



DEPARTMENT OF INFORMATICS

TECHNISCHE UNIVERSITÄT MÜNCHEN

Master's Thesis in Informatics

Implementation of Trucking Marketplace

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Implementierung des Trucking Marketplace

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I confirm that this master's thesis in informatics is my own work and I have documented all sources and material used.

Munich, 15.08.2022

Ahmed Darwish

A handwritten signature in black ink, appearing to be 'Ahmed Darwish', with a long horizontal stroke extending to the right.

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Abstract

A thesis presented on the implementation of trucking marketplace, beginning with a study about trucking marketplaces globally, and details in the Egyptian market. Furthermore, it discusses the implementation of the proposed system in the Egyptian market and the potential solutions it provides for the trucking industry. Furthermore, a cost estimation equation is proposed to calculate the cost of the shipment. Finally, general discussion about the advantages and disadvantages of the proposed solution is mentioned.

Glossary

Vendor. A service provider/carrier company, that owns or manages a fleet of trucks.

Customer. A factory/company that requires a trucking solution to transfer goods from one location to another.

Contract. A contract is a fixed agreement between a vendor and a customer on a specific route/corridor, truck type, number of trucks, and period of time on a specific cost per Order.

Order. An order is a shipment that might contain one or more truck that goes on one specific route/corridor.

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1 Introduction

Freight logistics plays an important role in impacting the economic growth of every nation. Due to the rising concerns about the CO₂ emission and the impact of transportation on the climate change, more and more attention is given to the Freight management. Egypt has a high export potentials in various sectors due to its competitive advantage in many manufacturing industries and its strategic location. Moreover, Egypt is considered one of the fastest growing emerging markets in COMESA. However, transportation is still considered as one of the main challenges in Egypt. Nevertheless, the inadequacy of transportation is considered a major problem that is affecting the flow of goods not just within Egypt but also to COMESA [5]

Egypt has several agreements with Arab countries, African countries, and other countries all of the world. The impact of the Inland logistics system is not limited to COMESA but also to every trade agreement Egypt has with other countries. According to the Egypt Trade [16], "Egypt has signed several bilateral agreements with Arab Countries: Jordan (December 1999), Lebanon (March 1999), Libya (January 1991), Morocco (April 1999), Syria (December 1991), and Tunisia (March 1999). Egypt signed an Association Agreement with the European Union (EU) which entered into force on June 1, 2004. The agreement provided for immediate duty-free access of Egyptian products into EU markets, while duty free access for EU products was phased in over a twelve-year period. In 2010, Egypt and the EU completed an agricultural annex to their FTA, liberalizing trade in over 90 percent of agricultural goods." The following is a list of several multilateral trade agreements Egypt is a signatory to :

- The African Continental Free Trade Area (AfCFTA)
- The General Agreement on Tariffs and Trade (GATT)
- The General Agreement on Trade in Services (GATS)
- European Union-Egypt Free Trade Agreement (Association Agreement)
- Free Trade Agreement with EFTA States
- Turkey-Egypt Free Trade Agreement

- Greater Arab Free Trade Area Agreement
- Agadir Free Trade Agreement among Egypt, Morocco, Tunisia and Jordan
- Egyptian-European Mediterranean Partnership Agreement
- The Common Market for Eastern and Southern Africa (COMESA)
- Pan Arab Free Trade Area (PAFTA)
- Egypt-MERCOSUR Free Trade Agreement

In this Thesis some of the challenges that are faced in the Egyptian In-land Logistics are addressed. In the following sections more details are given to the logistics market in Egypt and MENA region, followed by the rise of the Third-Party Logistics (3PL) solutions in the region. In Chapter 2, more detailed insights are given about different trucking solutions, and a comparison is driven between them. In Chapter 3, the proposed system is explained with its technical implementation and architecture design. Nevertheless, real-life experiment data is also documented. In Chapter 4, a driven conclusion is written about the proposed solution and its advantages and disadvantages compared to other existing solutions in the trucking market.

1.1 Logistics Market in Egypt and MENA Region

Logistics in the supply chain has several definitions. The Council of Supply Chain Management Professionals (CSCMP) defines it as “Logistics is the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements”[9].

Furthermore, logistics performance indicates the institution/organization’s ability to deliver goods within an acceptable time, and acceptable cost. Moreover, The creation of the logistics activities can be reflected in the seven-R formula. As It refers to the organization’s ability to deliver the right amount of the right product at the right place at the right time in the right condition at the right price with the right information [6].

Given that the Middle East and North Africa (MENA) region is rich in human, natural, financial, and physical resources, and is increasingly challenged to manage these assets in ways that create value for all its citizens. With a population of nearly 300 million people. And a healthy entrepreneurship eco-system, significant raw materials, and unique geographic situation, the economies of the MENA region have much to offer domestic and foreign investors [12]. In the following diagram 1.1 that is retrieved from [4], it is illustrated the Free Trade Agreements (FTA) in the MENA countries in 2006.

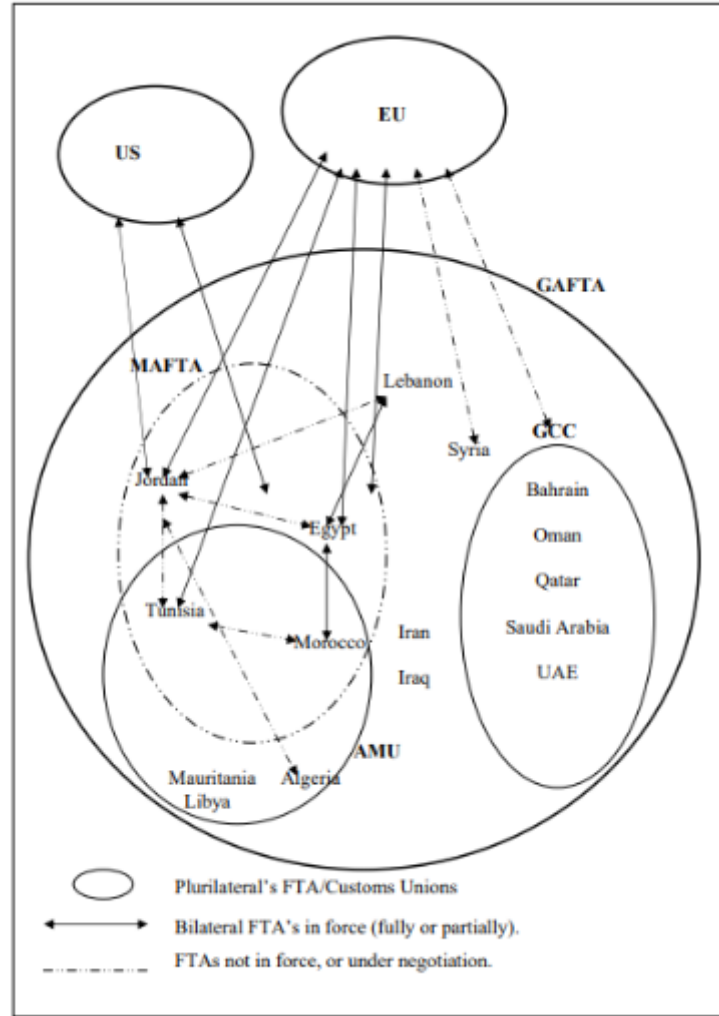


Figure 1.1: FTA in MENA region

With these rich resources and different FTAs within the MENA region, great concern about the impact of freight transportation on the environment rises. [13] Saidi is discussing in his publication the impact of freight transportation on CO₂ emission. His study found that carbon emission is driven by trade openness, financial development, and growth. Nevertheless, the findings indicate an urge for a sustainable freight transportation solution, that is energy efficient to resist serious environmental degradation.

Focusing on Egypt as it is one of the major trade players in the MENA region. Egypt

is a member of several trade blocs including the African Economic Community (AEC), Preferential Trade Area for Eastern and Southern Africa (PTA) and Common Market for Eastern and Southern Africa (COMESA). However, most of these agreements are fairly unknown according to Hussein Hachem, CEO, of Aramex. He mentioned “COMESA is a fantastic trade agreement. And it comes as an advantage if you are trading between Cairo and East Africa, for example. Every product produced in Cairo – and Cairo has some manufacturing power – if you transport it to East Africa, it goes without duties. On top of that, the chamber of commerce back in Egypt will give you an incentive on the shipping as well: they subsidise the shipping. But the problem that we have is that these agreements are fairly unknown.” [10]

Nevertheless, the services sector is by far the largest and fastest-growing in the Egyptian economy, accounting for nearly 50% of GDP. Tourism, trade, banking, and shipping services on the Suez Canal all constitute the main sources of revenue in the Egyptian economy. [10]

Egypt’s geographical location lends an important aspect to the maritime transport sector linking both the Mediterranean and Red Seas by the Suez Canal. Moreover, the Suez Canal is the main trade route between Europe and Asia, accounting for roughly 7.5% of world sea trade, and counted as a huge asset that Egypt has. With the newly expanded Suez Canal, the country oversees coastlines up to (2,900 kilometres) on the Red Sea, River Nile, and Mediterranean Sea, which magnifies the impact of the marine activities on the country’s social and economic well being [2]. According to Eberts, (2000) “Transportation is inherently one of the driving factors of economic development” [2]. The impact on the marine activities in the country would affect directly the inland logistics system and vice versa.

Egypt has 40 seaports, apart from the dry ports. with a variety of specializations from commercial ports, mining ports, finishing ports, marinas, and oil-shipping ports. Alexandria is considered the most important port and biggest in Egypt. Due to its heritage and its geographical location, it has the most sophisticated equipment in the Middle East. [10]

[2] According to the statistical yearbook issued by the Egyptian Ministry of transport: “In 2020, the Egyptian ports handled 156 million tons of cargo in total, including 7.56 million TEUs, compared with 172 million tons during the year 2019 including 7.24 million TEUs, with a decline of 16 million tons (Egyptian Maritime Data Bank, 2021) A report issued by the maritime transport sector in 2020 indicated that, Alexandria Port handled 55.6 million tons in 2020, compared with 62 million tons in the previous

year, while Damietta Port handled 32.7 million tons, compared with 36 million tons in 2019.”. The trend shows a clear decline in the overall cargo that Egyptian ports handled. However, as there are external factors that influenced the supply chain sector all over the world such as the corona pandemic, these numbers does not reflect the capacity of the ports or the quality of the service in any sense.

Egypt’s inland freight is considered the largest share of freight transportation with a value of approximately 53%, which increases the country’s dependence on the maintenance of the road infrastructure. Until now, the quality of Egypt’s road network has been considered good, with 92% being paved. [10]

According to Helmy et al. [7]: “Transport routes in Egypt are mainly focused on Cairo and also follow settlement patterns along the Nile. The road transport network is supplemented by good inland water connections along the Nile as well as a good rail network. In addition to the sea ports, a network of river transport across the Nile Delta and its tributaries facilitates the transport of goods and commodities.”

Ali et al. [1], was discussing in his publication different Logistics Service Quality Measurements (LSQ) to evaluate Logistics Service Providers (LSP). They categorized the measurement scales into five primary dimensions:

- Reliability is the ability to achieve the promised service correctly.
- Assurance is the trust and the confidence toward the customers in dealing with the organization. This reflects the employees’ experience, understanding, and ability to transfer confidence to customers themselves.
- Tangibles are the physical indication of the service; for instance, the appearance of the physical facilities, tools, and equipment used to provide the service and the link tools between the customer and the company.
- Empathy is the individualized care that a company provides to the customers.
- Responsiveness refers to employees’ intentions to help customers deliver the services in time.

