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End-Of-Studies Project

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Master's Degree

In

Software Engineering

Presented by

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Notification Center

Defended on September 2023 in front of the committee members:

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For everyone who has ever been a part of my life.

I dedicate this work.

Abstract

This report outlines the design and implementation of a notification center as a part of the "Convergence" project, which aims to drive digital transformation within the insurance and finance sectors while improving client engagement and optimizing internal processes. The notification center provides a scalable solution for managing and delivering tailored notifications through various channels, facilitating timely and personalized interactions. This project was made during an end-of-studies internship in order to obtain the Master's degree in Software Engineering at the Higher Institute of Informatics and Mathematics of Monastir (ISIMM).

Keywords: Client Engagement, Notification Channels, User Segmentation, Spring Boot, Angular, PostgreSQL, Docker.

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Acronyms

CTR Click-through Rates.

HTTPS Hypertext Transfer Protocol Secure.

UML Unified Modeling Language.

Introduction

In today's rapidly evolving digital landscape, the insurance, banking, and finance sectors are facing unprecedented challenges and opportunities. As customers increasingly expect seamless and personalized experiences, it has become imperative for companies in these industries to undergo a digital transformation. This shift not only enhances customer engagement and satisfaction but also boosts operational efficiency and employee productivity.

Recognizing this need, the "Convergence" project was initiated to provide innovative solutions that facilitate the digital transformation process, enabling organizations to stay competitive, deliver exceptional customer experiences, and achieve sustainable growth in the ever-changing marketplace.

Within the "Convergence" ecosystem, various tools and sub-projects are assembled, each playing a crucial role in this shared mission. Among these modules, we will be focusing on the Notification Center, as it plays a pivotal role in enhancing communication by providing a centralized system for timely and relevant notifications.

This report is structured in several chapters to provide a comprehensive overview of the project's progression. It begins with an introduction to the project context, including a profile of the host organization and an overview of the project itself. The challenges and problems faced in the insurance and finance sectors are also assessed.

The second chapter discusses the initial sprint of the project, which revolves around gathering requirements, defining specifications and setting the groundwork to start the project execution.

Subsequent chapters delve into the specific releases of the project, outlining the specification, design and implementation steps. Each chapter provides a summary of the key findings and progress made during the respective phase.

Chapter I

Project Context

Introduction

This chapter presents the project context, including an overview of the host organization, the project objectives and the problem assessment. Afterwards, we will benchmark some existing solutions, and select a suitable work methodology for a successful project execution. By exploring the context surrounding the project, we aim to provide a deeper understanding of its relevance within the organization and the industry as a whole.

I.1 Host organization profile

Satoripop is a custom software development house that delivers a wide range of end-to-end, reliable software services and solutions for businesses across various industry verticals. Satoripop offers its services in many countries in Europe, Middle East and Africa.



Figure I.1: Satoripop Logo

Satoripop has structured its offering around four key service areas. As a solutions provider, and given that all interactions nowadays pass through IT systems, Satoripop is more than ever at the heart of customers' business.

Services	<ul style="list-style-type: none">• Custom development: Web applications, Mobile applications, Application modernization• Design UX/UI: SEO, Netlinking, Optimization and assistance with content creation, Reporting• Consulting & Framing: Design thinking, Customer journey map, Wireframing, Prototypage• Digital Marketing: SEO, Netlinking, Optimization and assistance with content creation, Reporting
Phone number	Tunisia: +216 73 210 332
Address	Satoripop MEA, Blvd Hassouna Ayachi, Sousse 4000, Tunisia
Website	https://www.satoripop.com

Table I.1: Host Organization Details

I.2 Project overview

A notification center is a system that allows businesses to send and manage notifications to their customers or employees. The value proposition of a notification center is that it can help businesses communicate with their stakeholders more efficiently and effectively, leading to increased engagement and productivity.

In the retail sector as an example, a company could use the notification center to send SMS, email, push or chat alerts about product recalls, special promotions, or other important information to customers. By using a notification center, businesses can improve communication with their customers and ensure that important information is quickly and effectively distributed.

I.3 Problem assessment and challenges

Implementing a notification center system in the retail sector poses certain challenges and requires a comprehensive assessment of the existing scenario. The following issues were identified during the evaluation:

- **Limited Communication Channels:** Many businesses in the retail sector rely heavily on traditional communication methods such as flyers, physical notices, or in-store announcements. These methods often lack efficiency, reach, and real-time delivery, resulting in delayed or ineffective communication.
- **Information Overload:** Businesses need to disseminate various types of notifications, like product recalls or special promotions. However, the challenge is to manage and prioritize notifications to prevent overwhelming customers with exces-

sive information.

- **Personalization and Targeting:** Effective communication requires tailoring notifications to specific customer segments or individuals. The challenge lies in ensuring that customers receive relevant and personalized notifications based on their preferences, previous interactions, or location.
- **Multichannel Delivery:** Customers today expect to receive notifications through various channels such as SMS, email, push notifications, or social media. Managing multiple communication channels and ensuring consistent and synchronized delivery presents a significant challenge.
- **Privacy and Data Security:** With the increasing concerns about privacy and data protection, businesses must handle customer data securely while complying with privacy regulations. Safeguarding customer information and maintaining trust is crucial in implementing a notification center system.

