning we used a simple text file to keep message info. Later on we decide to store messages in a ttl file. We stored message content and metadata in Turtle language (.ttl). The main reason to store data in rdf is that we can communicate with other applications that have the same ontology. It is useful to store the information in Turtle language because when trying to obtain pod`s information, you will be able to obtain it faster when working with Sparql queries.
- As we store message data in ttl format, we need a tool for getting that ttl info. The way we recover that info is with Sparql queries, We create queries to access the Turtle files and get

resources faster than using plain text.

- We have a notifications service that works in every browser and allows us to send a notification to a user when he receives a message. We decide to use this notification service because we think it's relevant in a real time chat application.
- Group chat develop is in a alpha version, we have decided to store all the conversation in group creators/owner pod. The main difference between group and single chats is that in group chats messages store in thw group owner`s pod, but in single conversations, information stores in the mmessage writer`s pod.
- When trying to store information in another user`s pod, you will not have edit permissions, so you need an acl (Access Control List) to control the permissions.



SOFTWARE
ARCHITECTURE

10. Quality Requirements

There are some important quality requirements that need to be considered when developing an application, specially when you develop a server-connected one.

The most importants are:

- **Velocity:** When you are chatting with a friend, you need a fast application to make sure the conversation is fluid.
- **Security:** When talking about a de-centralized chat, we ensure that our application is well-safe and we have control of our own informations.
- **Fluency:** We need a optimized application.
- **Space:** This is a forgotten one. This kind of application should be light and easy to convert to an executable file.

10.1. Quality Tree

Heres a map that allows us to easily get a high quality application:



10.2. Quality Scenarios

Scenario 1 - Security

When a user tries to access to a private conversation, it should´ t be permitted.

Scenario 2 - Velocity and Fluency

When conversating with a friend, it is really logic that conversation should be fast.

Scenario 3 - Space

As we said, an application should be as lighter as possible, if a concrete use wants to create a portable version.

11. Risks and Technical Debts

Contents

A list of identified technical risks or technical debts, ordered by priority

Motivation

“Risk management is project management for grown-ups” (Tim Lister, Atlantic Systems Guild.)

This should be your motto for systematic detection and evaluation of risks and technical debts in the architecture, which will be needed by management stakeholders (e.g. project managers, product owners) as part of the overall risk analysis and measurement planning.

Form

List of risks and/or technical debts, probably including suggested measures to minimize, mitigate or avoid risks or reduce technical debts.

Risks	Solutions
Lack of knowledge and use of angularjs	<ul style="list-style-type: none">• Consult forums• Look at the documentation• take courses
Lack of knowledge of solid	<ul style="list-style-type: none">• Look at the solid forums• Ask other classmates
Abandonment / lack of work of a member	<ul style="list-style-type: none">• Know the status of the entire project• Hold periodic meetings
Lack of time to complete the project	<ul style="list-style-type: none">• Do it stepwise and continue
Misunderstood the requirements of the application	<ul style="list-style-type: none">• Consult with the professor about the requirements
Problems with git	<ul style="list-style-type: none">• Use a specific methodology to do merges and commits
Privacy risks	<ul style="list-style-type: none">• We have to create ACL for the app correctly

12. Glossary

Definition of most important terms every stakeholder should know to understand the documentation.

Order by rarity.

Only in english at the moment.

Term	Definition
Decentralized	User is the owner of their data and not the application
Git	Version control system
Inrupt	SOLID enterprise
MVC	Model-View-Controller, software architecture
PODS	Personal Online Data Stores, used to save data
RDF	Resource Description Framework, standard model for data interchange in the web
Scrum	Agile methodology for working in group
SOLID	Social Linked Data
Stakeholders	People interested in a project
Angular	A framework for working in typescript
Turtle	Is a syntax for expressing data in RDF
Karma	IDE for testing an application
Jasmine	Framework to easily test Angular JavaScript based applications
Sparql	Query language to obtain RDF graphs

About arc42

arc42, the Template for documentation of software and system architecture.

By Dr. Gernot Starke, Dr. Peter Hruschka and contributors.

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