Egyptian recent focus on sustainability proactive in different sectors will have its positive affect on the logistics performance and measurement of the service quality. To insure a sustainable transport system, Ali et al. [1] observed five main aspects which inspires the assessment of the current service providers in this thesis project:

sustainable transport, sustainable packaging, sustainable information, training, and collaboration

Logistics companies nowadays are not viewed simply as a source of cost saving, but rather a source of improving the service quality and offerings [7]. LSP are seen as a part of the bigger supply chain process that impact the competitive success. Therefore, it is important to set a comparison scale for the current developed logistics solutions and discuss potential of LSQs.

1.2 Trucking Market

According to the findings of Paragon Software Systems' annual UK customer survey, 2018 on the most significant barriers facing the road transport sector in 2018 [14]: approximately half of the respondents (46.6%) view the lack of drivers and skilled workers as the first, and biggest challenge of all. On the other hand, the cost of transportation came second with nearly 13%.

Road Transport Operators face various issues and challenges. Fluctuation of oil prices is considered one of the influential factors on the transportation cost. Another factor is the driver education, as most of the transport operators in Egypt depends on individuals and few companies are operating in an organized manner. According to some statistics 95% of accidents on roads caused by heavy transport vehicles. Moreover, the damage caused by transport vehicles from road cracks, pointing to the need to establish centres to train and qualify drivers to reduce these terrible incidents. Nevertheless, road transport operators have to increase the road transport tariffs in response to the raise in the fuel prices, the spare parts prices and the increasing prices in tires. [14]

El Sayed et al. [14] have conducted some interviews with trucking companies in Egypt. The following table 1.1 shows the trucking companies and their number of owned trucks. Overview of the one-to-one interviews with trucking companies in Egypt

Company name	Interviewee title	Number of trucks owned by the company
Egyptian Saudi company for importing and transport	Chairman of Board of Directors	33 truck
Elbahnasy company	Company owner	6 trucks
ElAtaal company	Company owner	40 truck
Abd elrahman abdelhamid company	Company owner	40 truck
El Kuwait	Chairman of Board of Directors	20 truck
Ekhwan ewes company	Company owner	20 truck
Maher Elgarhy	Chairman of Board of	One truck
Rabe3 batran	Directors	2 trucks
Taha elsada	Individual	5 trucks
Ebrahim zarea	Individual	2 trucks

Table 1.1: List of trucking companies interviewed by El Sayed et al. [14]

According to El Sayed et al. [14]: “The conducted interviews revealed that the majority of transport operators has been affected by the increase in the fuel prices over the last three years. Fuel cost is only one of the main components of total transport costs and its role in total freight transport costs differs by type of shipment, distance, load factors, but also per country. But the problem is when fuel price increase all related items in the transportation process also increase such as spare parts, tires, oil, etc.

The tires prices that are in continues increase, Alexandria company for tires have a monopolistic position in Egypt because the exported tires are very expensive and without warranty but this company offer their tires with warranty.”

Nevertheless, on the additional fees that road operators have to pay, El Sayed et al. [14] mentioned: “Before the revolution road operators only pays road toll that are govern by the ministry of transport but now the Egyptian armed forces obliged road operator to pay a military fees. Military fees is a main financial problem that are not standardized and differs according to the type of the product. Medium truckload (50 tons) for imported products, the fees vary between 350 and 700 Egyptian pound for steel Billets, from 2000 to 3000 pounds for cold rolled Sheets, from 3000 to 4000 steel profile, from 7000 to 12000 for oil-producing industry equipment and from 4000 to 7000

for transport equipment etc. Steel prices vary according to its thickness. Then they added that all these prices are not legalized. Transport operators asked several times to have a legal documents for this military fees that contains definite price for each product but they fail to have it.”

1.3 Third-party logistics providers (3PLs)

According to Awad [2]: “Egypt has adopted effective tools to facilitate trade including, internet interface and EDI systems and SPS (Smart Port Solution) at ports. However, the promising impacts of these initiatives were quickly overrode by the red-tape, complex regulatory procedures, prolong documentary compliance and complicated customs processes”. These complexities increase the barrier for adoption especially for manufacturers that do not have a strong logistics edge. Hence, the importance to find some alternative solutions to facilitated and improve the LSQ by the LSPs and the rise for 3rd Party Logistics (3PL) emerged from this needs. [15] Third-party logistics providers (3PLs) are defined as “a firm which provides multiple logistics services for use by customers. Preferably, these services are integrated, or "bundled" together by the providers.”

Due to the fierce competition between manufacturing companies, they are forced to distinguish their performance and quality of service from their rivals. Nevertheless, loyal customers leads to long-term success for companies. Retaining the existing customers is more economical for companies than acquiring new customers as it require money, effort, and time. Therefore, the importance of enhancing the organizational performance through 3PLs partnership [15].

According to Ismail et al. [15], “(Mordor Intelligence, 2020), the global (3PLs) market is expected to reach \$ 1.7 trillion by 2025, with a CAGR (Compound annual growth rate) of more than 8% over the projected period, 2020-2025. Moreover, The 2019 23rd annual third- party logistics study 3PLs providers and their customers are working together to build strategic relationships to achieve their ultimate supply chain goals. In addition to those statistics showed that the global third-party logistics (3PLs) market was valued at the US \$802 billion in 2016 and is expected to exceed US \$1.1 trillion by 2022. Hence, it is recommended for both the (3PLs) service providers’ and (3PLs) service users to coordinate and agree on their future logistics strategies and operations (Smriti and Ashish, 2020).”

According to Technavio [8]: 3PL market in Egypt is estimated to have a growth of 1.3 Billion Dollars from 2022 to 2026. Nevertheless, it is expected that the market growth will accelerate at a CAGR of 8.93%. The Egyptian 3PL Market segmented as below:

- By End-user
 - Manufacturing
 - Retail

- Consumer goods
- Healthcare
- Others
- By Service
 - Transportation
 - Warehousing and distribution
 - Others

Technavio report on 3PL market in Egypt covers the following areas:

- 3PL market sizing
- 3PL market forecast
- 3PL market industry analysis

Technavio's vendor analysis is analysing several leading 3PL market vendors in Egypt that include Aramex International LLC, DCM Logistics, Deutsche Post AG, FedEx Corp., and Schenker AG, and more. The following diagram 1.2 is fetched from the Technavio report and shows the 3PL main findings, and estimations in Egypt between 2022 and 2026.



Figure 1.2: 3PL Market in Egypt 2022-2026

As discussed, due to the current trend on enhancing the freight management system and its impact on the environment, every nation has its initiatives. Nevertheless, focusing on the Egyptian freight market as a major player in the MENA region and with its strategic geographical location. Therefore, It is important to understand the freight system and its reliability on the in-land transportation as it affects the country eco system and its trade agreements. Moreover, the rise of the 3PL as initiatives to enhance the supply chain market. In the following chapter, a general overview over the existing startups and initiatives in the Egyptian market in the field of supply chain is given. Furthermore, a comparison between two of the market leaders in the domain of in-land transportation is discussed. Following that, a proposal of a solution is given to overcome some of the existing challenges, and potential enhancements are given.

2 Current Technologies and Solutions

In this chapter, a general overview of the trucking solutions in the MENA region are discussed and the difference between them. Moreover, a study of 2 of the trucking market leaders is introduced, followed by a comparison between the advantages and disadvantages of their solutions. Hence, analyzing and introducing potential improvements there might be.

2.1 Trucking Solutions in the MENA Region

The number of Startups in the Supply Chain Market in Egypt are increasing recently. Various startups cover different sectors of the Logistics industry, starting from Last-Mile deliveries to Middle-Mile and First-Mile. as seen in the figure 2.1, in the Last-Mile (Fulfilment) sector, different market players offer different solutions, mainly focusing on small packages as bosta, transporter, and sprint. Nevertheless, others offer inventory in addition to their delivery services such as Milezmore, and Flextock. The following diagram shows some of the supply chain startups in Egypt and their focus.



Figure 2.1: List of Supply Chain Startups in Egypt [11]

2.1.1 Naqla

Naqla was founded in 2017, with a mission to simplify the logistics experience. It is a multi-sided platform with one side the customer as factories or companies that needs the trucking service, and on the other side, the service providers/carrier companies. It has 2 different plans, 1) On-Demand orders, and 2) Contract-based. Naqla sets a fixed rate with each of its vendors, once the order is placed from the customer side, the operation team contacts the vendors and check if they are able to fulfil the order. Then upon matching a vendor with the respected order the rate of this shipment is sent to the customer. Followed up with status update of the shipment and operation is managed through Naqla team. The above mentioned model result to have different rates for the same orders as fulfilled by different vendors. Nevertheless, in Contract-based model, Naqla fixes the rates with customers for fixed corridors for fixed duration, and on the other hand, it makes contract with the vendor side to fulfil those contracts.

Naqla is the trucking market pioneer in Egypt as it is the first to deliver such service in the region. Moreover, they have limited number of customer (big corporates) such as DHL, P&G, DALTEX, ezzsteel, COSCO, MAERSK, and more.

According to Naqla [8]: “Naqla has seen rapid growth into 35+ active zones, overseeing the movement and delivery of over 4.6 million tonnes of cargo since its establishment in 2017, and is currently working with more than 400 shippers and 10,500 drivers across Egypt.”. “Many of the 1.5 million trucks in Egypt are owned by individual drivers, whom Naqla aims to onboard onto its Carrier ecosystem, consisting of road assistance, finance, insurance, health care and maintenance.”

One of the main issues is the availability of on-demand orders, and already some users of their system have been interviewed and mentioned that they have placed multiple of orders and they have not been fulfilled or followed up with after 1 week from the placement.

2.1.2 Trella

Trella was founded in 2019. It is focusing on heavy trucks and First-mile and Middle-mile delivery. As Naqla, it is a multi-sided platform. It has 2 models, 1) On-Demand orders, and 2) Contract based. For the On-Demand orders the customers are the ones that define the rates for their shipments not as Naqla that it is from the vendor side. This approach has its pros and cons, as if the customer put a high rate they guarantee one way or another that more vendors will be interested in fulfilling those orders with the respected defined price. However, if the budget is low or the rate that is defined by the customer is low they might not get any offers from the vendors. Nevertheless, it requires knowledge about the market dynamicity to place the right rate for the right order in the right time, which is counted as a challenge for some customers that their orders are already over due and not been fulfilled by the system. On the other hand, the contract based model is more or less same as Naqla, as they also set the rate with customers for a fixed corridor for a fixed period depending on the customer portfolio.

Trella is targeting individual truck drivers within its platform and small carrier companies to fulfill the orders placed on the system. It has a limited number of customers but only providing the service for such as DHL, P&G, DALTEX, ezzsteel, COSCO, MAERSK, CMA, and more. [17]

One of the main issues presented by one of the vendors placed on the system is the money collection as they give half of the transport tariff as a deposit to fulfil the order and get the rest of the money by the end of that week. However, in some cases, there are delays to collect the remaining amount which is counted as a big issue especially for individual truck owners as they have installments to pay for their trucks.