I.4 Competitor benchmarking

In this section, we will evaluate and compare existing notification delivery solutions. By examining the features, functionalities, and performance of these solutions, we aim to identify the strengths and weaknesses of each competitor in order to inform our own development process.

I.4.1 Competitors selection

During our search for similar existing functionalities, we have carefully evaluated numerous solutions and identified the three most closely aligned with our specific needs. We will present an overview of these chosen solutions, highlighting their key characteristics and capabilities.

I.4.1.1 OneSignal

OneSignal is a popular notification service that supports multiple platforms including iOS, Android, and web. OneSignal offers a wide range of features, including segmenting users based on custom attributes, A/B testing, automation, and personalization. OneSignal also provides real-time analytics and delivery reports, allowing tracking and optimization of notification campaigns.



Figure I.2: OneSignal Homepage

I.4.1.2 Pusher

Pusher is a cloud-based notification service that provides real-time messaging for mobile and web applications. It supports push notifications, in-app notifications, and allows integration with other services and platforms.



Figure I.3: Pusher Homepage

I.4.1.3 Amazon SNS

Amazon SNS (Simple Notification Service) is a fully managed messaging service provided by Amazon Web Services (AWS) that enables you to send messages or notifications to a variety of distributed endpoints or clients.



Figure I.4: Amazon SNS Service Homepage

I.4.2 Comparison

We will conduct a comprehensive analysis of the selected existing solutions. By thoroughly examining their functionalities, strengths, and weaknesses, we aim to gain valuable insights into areas where improvements can be made to enhance user experience, streamline processes, and deliver a superior solution tailored to our specific requirements.

Our evaluation will be based on 6 criterias (Cx) that have been carefully selected as being the most relevant and aligned with the Convergence project requirements:

- **C1: Multi-channel delivery:** The ability to configure multiple channels (Email, SMS, Push, Chat) for notification delivery.
- **C2: Deliverability:** Ensuring that notifications and alerts are successfully delivered to users' devices.
- **C3: User Segmentation:** The ability to select and target specific groups of users based on criterias defined by the business requirements.
- **C4: Customization:** The ability to customize notifications content for targeted users accordingly.
- **C5: Analytics:** The ability to track different metrics during the delivery process in order to inform businesses about the effectiveness of notification campaigns and improve user engagement.
- **C6: Cost:** Charge per sent notifications for a larger user base and high notification volume.

- **C7: Ease of use:** The ability to easily setup and configure the different steps of the notification delivery process for non technical users.

	OneSignal	Pusher	Amazon SNS
C1 Multi-channel delivery	Provides most of channels (Push, Email, SMS), except for the Chat channel	Provides Push (Android, iOS, Web) notifications only	Does not provide native support for multi-channel notifications
C2 Deliverability	Low CTR and drops over time due to inactive receivers leading to misinformation for senders about the deliverability of their notifications.		
C3 User Segmentation			Does not support targeting specific segments of users based on their behavior or preferences.
C4 Customization	Limited: Users can't fully customize the layout of the notification.	Limited: Only a subject and a body, no dynamic content.	Limited: Only text message, subject and body, no dynamic content.
C5 Analytics			No detailed insights on sent notifications
C6 Cost	249\$/month (for 50,000 subscribers from push notifications only)	99\$/month for 50,000 subscribers	Charge per usage (Pay as you go)
C7 Ease of use		Mostly Programmatic, does not provide a fully featured web interface.	Complex and time-consuming particularly for non technical users.

Table I.2: Comparison table

I.5 Proposed solution

The benchmarking process allowed us to identify pain points and challenges commonly faced by businesses when implementing a notification center system.

Based on these findings, we have concluded that developing a custom notification center tailored to our specific needs is the most suitable approach. By addressing the identified pain points and challenges, we can create a robust and user-friendly solution that empowers businesses to communicate more efficiently with their customers and employees.

The proposed notification center will incorporate multi-channel delivery options, advanced user segmentation, and personalized messaging capabilities. It will also prioritize customization and prioritization, enabling businesses to tailor notifications based on audience preferences and deliver essential information effectively.

I.6 Work methodology

With today's customers and businesses requiring rapid responses and changes, teams at Satoripop are embracing the Agile methodology, a project management approach that involves breaking the project into phases and emphasizes continuous collaboration and improvement, following a cycle of planning, executing, and evaluating.

One of the frameworks that helps practice building the mentioned agile principles into work and that we will be focusing on is Scrum. We will provide an overview of this framework, highlighting its approach and key principles.

I.6.1 The scrum framework

Scrum is a lightweight framework that helps people, teams and organizations generate value through adaptive solutions for complex problems. It employs an iterative, incremental approach to optimize predictability and to control risk, while engages groups of people who collectively have all the skills and expertise to do the work and share or acquire such skills as needed.