2.1.3 Comparison

Naqla and Trella are two of the most well known and leading companies in Egypt and MENA region. Both are offering a software system that manages the trucking fleet. Although, each of them offers On-Demand based orders or Contracts. However, each of these models is different. On-Demand orders in Naqla is considered easier as the customer does not have to specify the rate for the shipment. Nevertheless, it somehow guarantee that a rate will be given to the end user and a match making will be proposed to fulfil the order. Due to the dynamocity of that market from rise of oil and gas prices, military tariffs on the road, to any additional external cost that the carrier is not responsible for, that results to a high dynamic rating/tariff for road transport. Nevertheless, it introduces a big hassle if the rates are to be defined from the customer side as Trella has it. Understanding all factors influencing the road transport tariff is less likely to be expected from the customer side, but rather expected from the vendor side. On the other hand, Trella gives the customers the option to choose themselves the fit price and whom to work with.

In road transport, there are multiple of factors that influence the match making between the customer and the vendor, and it is not limited to only pricing. Quality of the service, or quality of the truck itself are considered some of the factors that might influence customers to go for higher prices just for the sake of the quality. Customer segments such as Fast-moving consumer goods (FMCG), oil and gas, food, are focusing on the quality of the service more than the price itself. Trella has an edge on this as it allows communication between the customer and vendor to check if a match is there or not. On the other hand, Naqla only focusing on reducing the cost for the customer, but in some cases it might not be enough.

In Contract based model each of Naqla and Trella are proposing similar solution that is customized for the customer needs.

In conclusion, on-demand orders that are based on customers placing the rate as by Trella, requires knowledge and experience which might be not available for customers, especially if there are changes on the inland transportation fees. Hence, developing a cost estimation function for orders would be beneficial for customers as well as vendors. Nevertheless, the current proposed contract based models are manually implemented which requires various communication between both sides (customers, and vendors). Automating the contract based model process would save time and cost for both customers and vendors.

3 The proposed Solution

Purpose :

The true need from this platform comes from the current ridged and outdated practices/solutions. Egypt has recently witnessed a huge improvement with its infrastructure where more than 1M km were paved making way to new corridors and lanes that need a digital solution. Purpose and necessity will be met via key performance indicators that our customers will enjoy

The market players/vendors are port gate commissioners, customs commissioners, trucking family companies, and well structured trucking companies. To assess the vendors, the following key assessment points are proposed:

- Number of owned/controlled trucks.
- On time Delivery (extensive exercise to be followed)
- Communication flow (confirming, rejecting , flexibility & troubleshooting)
- Timely Notification on systems
- GPS as a facility
- Invoice quality (scanning, courier, minimum disputes, delays VAT etc)

The above mentioned matrices will be used to assess the vendor base accordingly, and offer a better match making experience between both customers and vendors.

3.1 Solution Brief

3.1.1 Comparison with other solutions in the MENA region

Current trucking solutions are focusing on veiling the service provider. Taking control over the whole process. For example, Naqla is partnering with carrier companies to fulfill the shipments, however, the customers, on the other hand, are not aware of who exactly is making the delivery or the reliability as Naqla is taking full responsibility. This strategy has its pros and cons, as on one hand the vendors are somehow shadowed and not visible to the customers, and on the other hand, Naqla is the one that decides on the pricing itself for both sides. Hence, this veil is not showing the OTD (On Time Delivery) of the vendors assigned to the shipment, and other attributes to assess the capabilities that the vendor has to handle the requested shipment from the customer. Solutions such as Trella, Trukker, or Naqla does not work with SMEs as they are focusing on a fixed number of the customer. On-boarding SMEs is currently not available. It is expected that it is mainly due to the capacity that each of them can handle its operation and also the capital. However, in the distributed system, where there can be direct communication between the customers and the vendors, such issues can be overcome. As seen in the following table shows a brief comparison between what is proposed in the Thesis as a trucking solution and what is currently available in the Egyptian market.

Moreover, the proposed solution is to offer a transparent match making between customers and vendors as it allows the customers to see the history, past experience, brief, and more the key assessment criteria before taking the decision of assigning that vendor for the specified order. On the other hand, it allows the vendors to check the customer past experience on the platform, business brief, and payment terms before making their own bid.

The proposed solution is to offer a bidding experience for customers on their orders by the vendors on the platform. The customer places their order on the platform and vendors check the order specifications and customer profiling, then accordingly they offer a rate for that customer depending on the commodity, weight, pickup and drop-off points, and payment terms. Upon placing their bids, customers can check the offered bids and decide on which of the vendors to proceed forward. Nevertheless, a cost estimation function is developed according to the truck type selected by the customer and the route of the order. The cost estimation will be used to allow vendors to bid within an acceptable margin from the cost estimation value itself. Moreover, it allows the customer to have an indication of the cost of the shipment beforehand.

3 The proposed Solution

The following is a table 3.1 that shows a brief comparison between the proposed solution compared to other existing solutions in the market. The proposed solution depends on outsourcing the trucking fleet as it allows faster expansion for the vendor base. It is targeted for businesses such as Small and medium-sized enterprises (SMEs), Factories and large enterprises. The road transport operators are not limited to truck owners, but also, the small carrier companies. Nevertheless, the proposed business model is commission based as it is similar to the current traditional method of conducting the road transport. Other solutions are fixing a rate per distance with vendors and profiting from the difference between the price they set with the customer and the price they set with the vendor. The unique selling point (USP) of the proposed solution is the bidding experience that is offered for On-Demand orders, also for Contracts. It allows the customers and vendors to fairly check the orders or contracts and match between them. Nevertheless, it allows the customer to choose the right vendor for the right shipment, not just committed to whoever comes from the platform. This is important especially for special goods as it requires special equipments or needs that might be custom to the shipment itself and corridor of the shipment.







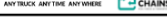

	The Proposed Solution	 		 	  <small>ANY TRUCK ANY TIME ANYWHERE</small> 
Percentage of Transactions in App	-	-	-	-	< 20%
Fleet Type	Outsourcing	Outsourcing	In house/contract based	In house/contract based	Outsourcing
Target Segment	SMEs, Factories (B2B)	B2B & B2C	FMCG (B2B)	B2B & B2C	B2B
Service Provider	Carrier Companies and Truck Owners	Truck Owners	Truck Owners	Truck Owners	Carrier Companies and Truck Owners
Business Model	Commission Fees	Commission Fees	Double sided contract	Double sided Contract	Double sided Contract
USP	Bidding & Contract	Bidding	Contract	Fixed Fees & Contract	Contract

Table 3.1: Comparison between the proposed solution and current existing solutions in the market

Value added

Customers will benefit from the unique bidding experience. They will have easy access to different and competitive rates from vendors they know and new vendors through they will get introduced to via a smooth digital experience. This greatly minimizes the daily hassle of getting the best rates by eliminating time consuming steps such as calls, emails and meetings to secure various services and rates.

Bidding

The proposed solution offers a free and equal opportunity for each Logistics service provider for any corridor offered on the platform. The customer will be required to insert some info for the platform to match their needed rates, such as Cargo type, packaging details, Pick up place, Place of Delivery, etc.

The experience will be controlled or managed through a list of given data that each customer will be providing with to assist the assignment of the best vendor suitable for their shipment.

Once a one-time bidding is done, a contract is fixed with a vendor on a regular corridor.

The platform supports bidding experience with profile viewing that includes a list of criteria such as past performed operations on the platform, history in the market, assets ,team members. . . This will be visible for both (customers & vendors) to enable fair evaluation for both all stakeholders.

Transparency

In the proposed platform transparency is valued for all parties involved, where it increases the level of trust and common understanding and that's the true value proposition that the proposed solution is proposing to this unstructured market.

Where the platform provides the platform for all vendors to promote their services openly to the customers and present their capabilities and experiences. Nevertheless, customers can view the previous history of specified vendor and vice versa.

Profiling

The profiling tools/process is seen as a basic yet unique and important aspect of transparency. The customers can see through and know who is the vendor that rendered the service and will have visibility on details and capabilities of every vendor through a list of performance differentiators:

- Owning trucking or commissioner
- GPS or without
- History
- Past Experience
- Invoicing quality
- Cash flow capabilities and Head count

Vendors will be also able to evaluate customers and bid on the proposed shipments through a list of available information like

- Commodity type
- Corridors (pick up place – destination)
- Volume
- Payment history
- Payment terms

In the above flow chart 3.1 illustrates the process and flow the customer of the system goes through. The customer is able to register their company if it is the first time, or sign in with a valid credentials. The system checks if there was a match with exiting account to notify the user. Nevertheless, it is possible to request a new password reset through the app, and an email will be sent to update the password using Firebase Auth services.

Following the user credentials check the user will be directed to the dashboard page where an illustration of general statistics about the customer current shipments and total successful ones is displayed along with the services and pages they can access.

The customer can check their list of existing contracts where they can check specific contract details. Each contract contains an overview about the contract from commodity, weight, route, sender & receiver information, and other details. Nevertheless, it also contains list of updates on that contract from the customer side or assigned vendor side or from the platform support team. Moreover, the customer and the assigned vendor both can attach documents to the contract to be stored and shared with all parties. In case the contract is a new contract and does not have an assigned vendor, vendors will be able to place their bids on that contract, and correspondingly the customer can choose from the list of bids made on the contract. Each contract is a container for order for specific valid duration set between both customers and vendors. In one contract, customer can place an order that is under that contract, and check current list of orders that already placed on that contract.

The customer can check their list of orders in the system and filter on their status. From the list of order, they can check an order details where they can have an overview of the order details and its current status. Moreover, they can check timely updated status in the activity feed of that order, and update it. Additionally they can add all necessary documents needed from their side for that contract and check the attached documents added by the assigned vendor for that order.

The customer can place a new contract. The customer can define the corridor for that contract, the corresponding responsible people in each of the stop location defined in the corridor. The customer can check the required truck type from a list and define the validity of that contract, commodity, weight, and all other required details to have a fair and quick assessment from the vendor side to be able to place their bid correspondingly. Upon receiving bids and assigning the vendor for that contract, the customer will be able to place orders on that agreed contract for the agreed rate.

The customer can place a new on-demand order. The customer can define multiple of stops for that order, and define the general information of the responsible people in each of the defined stop. Moreover, the customer should define the commodity, weight of the shipment, number of trucks needed, pickup date and time, and all other needed information to allow vendors to place their bids fast and efficiently without wasting time. Upon receiving bids on the order and assigning a vendor for that order, the customer will be able to view lively status update on the order and its attachments and all relative documents from driver license, truck license, and more.

3.2.2 Vendor-App

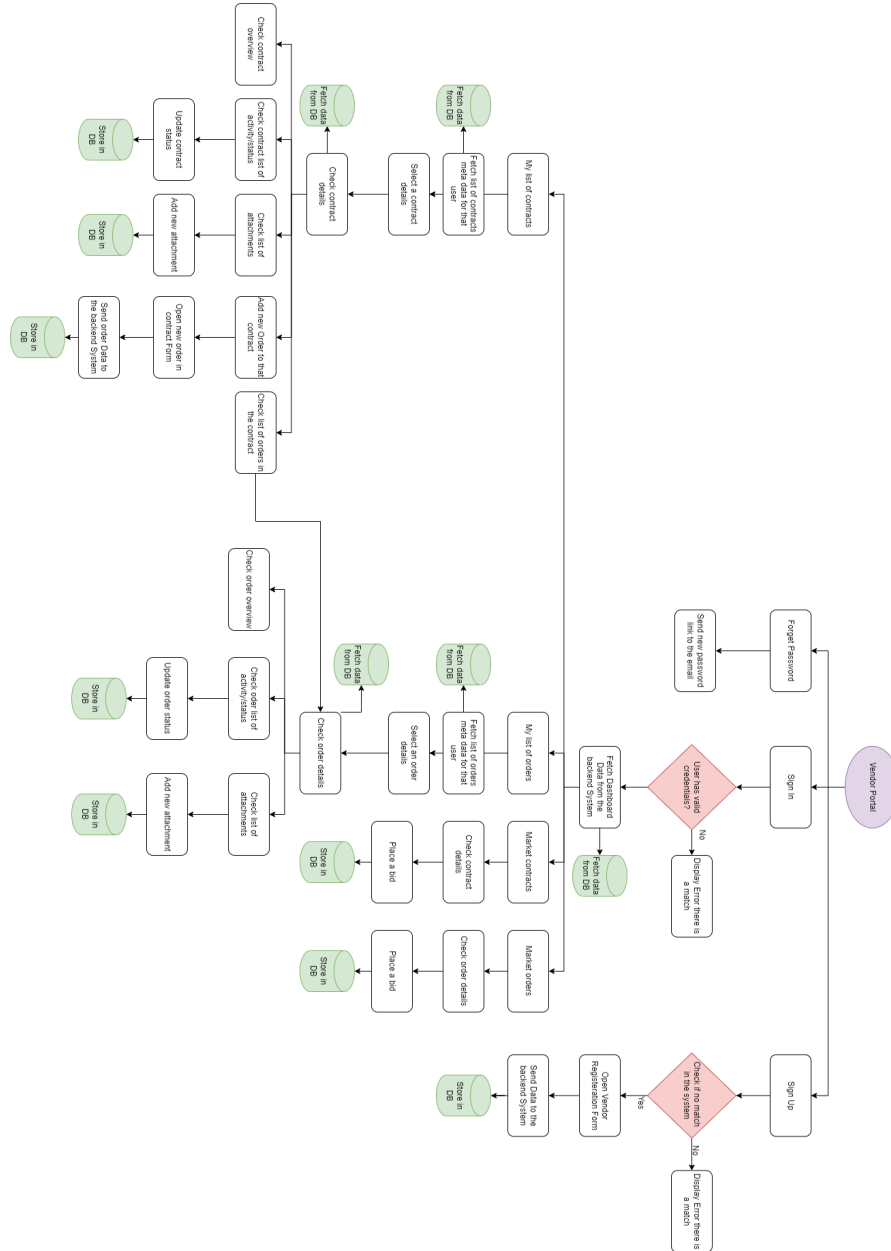


Figure 3.2: Vendor application flowchart

In the above flow chart illustrates the process and flow the vendor of the system goes through. The vendor is able to register their company if it is the first time and their account will be approved by the system admin portal, or sign in with a valid credentials. The system checks if there was a match with exiting account to notify the vendor. Nevertheless, it is possible to request a new password reset through the app, and an email will be sent to update the password using Firebase Auth services.

The vendor will able to check their list of assigned contracts. Upon selecting any of the contract they will be directed to the contract details page, where they will be able to check the contract details and its current status. Moreover, they will be able to update the contract if needed or attach any need document from their side, or view current list of attachments. Nevertheless, they will be able to access the list of orders that are placed within this contract by the customer.

The vendor is able to check their list of assigned orders. They will be able to check the order overview, the route for that order, the number of trucks, and road transport rate that they made their bid with. Moreover, they will be able to update the status of the order and view the list of updates made on that order. Nevertheless, vendors will be able to attach all relevant documents to that order such as drivers licenses, military tariffs, receipts of any payment that was done during the shipment process.

Vendors will be able to check the list of contracts in the market that have not yet been assigned to any vendor, and place their bids according to the contract information. Vendors bid can be influenced by many factors such as the duration of the contract, the number of trucks, the type of trucks needed, the commodity, and weight of the goods, any additional needs by the customer. All of the relative information that is needed for the vendors to successfully place their bids is already in the contract details itself. The information needed and contract details was defined through checking other existing solutions in the market, and conducting 30 interviews with different carrier companies.

Vendors will be able to check the list of order in the market. The order details contains the general information about the order such as: pickup time, shipment route, commodity, weight of the shipment, and any other notes added by the customer. Nevertheless, they can check the list of attachments for that order. The vendor bid is influenced by multiple of factors such as the pickup time and pickup location and number of trucks needed. These can be considered some of the main factors that influence the on-demand order bid, as the rate of the shipment can be reduced to 30% of the actual value if the truck had a previous schedule of moving from the pickup point to the drop off point empty for other shipment or already fulfilled a shipment

and going back empty. To reach such scenario, the network of vendors needs to be extended to have possible cases where the vendor can place the route that their truck will take in advance

3.2.3 Admin-App

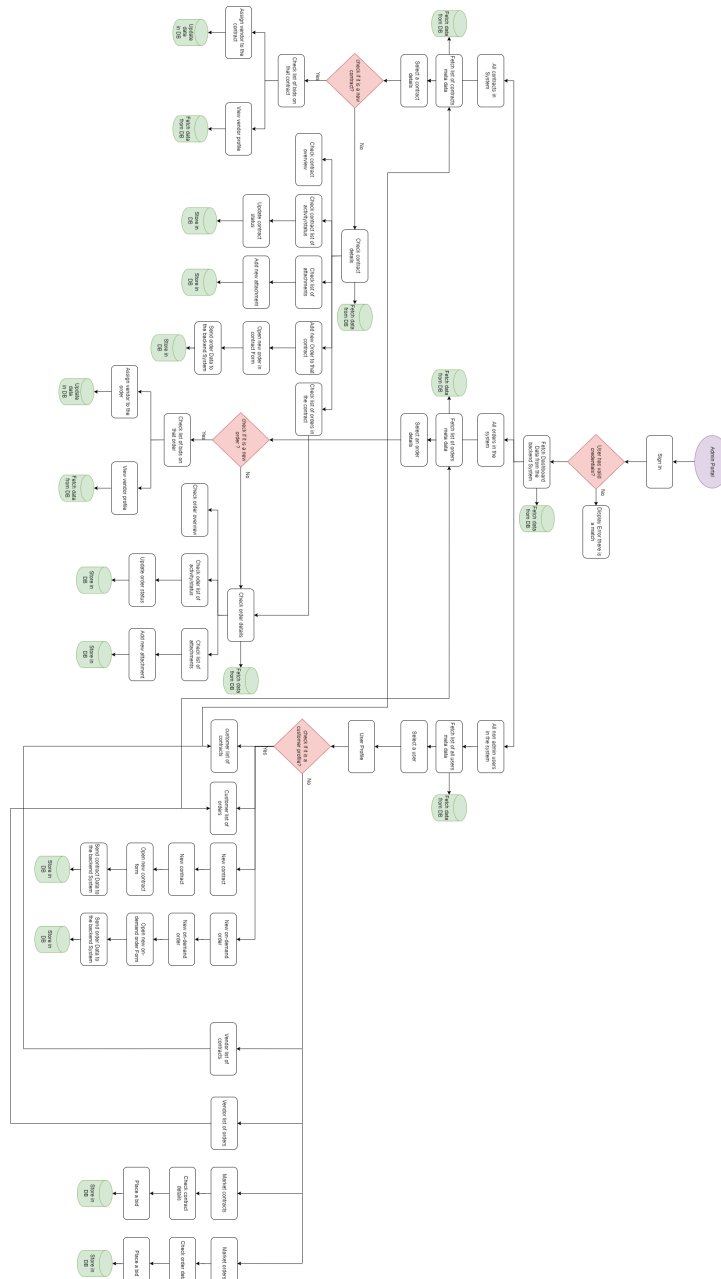


Figure 3.3: Admin application flowchart

In the above flow chart illustrates the process and flow the admin user of the system goes through. Upon checking the user credentials, the admin account holder will be directed to the admin home-page. The admin account holder can check the list of users in the system (customers, and vendors).

They can check all orders that are in the system, all contracts that are placed on the system. Furthermore, the admin account holder, can access any of the users accounts and check their accounts. The admin app allows the holders to check list of contracts a customer account have, list of order and place new contracts, and orders on behalf of the customers themselves in case they faced any issue. Nevertheless, they can update the status of the order or contract for that customer in case they face any difficulty doing it themselves, and add any attachment needed for the selected order or contract.

On the other hand, admin users are able to access also vendor accounts and place bids on their behalf in case they are facing issues doing it themselves. Furthermore, they can update the status of the assigned and selected order or contract on behalf of the assigned vendor and attach any document needed. Admin account holders are able also to verify accounts or suspend any in case of fraud.

3.3 System Design

3.3.1 System Architecture

In this section, the general architecture of the system is explained. Each level indicates the depth of the architectural design.

Architecture-0

NaqlX is the name of the proposed solution. 3.4 Different personas can interact with the system from customers placing their orders, to vendors making their bids, and admin users that can manage the operation flow of the system successfully.

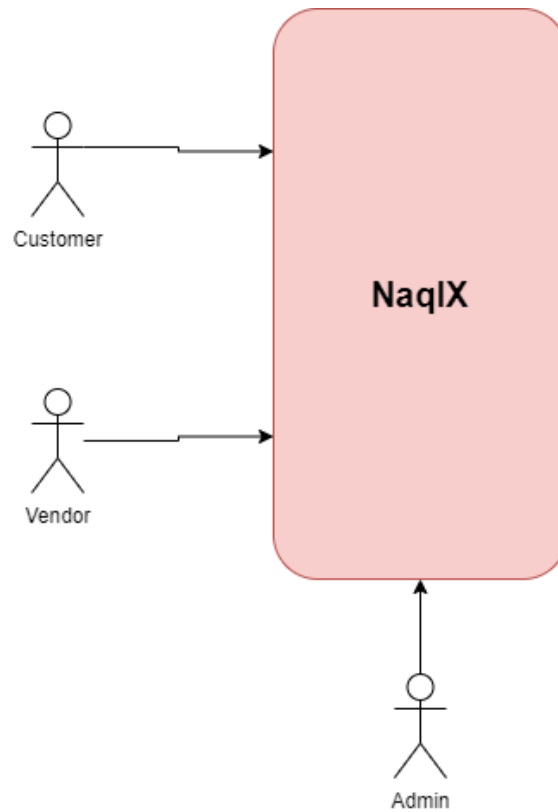


Figure 3.4: System Architecture-0

Architecture-1.1

The web application interacts with different systems as seen in the following diagram 3.5. The system uploads and fetch the media content through the Firebase Cloud Storage service. It manages its backend through the AWS infrastructure, including data creation, read, update, and deletion (CRUD). Nevertheless, the Authentication of different user accounts is managed by the Firebase Authentication service.