I.6.2 Members of a scrum team

The fundamental unit of Scrum is a small team of people. The Scrum Team consists of one Scrum Master, one Product Owner, and Developers. Within a Scrum Team, there are no sub-teams or hierarchies. It is a cohesive unit of professionals focused on one objective at a time, the Product Goal. [1]

- **Developers:** People in the Scrum Team that are committed to creating any aspect

of a usable Increment each Sprint.

- **Product Owner:** One person that may represent the needs of many stakeholders in the Product Backlog. The Product Owner is accountable for effective Product Backlog management and maximizing the value of the product resulting from the work of the Scrum Team.
- **Scrum Master:** Deeply understands the work being done by the team and can help the team optimize their transparency and delivery flow. As the facilitator-in-chief, he/she schedules the needed resources (both human and logistical) for sprint planning, stand-up, sprint review, and the sprint retrospective.

I.6.3 Scrum events

The Sprint is a container for all other events. Each event in Scrum is a formal opportunity to inspect and adapt Scrum artifacts. These events are specifically designed to enable the transparency required.

- **The Sprint:** Sprints are the heartbeat of Scrum, where ideas are turned into value. They are fixed length events of one month or less to create consistency. A new Sprint starts immediately after the conclusion of the previous Sprint.
- **Sprint Planning** The work to be performed during the current sprint is planned during this meeting by the entire development team. Specific user stories are then added to the sprint from the product backlog. These stories always align with the goal and are also agreed upon by the scrum team to be feasible to implement.
- **Daily Scrum:** A 15-minute event for the Developers of the Scrum Team held every working day of the Sprint to inspect progress toward the Sprint Goal and adapt the Sprint Backlog as necessary.
- **Sprint Review:** The purpose of the Sprint Review is to inspect the outcome of the Sprint and determine future adaptations. The Scrum Team presents the results of their work to key stakeholders and progress toward the Product Goal is discussed.
- **Sprint Retrospective:** The purpose of the Sprint Retrospective is to plan ways to increase quality and effectiveness. The Scrum Team identifies the most helpful changes to improve its effectiveness and these changes are addressed as soon as possible.

I.6.4 Scrum artifacts

Scrum's artifacts represent work or value. They are designed to maximize transparency of key information. Thus, everyone inspecting them has the same basis for adaptation.

- **Product Backlog:** The primary list of work that needs to get done. It's a dynamic list of features, enhancements, and fixes that acts as the input for the sprint backlog. This list is constantly revisited, re-prioritized and maintained by the Product Owner in case items may no longer be relevant or problems may get solved in other ways.
- **Sprint Backlog:** The list of items, user stories, or bug fixes, selected by the development team for implementation in the current sprint cycle. A sprint backlog may be flexible and can evolve during a sprint without compromising the fundamental sprint goal.
- **Increment:** A concrete stepping stone toward the Product Goal. Each Increment is additive to all prior Increments and thoroughly verified, ensuring that all Increments work together. In order to provide value, the Increment must be usable.

Summary

To summarize our findings in this chapter, we introduced the host organization, then outlined the problem assessment and identified its related challenges. Next we analyzed competitors to get a grasp of the major pain points that we are going to tackle, and finally we presented the adopted agile approach in our team to foster flexibility and collaboration.

The next chapter will introduce the Sprint 0, where we kickstart the project, establish goals, and set the roadmap for upcoming sprints.

Chapter II

Sprint 0: Requirements gathering and Specification

Introduction

In this chapter, we place significant focus on gathering requirements and transforming them into well-defined and documented specifications. This includes creating use cases and user stories, which provide valuable insights into system interactions and user workflows. Furthermore, we establish a prioritized product backlog, ensuring efficient resource allocation and timely delivery of the most critical and valuable features.

II.1 Requirements gathering

By conducting a comprehensive analysis of the requirements, we aim to bridge the gap between the stakeholders' vision and the actual implementation of the product or system. This analysis helps us define clear and concise specifications that serve as the foundation for the design, development, and testing phases of the project.

II.1.1 Identifying end-users

Identifying end-users is a crucial step in requirements analysis as it helps determine the needs, expectations, and constraints of the target audience. In our application, we were able to identify three types of actors:

- **Administrator:** Is responsible for overseeing user accounts, configuring and maintaining the resources needed by agents or employees to ensure the smooth operation of the system inside the organization.

- **Agent:** Is an employee inside the organization in charge of executing actions on the notification center: creating and scheduling notification campaigns including the creation of notification content, client base segmentation.
- **Client:** Is a customer who is going to be targeted by notifications from the business or organization they belong to. A customer should be able to receive notifications and set their preferences for receiving notifications from that business.

II.1.2 Functional requirements

Functional requirements define the specific actions, tasks, and behaviors that the product must be able to perform in order to meet the needs of its end-users. These requirements form the foundation of the system's functionality.

The functional requirements we captured for each actor in are outlined below.