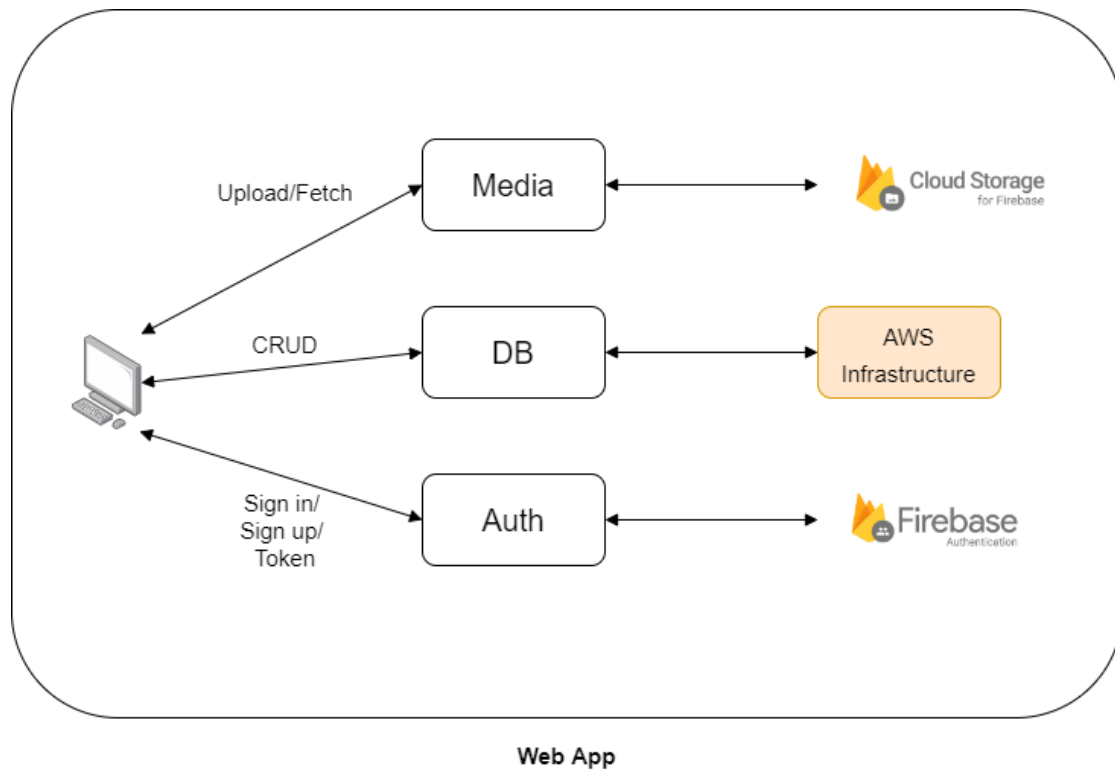


Figure 3.5: System Architecture-1

Architecture-2

The following diagrams 3.6 show the general architectural design of the AWS Infrastructure. It contains an API Gateway service to receive the different requests from the web application. For each request/connection received an authorization check is done through the Lambda authorizer and connected to the Firebase Authentication service, to maintain system security for all requests. Upon a successful authorization for the request, it is set to its corresponding subsystem (Lambda function) for execution. In

return CRUD the data from the Database in this case the DynamoDB or execute the request from any other external service.

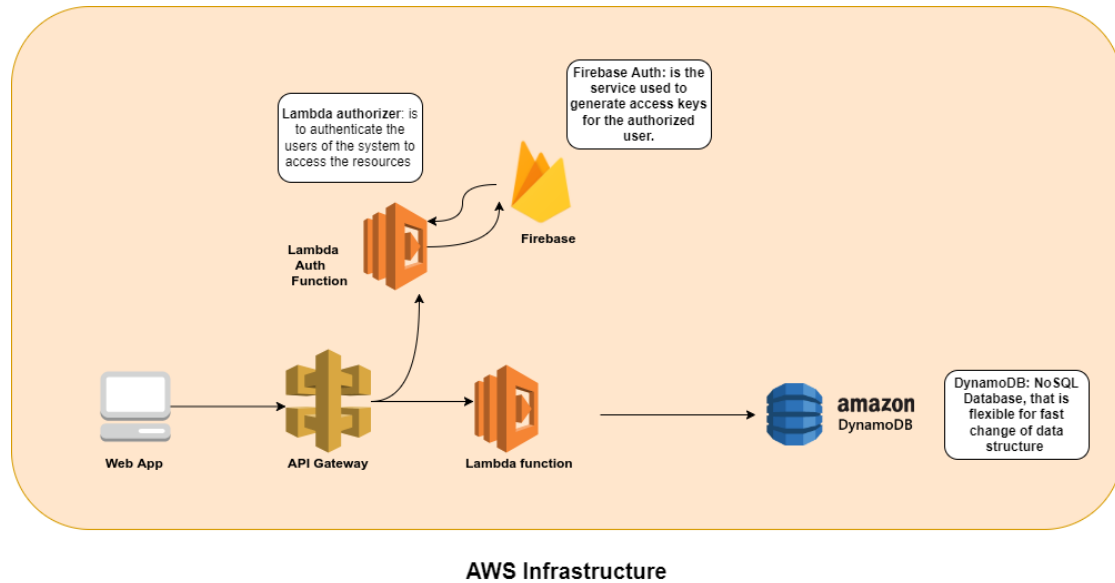


Figure 3.6: System Architecture-2

Architecture-3

The following diagram 3.7 shows different subsystems implemented using the Lambda functions. That interacts with the Database for Data related requests or Google Cloud services such as Google Map AutoComplete service for location autocomplete requests or Google Map Directions service for routing/directions-related requests. As visualized, there are 5 main subsystems. The user subsystem is related to user-related data from customers/vendors/admins. The contract subsystem is managing the created contracts between customers and vendors within the system. The order subsystem is managing the orders placed on the system. The truck subsystem is managing the different trucks in the system and the properties of each one of them. The services subsystem is managing miscellaneous services.

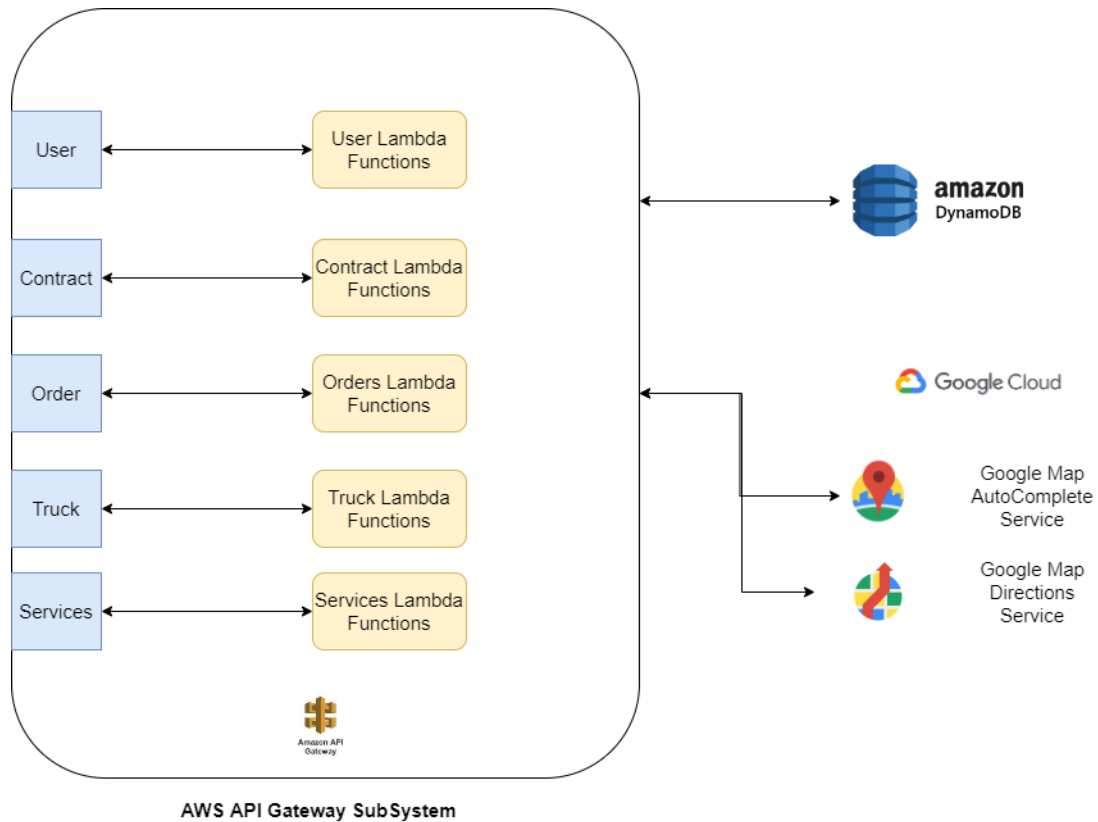


Figure 3.7: System Architecture-3

Architecture-4.1

User backend subsystem 3.8 manages the basic requests related to the users data. Each of the lambda functions has its own logic and its own queuing of the requests, making it flexible in the high volume of requests. This subsystem is interacting with the database checking the authorization of each request and if it has the right to execute the requested operation on the database.

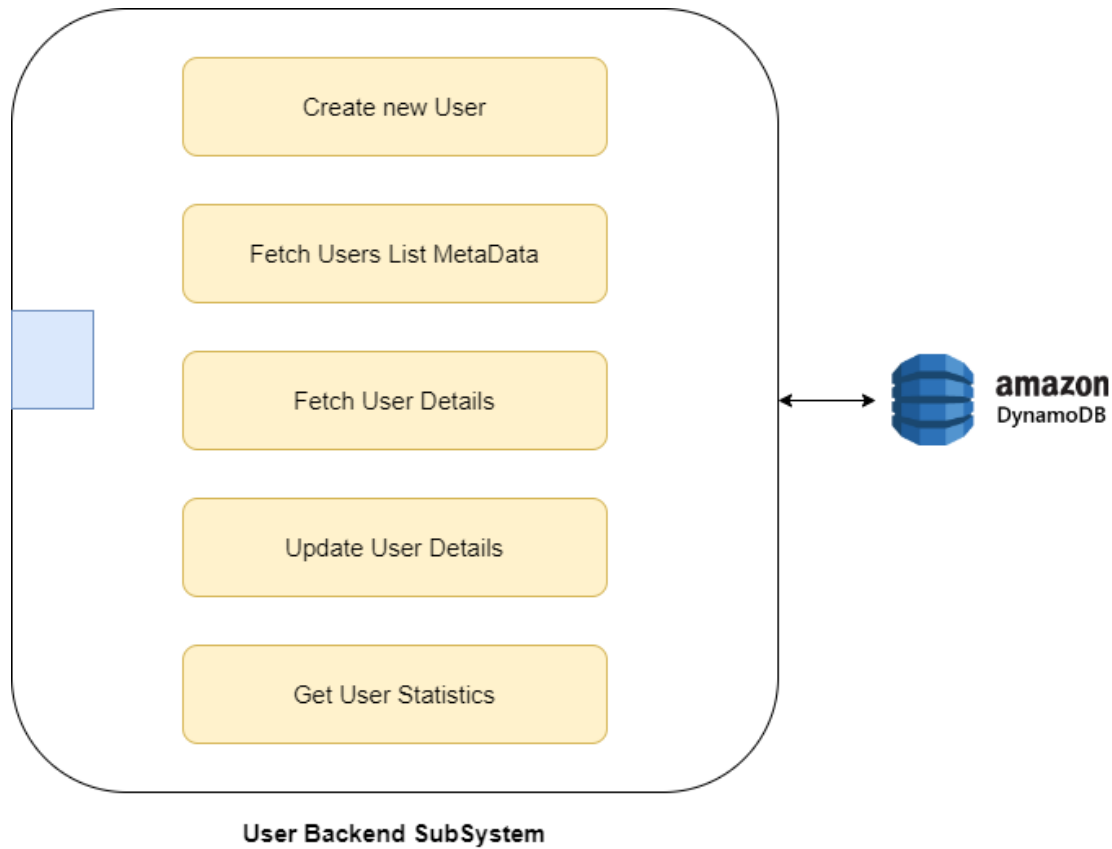


Figure 3.8: System Architecture-4.1

Architecture-4.2

Contract backend subsystem 3.9 manages the basic requests related to the contracts between the customers and vendors. Each of the lambda functions has its own logic and its own queuing of the requests, making it flexible to scale up on a high volume of requests and scale down accordingly. Nevertheless, it is triggered only upon receiving a request making it cost-efficient. This subsystem is interacting with the database checking the authorization of each request and if it has the right to execute the requested operation on the database.