Authentication and Profile settings

- **Sign in:** A registered user should be able to access the system by providing valid credentials.
- **Edit profile settings:** A logged in user should be able to edit his profile settings.
- **View statistics:** A logged in user should be able to view notification activity metrics on his dashboard.

Administrator requirements

- **Manage agents:** An administrator should be able to add new agents, update, delete, deactivate accounts and reset passwords for existing agents.
- **Manage channels:** An administrator should be able to create new notification channels, update, delete, configure service providers for existing channels.
- **Manage topics:** An administrator should be able to create new notification topics, update, delete and configure topic's priority for existing ones.

Agent requirements

- **Manage templates:** An agent should be able to create new notification templates, update and delete existing ones.
- **Manage triggers:** An agent should be able to create new notification triggers, con-

figure the target audience the scheduling, update, change status and delete existing triggers.

- **Manage audiences:** An agent should be able create new segments of users based on a criteria, update and delete existing ones.
- **View logs:** An agent should be able to view logs of sent notifications and their statuses.

Client requirements

- **Manage notification preference:** A client should be able to edit his notification preferences, channels and frequency of receiving notifications.
- **View notification history:** A client should be able to checkout a history of his received notifications (for in-app notifications).

II.1.3 Non-Functional requirements

When designing a notification system, various technical requirements need to be considered to ensure its effectiveness, reliability, and scalability. Here are the key requirements that should be addressed:

- **Security:** The system shall enforce secure communication protocols, such as HTTPS, to protect sensitive data during transmissionn, also data and preferences stored in the system shall be securely encrypted to prevent unauthorized access or data breaches.
- **Real-time:** The system shall deliver notifications in real-time or near real-time to ensure timely communication, messages and notifications should be delivered with minimal delay for high priority topics.
- **Scalability:** The system should be designed to handle a high volume of concurrent users and notifications without compromising performance and the system architecture should be scalable, allowing for horizontal scaling by adding more servers or utilizing cloud-based infrastructure as the user base grows.
- **Customizability:** The system should provide flexibility and customizability to meet the specific branding and user experience requirements of different organizations. Also the system should allow customization of user preferences to provide a personalized experience.

II.2 Scrum implementation overview

This section provides an overview of the Scrum implementation in our project. It includes a global use case diagram, showcasing the system's high-level functionalities, followed by the presentation of the product backlog and the planning of the sprints.

II.2.1 Global use case diagram

Using UML use case diagrams to model the requirements allows for a visual representation of the interactions between actors and the system, providing a clear and concise way to specify the functionalities and behaviors expected from the product.

The figure II.1 illustrates the global use case diagram we modeled for our notification system:

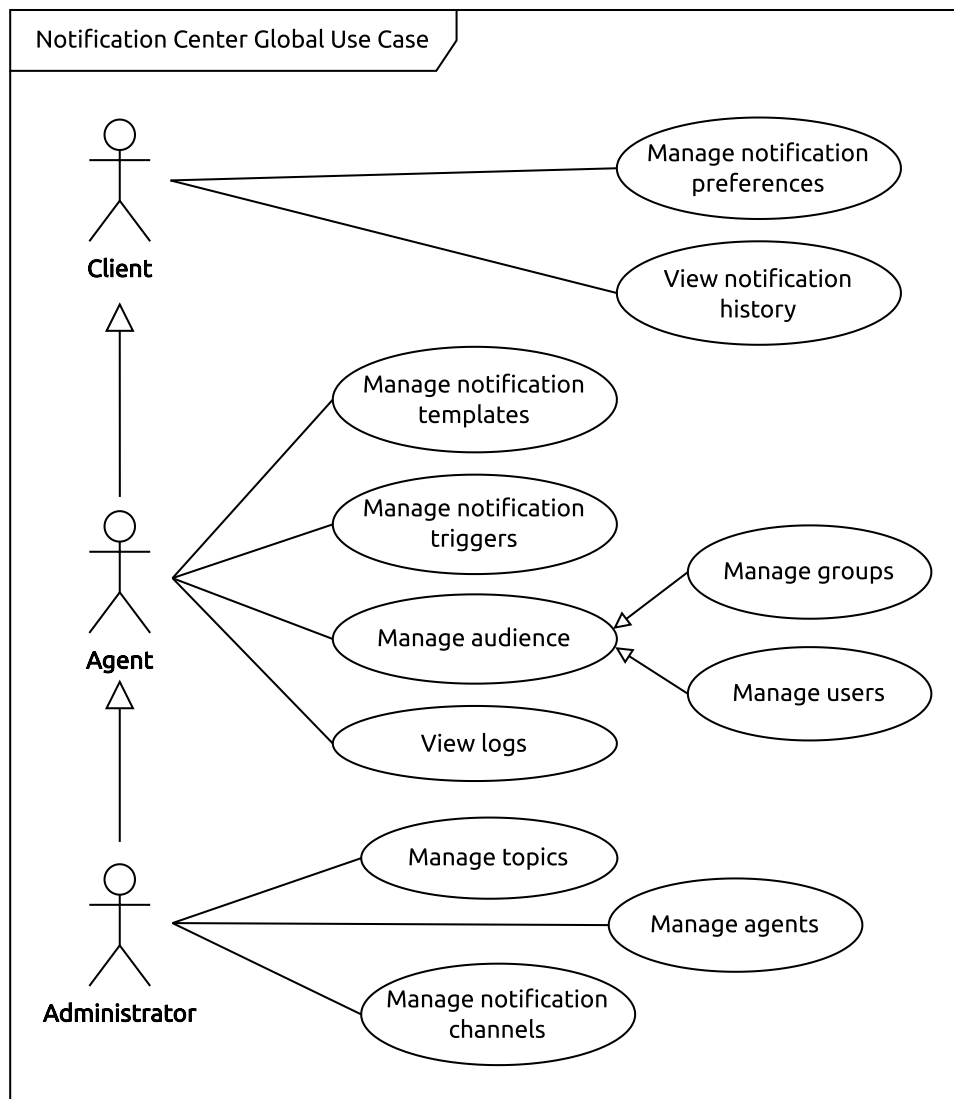


Figure II.1: Notification Center global use case diagram

II.2.2 Product backlog

The Product Backlog serves as a dynamic and living artifact that captures and organizes the ever-evolving list of features, functionalities, and enhancements desired for a software product.

- **Epic:** Is a large body of work that can be broken down into a number of smaller stories.
- **User story:** Is an informal, general explanation of a software feature written from the perspective of the end user or customer, in the form of:
“As a [persona], I [want to], [so that].”

Epic	User story
Authentication	As a new user, I want to be able to create an account so that I can use the notification center.
	As a registered user, I want to be able to log into my account securely using my email and password.
Agents management	As an administrator, I want to be able to create agents so that I can add them to the notification center.
	As an administrator, I want to be able to list agents so that I can view all registered agents.
	As an administrator, I want to be able to edit agents so that I can modify their information.
	As an administrator, I want to be able to delete agents so that I can get rid of no longer needed agents.
Users management	As an administrator/agent, I want to be able to create users so that I can send them notifications.
	As an administrator/agent, I want to be able to list users so that I can view all created users.
	As an administrator/agent, I want to be able to edit users so that I can modify their information.
	As an administrator/agent, I want to be able to delete users so that I can get rid of no longer needed users.
Audience management	As an administrator/agent, I want to be able to create an audience so that I can target specific individuals based on a criteria.
	As an administrator/agent, I want to be able to list audiences so that I can view all created segments.
	As an administrator/agent, I want to be able to edit an audience so that I can change selection criteria and segment configurations.

Epic	User story
	As an administrator/agent, I want to be able to delete a group of users so that I can get rid of no longer needed groups..
Notification channels management	As an administrator/agent, I want to be able to create notification channels so that I can send notifications through these channels.
	As an administrator/agent, I want to be able to list notification channels so that I can view all created channels.
	As an administrator, I want to be able to edit notification channels so that I can modify or update their configurations.
	As an administrator/agent, I want to be able to delete notification channels so that I can get rid of no longer used channels.
Notification templates management	As an agent, I want to be able to add notification templates so that I can send notifications based on that template.
	As an agent, I want to be able to list notification templates so that I can view all created templates.
	As an agent, I want to be able to edit notification templates so that I can keep them up to date.
	As an agent, I want to be able to delete templates so that I can get rid of no longer used templates.
Notification preferences management	As a user, I want to be able to set my notification preferences, so that I can receive notifications from the channels I want.
Notification triggers management	As an agent, I want to be able to create triggers for notifications so that I can schedule notifications to be sent automatically.
	As an agent, I want to be able to list triggers for notifications so that I can view all created triggers.
	As an agent, I want to be able to edit notifications triggers so that I can modify or update its configurations.
	As an agent, I want to be able to delete notification triggers so that I can get rid of outdated and no longer used triggers.
Notification history	As a user, I want to be able to list notification history so that I can review my received notifications whenever I want.
	As an administrator/agent, I want to be able to list sent notification logs so that I can review all sent notifications.
Dashboard	As an administrator/agent I want to be able to view metrics on my dashboard so that I can get an overview on important statistics related to notification activities.

Table II.1: Product backlog

II.2.3 Releases and sprints planning

A release refers to the deployment of a specific version or update of a software product. It involves meticulous planning and coordination to ensure successful delivery.

In the following table, we present the detailed planning of the releases, outlining the sprints included in each release, and the epics included in each sprint.

Release	Sprints	Epics
Release 1	Sprint 1	Authentication
		Agents management
		Users management
	Sprint 2	Audiences management
		Notification channels management
Release 2	Sprint 3	Notification templates management
		Notification preferences management
	Sprint 4	Notification triggers management
		Notification history
		Dashboard

Table II.2: Releases and sprints planning

II.3 Development infrastructure

Summary

In this chapter we laid the groundwork for the project by comprehensively gathering and analyzing the requirements. By identifying end-users, defining functional and non-functional requirements, and creating a clear specification through use case diagrams, elaborating the product backlog, and planning sprints, we have set the stage for the subsequent phases of development.