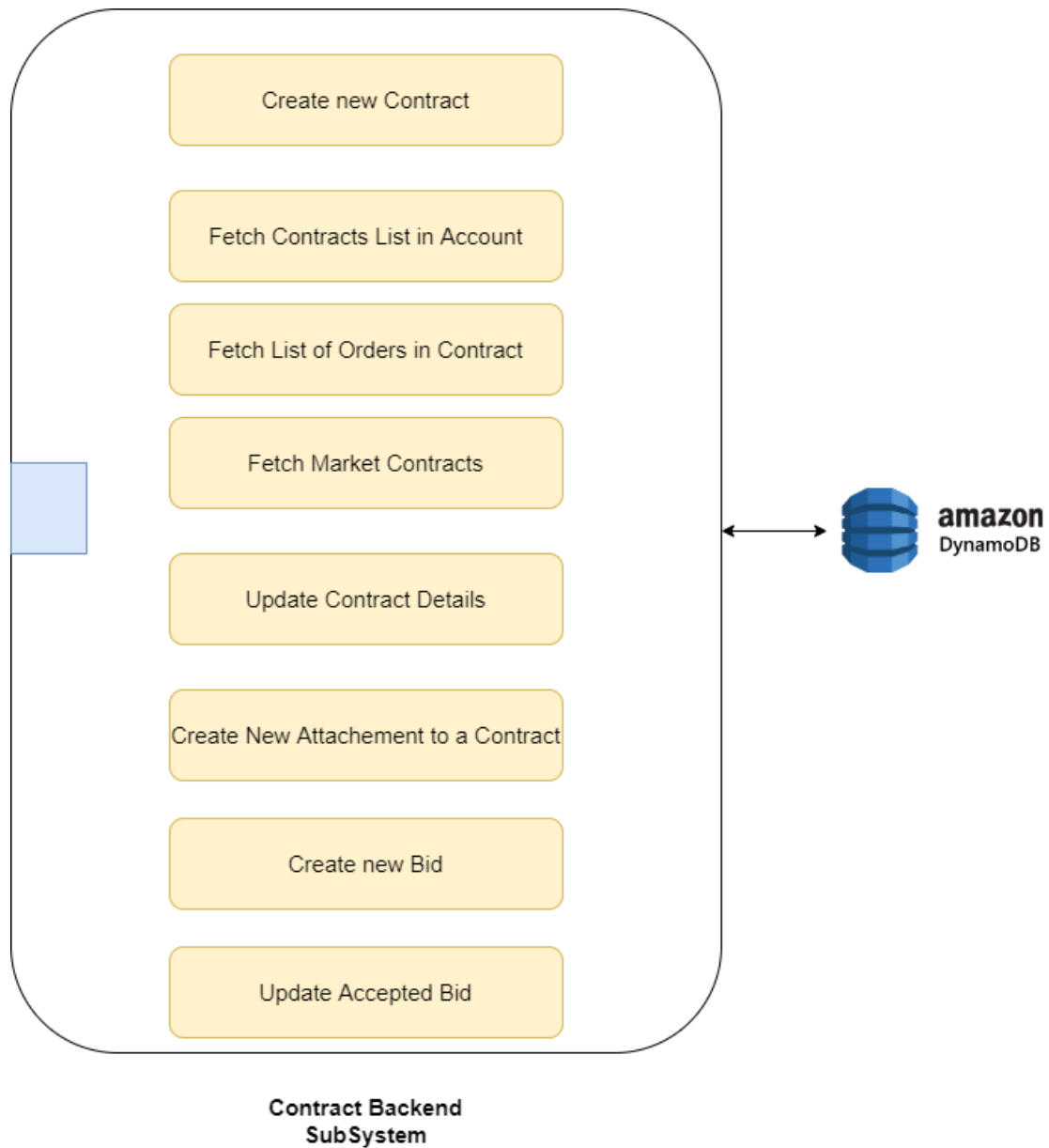


Figure 3.9: System Architecture-4.2

Architecture-4.3

Order backend subsystem manages 3.10 the basic requests related to the orders between the customers and vendors. Each of the lambda functions has its own logic and its own

queuing of the requests, making it flexible to scale up on a high volume of requests and scale down accordingly. Nevertheless, it is triggered only upon receiving a request making it cost-efficient. This subsystem is interacting with the database checking the authorization of each request and if it has the right to execute the requested operation on the database.

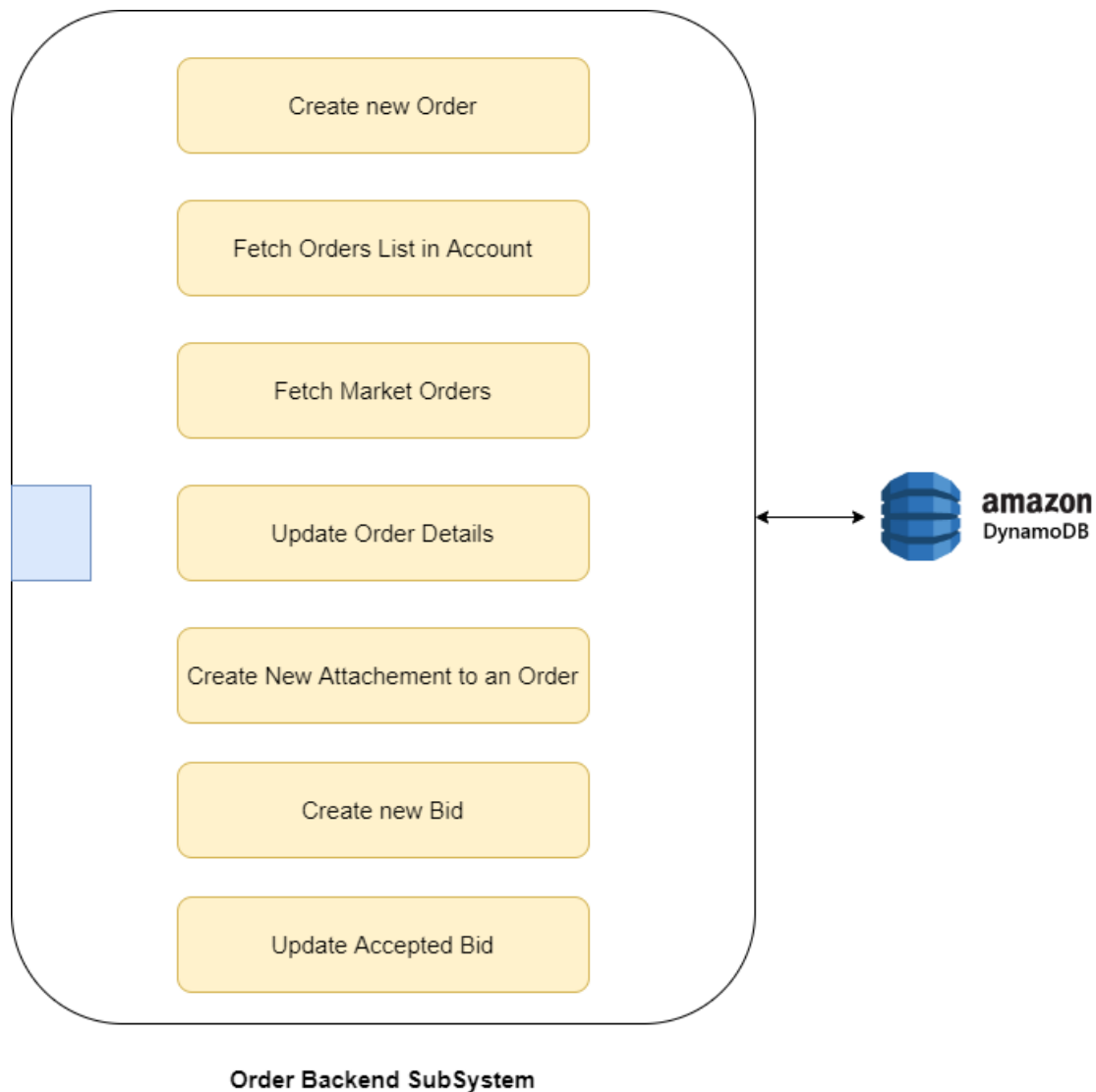


Figure 3.10: System Architecture-4.3

Architecture-4.4

Truck backend subsystem manages 3.11 the basic requests related to the trucks data. Each of the lambda functions has its own logic and its own queuing of the requests, making it flexible on a high volume of requests. This subsystem is interacting with the database checking the authorization of each request and if it has the right to execute the requested operation on the database.

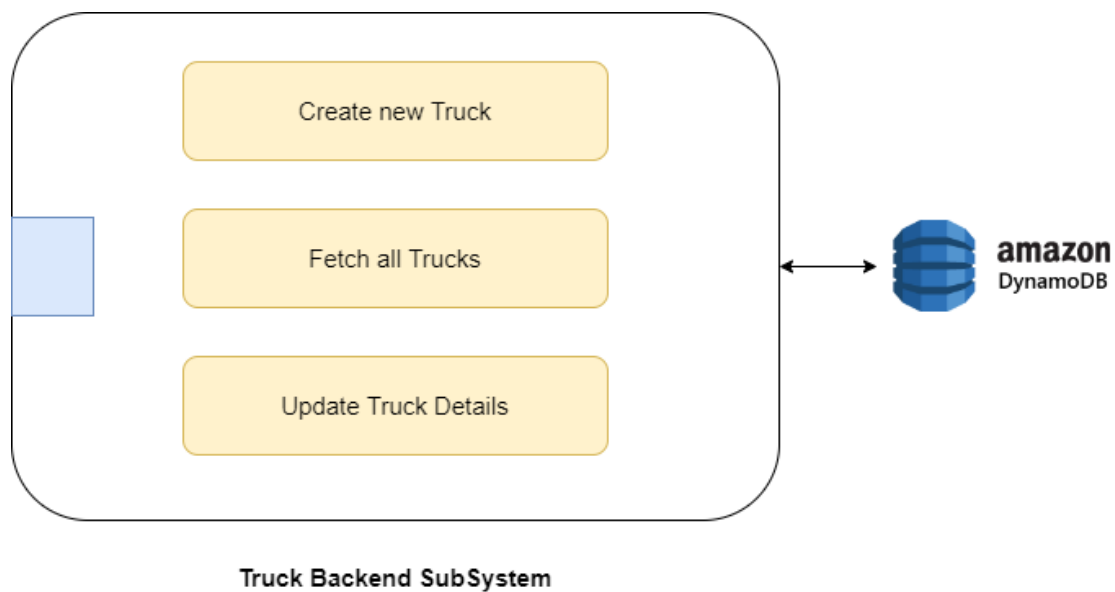


Figure 3.11: System Architecture-4.4

Architecture-4.5

Services backend subsystem manages 3.12 the basic requests related to the external services provided outside AWS or simply not fetching data from the database. Each of the lambda functions has its own logic and its own queuing of the requests, making it flexible on a high volume of requests. This subsystem is interacting with the database checking the authorization of each request and if it has the right to execute the requested operation on the database.