The insights gained from this chapter will prove invaluable in ensuring the successful implementation of the project and the satisfaction of the end-users. In the following chapter, we will start executing our project providing the practical realization of the initial release.

Chapter III

Release 1: Users, segmentation & channels

Introduction

In this chapter, we focus on the first release of our product, this release aims to create and enhance the user experience, implement userbase segmentation strategies, and manage notification channels. We will delve into the sprints backlog, design considerations, and the implementation process undertaken to bring these features to fruition.

III.1 Sprints backlog

During the Sprint Planning event, we estimated the effort required for each item in the sprint backlog based on the number of working hours.

The priority of backlog items is reflected by their relative order in the table. Items positioned higher in the table indicate a higher priority.

Sprint	Epic	User story	Estimation
1	Authentication	As a new user, I want to be able to create an account so that I can use the notification center.	16
		As a registered user, I want to be able to log into my account securely using my email and password.	16

Sprint	Epic	User story	Estimation
	Agents management	As an administrator, I want to be able to create agents so that I can add them to the notification center.	16
		As an administrator, I want to be able to list agents so that I can view all registered agents.	16
		As an administrator, I want to be able to edit agents so that I can modify their information.	8
		As an administrator, I want to be able to delete agents so that I can get rid of no longer needed agents.	8
	Users management	As an administrator/agent, I want to be able to create users so that I can send them notifications.	16
		As an administrator/agent, I want to be able to list users so that I can view all created users.	16
		As an administrator/agent, I want to be able to edit users so that I can modify their information.	8
		As an administrator/agent, I want to be able to delete users so that I can get rid of no longer needed users.	8
2	Audience management	As an administrator/agent, I want to be able to create an audience so that I can target specific individuals based on a criteria.	24
		As an administrator/agent, I want to be able to list audiences so that I can view all created segments.	16
		As an administrator/agent, I want to be able to edit an audience so that I can change selection criteria and segment configurations.	8
		As an administrator/agent, I want to be able to delete a group of users so that I can get rid of no longer needed groups..	8

Sprint	Epic	User story	Estimation
	Notification channels management	As an administrator/agent, I want to be able to create notification channels so that I can send notifications through these channels.	32
		As an administrator/agent, I want to be able to list notification channels so that I can view all created channels.	16
		As an administrator, I want to be able to edit notification channels so that I can modify or update their configurations.	8
		As an administrator/agent, I want to be able to delete notification channels so that I can get rid of no longer used channels.	8

Table III.1: Backlog of Sprint 1 & 2

III.2 Design

The design phase of software development is a critical step in the software development life cycle. It is the process of transforming the customer requirements into a detailed plan for how the software will be implemented. In this section we are going to focus on the design aspects related to the database and software design.

III.2.1 Database design

The figure III.1 illustrates the entity-relationship diagram for our first release.

III.2.2 Software design

III.2.2.1 Class diagram

The class diagram provides a high-level overview of the system's structure, relationships, and interactions between different classes. It represents the static structure of the system, including classes, attributes, methods, and associations.

The figure III.2 illustrates the class diagram for our first release.



Figure III.1: Notification Center entity-relationship diagram

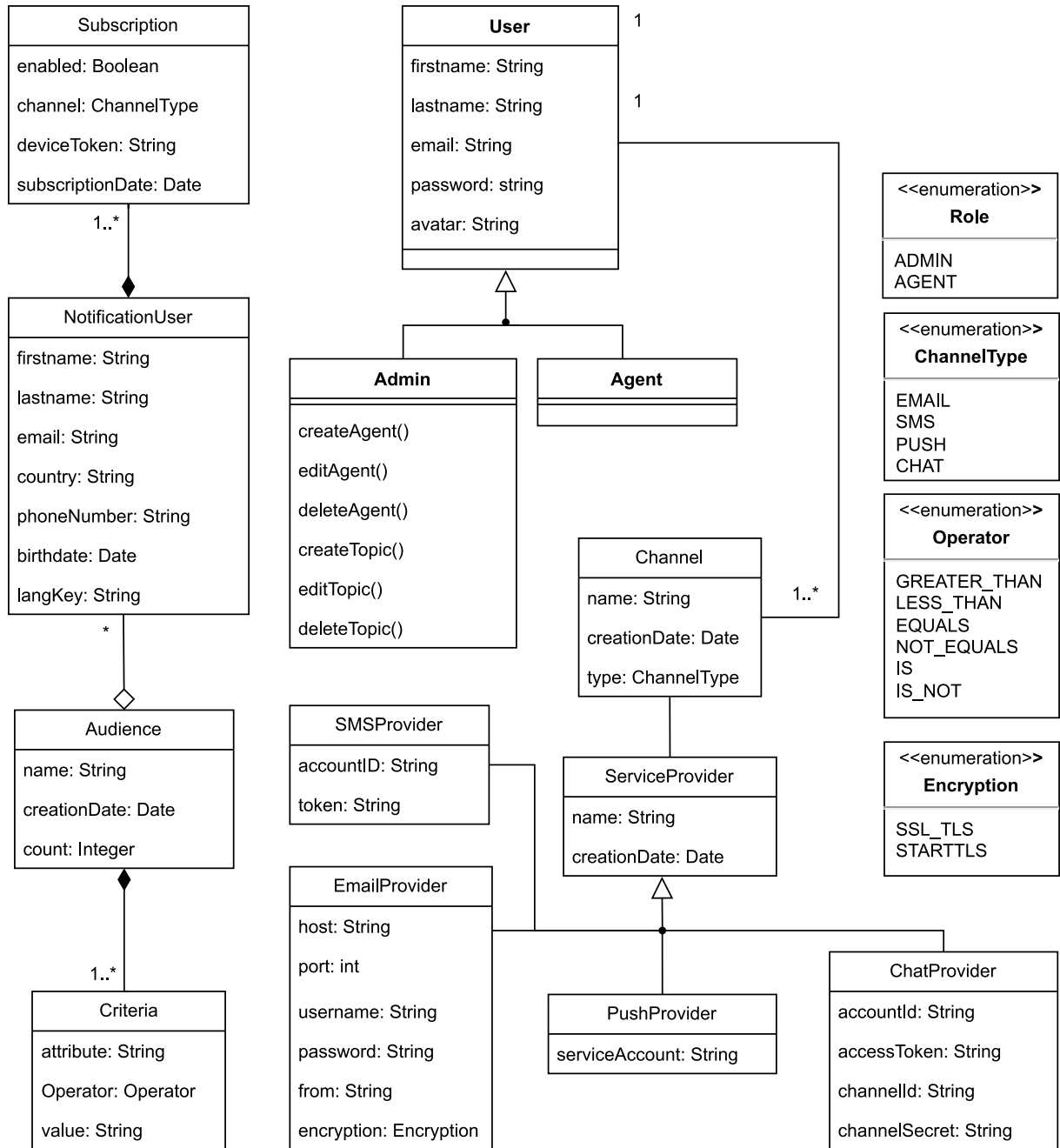
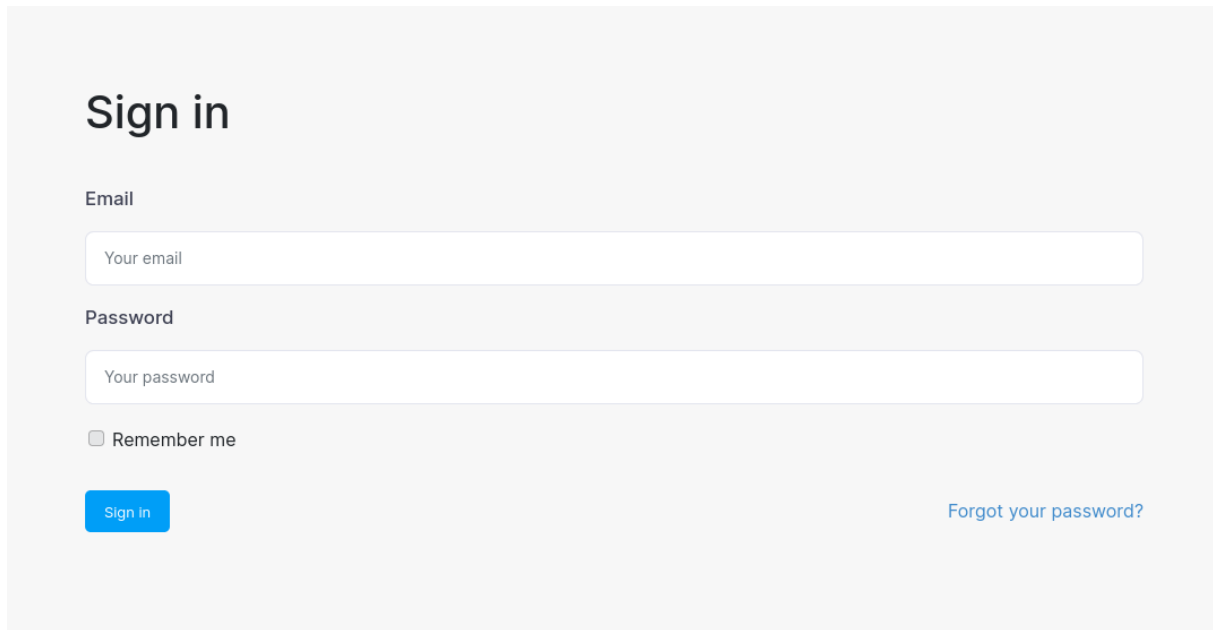


Figure III.2: Notification Center global class diagram

III.3 Implementation

III.3.1 Authentication page

The figure III.3 illustrates the final result of the implementation of the authentication epic.