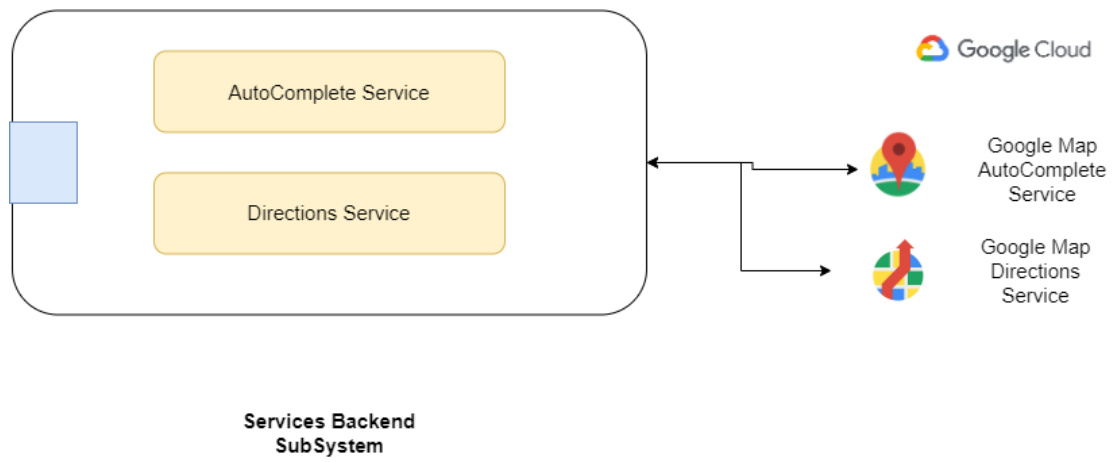


Figure 3.12: System Architecture-4.5

3.4 Cost Estimation

As discussed earlier, the need to have a guiding estimation for the customer to know the cost of the shipment roughly beforehand, is the foundation to develop a cost estimation function 3.3 that to be integrated within the system developed. Nevertheless, to prevent vendors from putting unreasonable cost as a bid for a shipment or undervaluing the shipment cost will not only affect the vendor, but also the platform and other vendors on the platform. Therefore, vendors are able to make a bid within a margin from the cost estimation value itself.

After conducting some interviews with vendors the margin of bids was defined as low as 50% of the cost estimation and as high as 130% the value estimated for the shipment. The cost is dependable on the selected truck type and route that the truck will take. The actual values to be used for the equation that were concluded through the study is added in the appendix 5 depending on the truck type. The collected values are tested against different solutions in the market and through interviews with vendors. Nevertheless, the name of the truck types and values are linked to the study in the Egyptian market on 2022, as the values might change according to changes on the inland cost influential factors.

Minimum charge check equation

$$distanceCheck(distance) = \begin{cases} minimum_charge, & \text{if } distance \geq minimum_charge \\ 0, & \text{otherwise} \end{cases} \quad (3.1)$$

Discount check equation

$$discountCheck(distance) = \begin{cases} discount_percentage, & \text{if } distance \geq discount_distance \\ 1, & \text{otherwise} \end{cases} \quad (3.2)$$

Cost estimation equation from 3.1 and 3.2

$$cost_estimation = ((distance * charging_rate) + distanceCheck(distance)) * discountCheck(distance) \quad (3.3)$$

3.5 Database

Multiple of customers and vendors are interacting within the system. Customers place orders and contracts and monitor their live updates, list of bids and proposed deals, adding new files to the orders, communicating with vendors. On the other hand, vendors checks market orders and contracts to place their bids, and in case of orders assigned they add documents. Orders and contracts within the system are containers that are updated and interacted by multiple users. It should be salable as list of documents attached, list of bids, and live updates can be as big as it can. Therefore, choosing a database that fits these requirements is crucial.

NoSQL database is selected as it allows the scalability of each order or contract separately. Nevertheless, it is more flexible than SQL as it offers flexibility in updating the table schemes and attributes without affecting the existing data. Such flexibility was important during the implementation of this project as it was faster to add new features to the system and modify some according to the users of the system. Nevertheless, it offers distribution of the data and auto repair of the data are great advantages of the technologies for the current use case. Alternatively, SQL database would require high maintenance for the database and more restrictive for data scalability.

DynamoDB is used as NoSQL database to store the data. It offers primary key and secondary key access to the files stored. Nevertheless, it offers query and filter on attributes without scanning the whole table by defining the filtered attributes as secondary keys. Hence, not compromise the performance for flexibility and scalability.

The schema of each table is discussed thoroughly in the appendix chapter 5.

3.6 APIs Implemented (Sequence Diagrams)

3.6.1 Users Table related endpoints

Create new user account

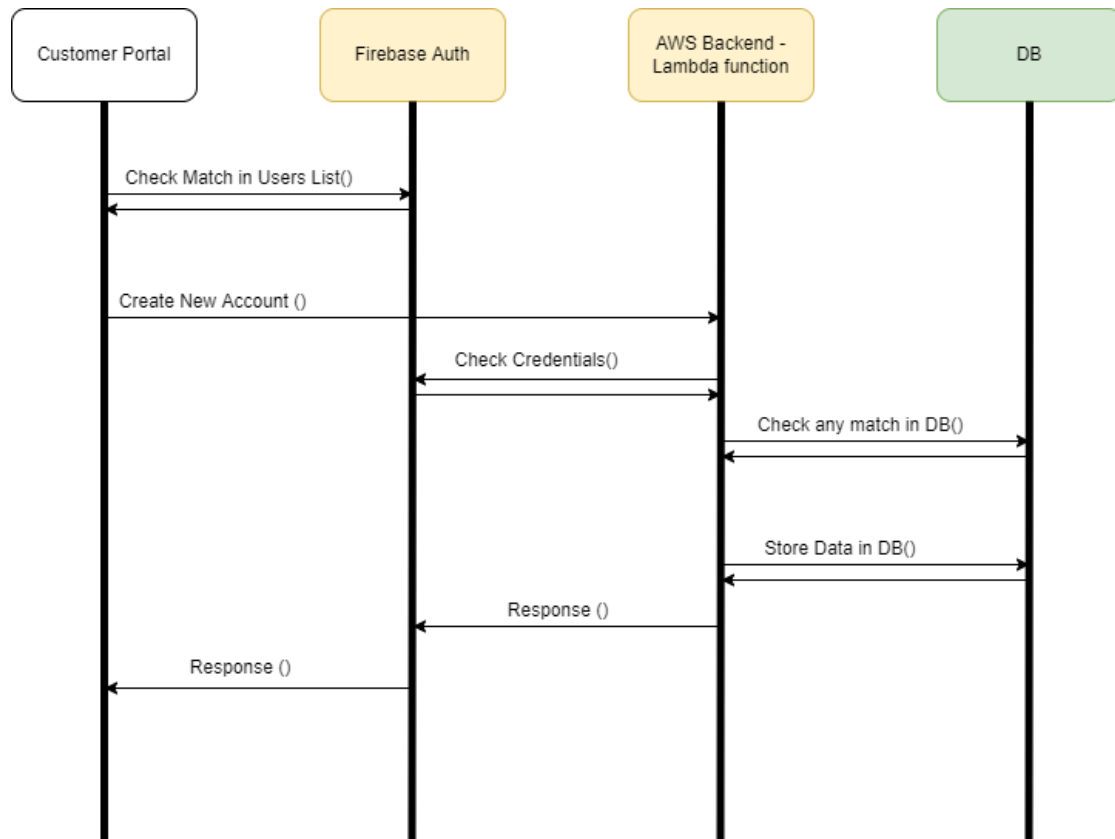


Figure 3.13: Create new user account Sequence Diagram

3.13 Create new account for customer and vendor goes through multiple of processes as displayed above. The request is initiated from the customer/vendor application and send to Firebase Auth for check if there is a match . Then, if there is no match, the request is sent to the AWS Backend server endpoint. Authorization of the request takes place to check the credentials given to this new account from Firebase Auth. The lambda function responsible checks the database if there is a match for a similar user with similar defined properties. In case there is no match, a new account is registered and backend server endpoint for creating new user. Finally, the response is sent back

to the user.

Fetch user details

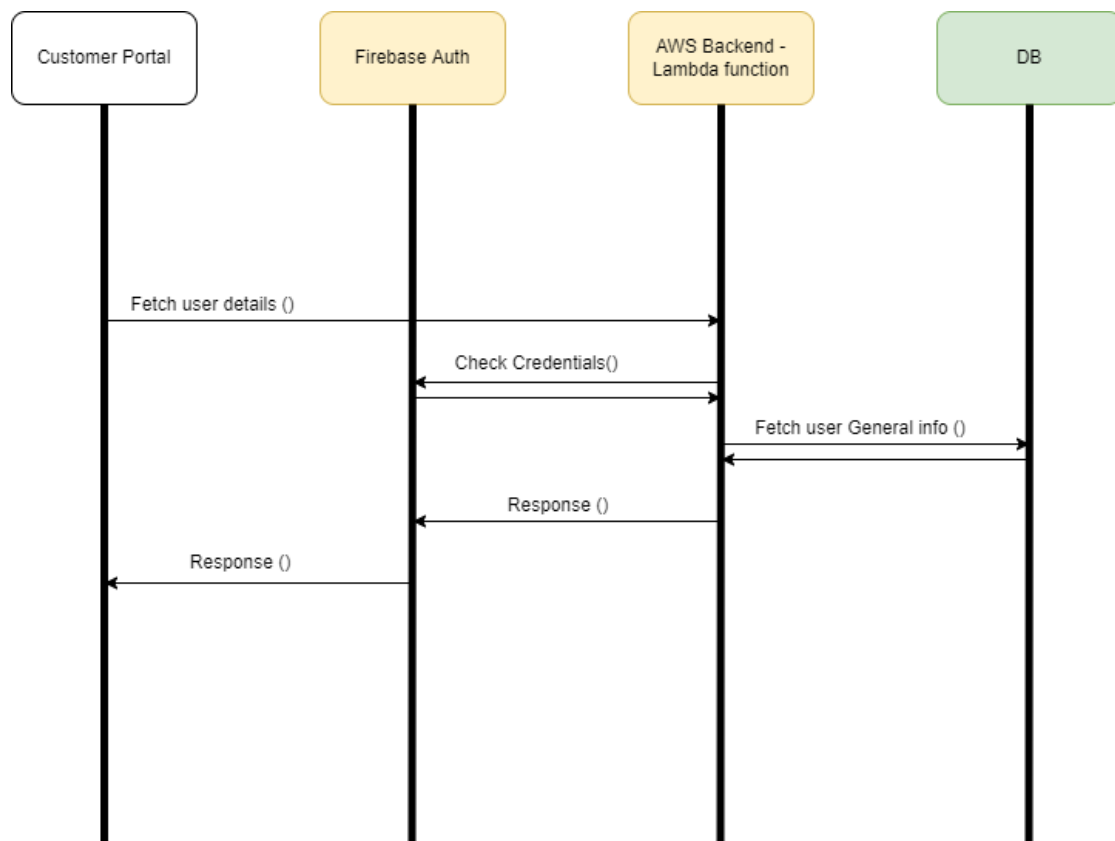


Figure 3.14: Fetch user details Sequence Diagram

3.14 Fetching user details can be requested for different cases. In case, the user is checking their profile information or the application is fetching the data to check the status and store the user info on the application, then all user details will be sent back. However, customers can check the profiles of the vendors that placed bids on their orders or contracts. Nevertheless, they can also check the assigned vendors for current or previous orders or contracts. In Addition, vendors can check customers profiles before placing their bids on their orders or contracts. In theses cases, limited information about the user details is shared back such as the company_name, company_logo, company_address, and more, but not their email address used for account creation or

phone number used for the account creation and login or any of the company related documents (ex. commercial_register, or tax_number). Admin accounts has access to all user details to update or validate the accounts accordingly.