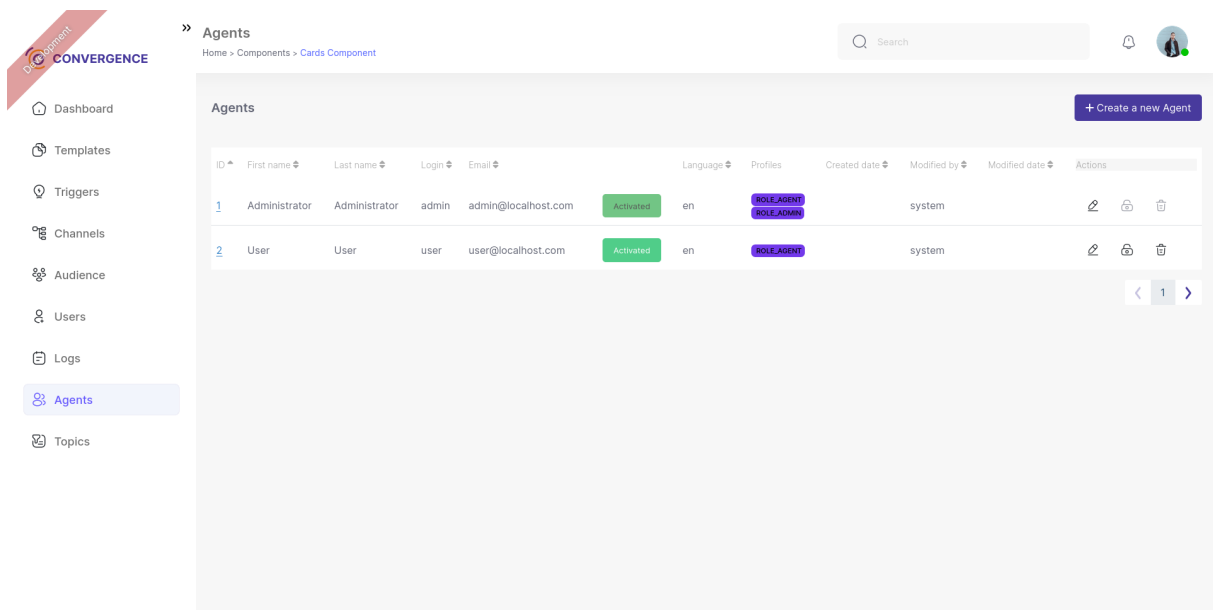


The image shows a 'Sign in' page with a light gray background. At the top, the text 'Sign in' is displayed in a large, bold, black font. Below this, there are two input fields: 'Email' with the placeholder text 'Your email' and 'Password' with the placeholder text 'Your password'. Both fields have a light gray border and a small 'x' icon to clear the input. Below the password field, there is a checkbox labeled 'Remember me'. At the bottom left, there is a blue button with the text 'Sign in'. At the bottom right, there is a link that says 'Forgot your password?' in a smaller, blue font.

Figure III.3: Authentication page

III.3.2 Agents management page

The figure III.4 illustrates the final result of the implementation of the agents management epic.



The image shows a web application interface for managing agents. On the left, there is a sidebar with a red diagonal banner that says 'Component CONVERGENCE'. The sidebar contains a list of menu items: Dashboard, Templates, Triggers, Channels, Audience, Users, Logs, Agents (highlighted), and Topics. The main content area is titled 'Agents' and has a breadcrumb trail 'Home > Components > Cards Component'. There is a search bar and a user profile icon in the top right. A '+ Create a new Agent' button is in the top right corner. The main area contains a table with the following data:

ID	First name	Last name	Login	Email	Language	Profiles	Created date	Modified by	Modified date	Actions
1	Administrator	Administrator	admin	admin@localhost.com	en	ROLE_AGENT ROLE_ADMIN		system		Edit Copy Delete
2	User	User	user	user@localhost.com	en	ROLE_AGENT		system		Edit Copy Delete

At the bottom right of the table, there is a pagination control showing '< 1 >'.

Figure III.4: Agents management page

III.3.3 Channels management page

The figure III.5 illustrates the final result of the implementation of the channels management epic.

The screenshot shows the 'Channels' management page within the 'CONVERGENCE' system. The left sidebar contains navigation links: Dashboard, Templates, Triggers, Channels (selected), Audience, Users, Logs, Agents, and Topics. The main content area is titled 'Channels' and includes a '+ Create a new Channel' button. Below this is a table with the following data:

Name	Creation Date	Channel Type	Service Provider	Actions
test-EMAIL-CUSTOM_SMTP	12 Jul 2023 02:00:00	EMAIL		
test-SMS-TWILIO	12 Jul 2023 02:01:00	SMS		
test-PUSH-FIREBASE	12 Jul 2023 02:02:00	PUSH		
test-CHAT-WHATSAPP	12 Jul 2023 02:03:00	CHAT		
test-CHAT-SLACK	12 Jul 2023 02:03:00	CHAT		

At the bottom right of the table, there is a pagination control showing '< 1 >'.

Figure III.5: Channels management page

Summary

Chapter IV

Release 2: Sending notifications & dashboards

Introduction

IV.1 Sprint backlog

IV.2 Specification

IV.3 Design

IV.4 Implementation

Summary

Bibliography

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