Fetch list of users

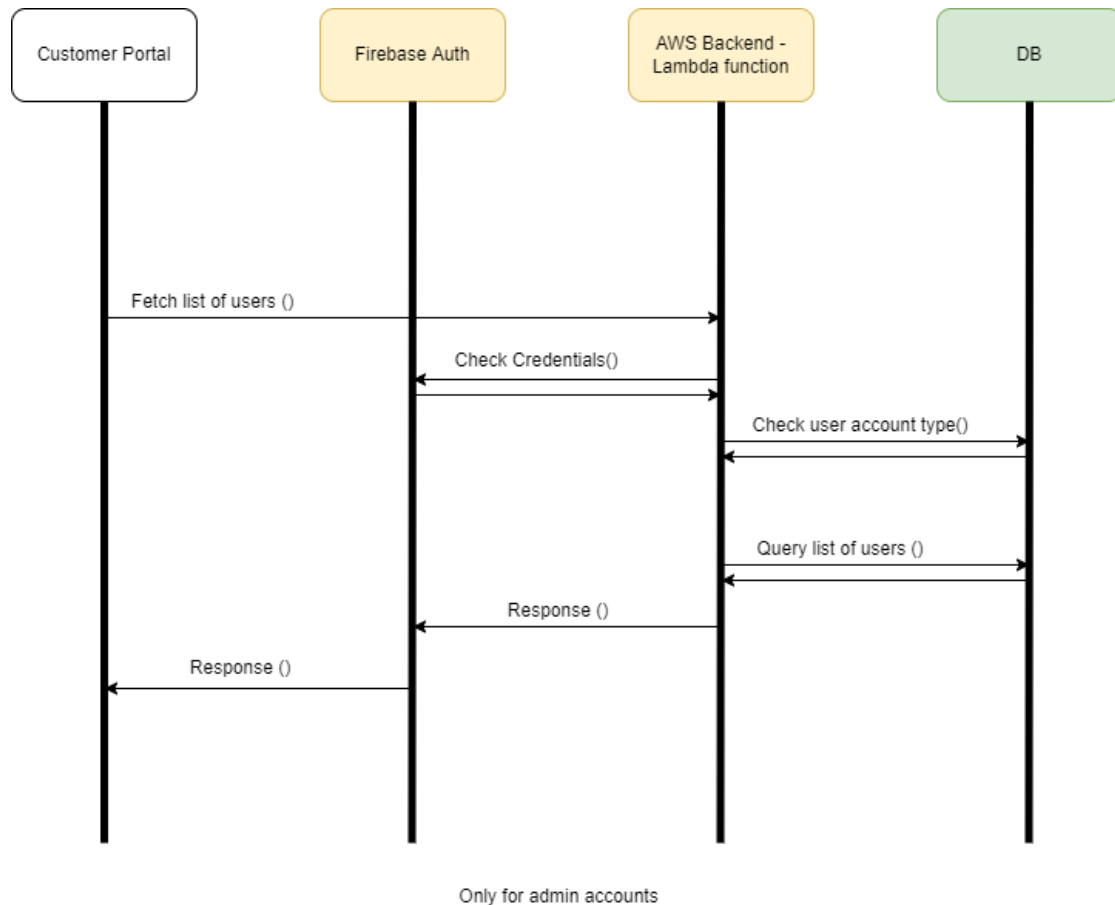


Figure 3.15: Fetch list of users Sequence Diagram

3.15 Fetching list of users is only possible for admin accounts to check the users of the system, or users they have access to. Upon sending the request to the responsible endpoint in the server, the lambda function is triggered and authorization of the request is executed. Upon checking the token of the request from the Firebase Auth service, the lambda function checks the account type of the user requesting. Upon confirming

the request is from admin account a query to the database is executed and response is sent back the admin application.

Updating user details data

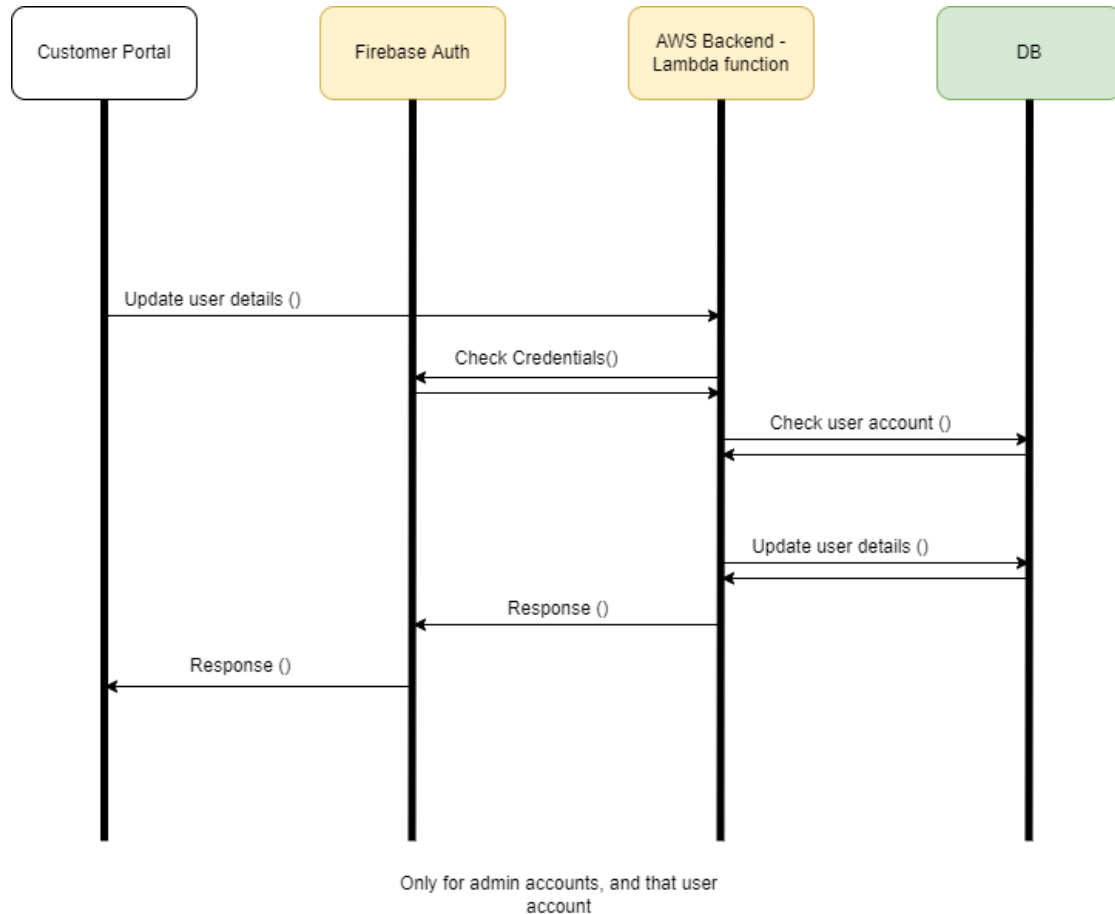


Figure 3.16: Update user details Sequence Diagram

3.16 Updating user details is only possible from the same user account or from the admin account. Upon receiving the request an authorization check is executed. Then, the user token is used to check the user account and the lambda function uses it to check the account type of the requester. In case it is same account requester or admin account, then the user details data is updated.

Fetch user statistics

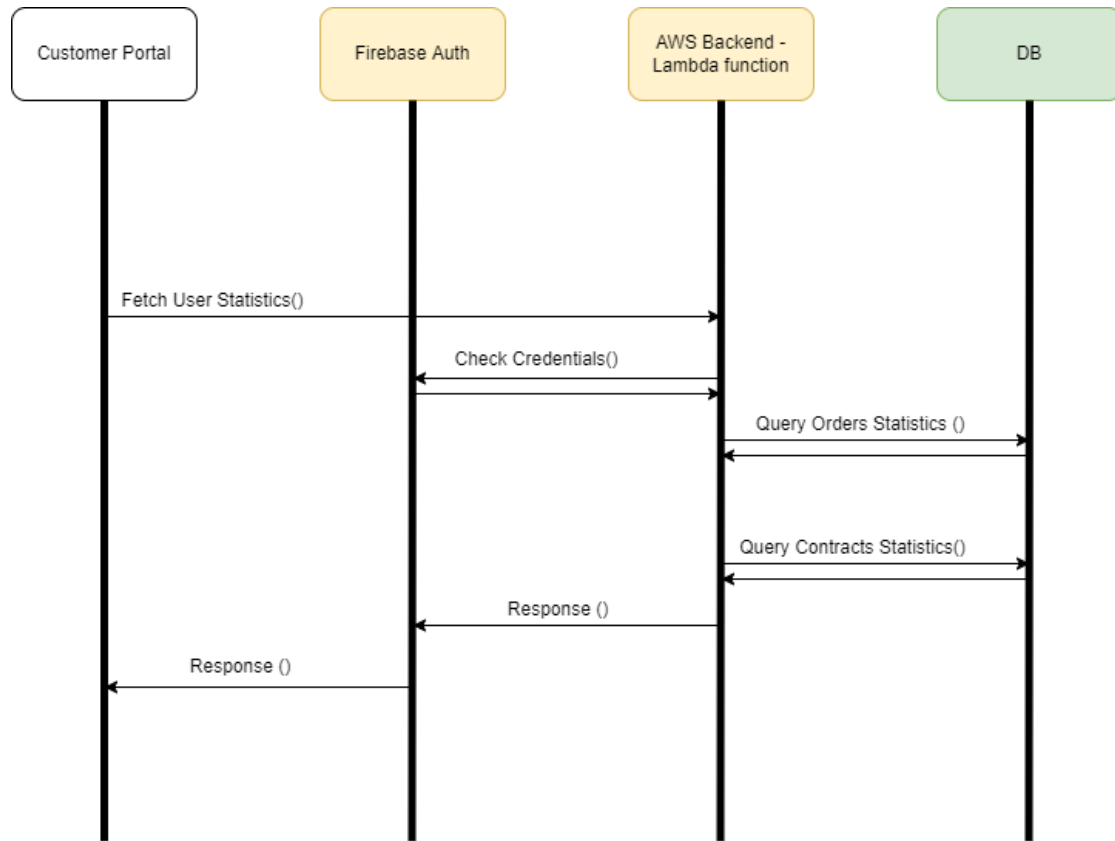


Figure 3.17: Fetch user statistics Sequence Diagram

3.17 Fetching user statistics is requested from the dashboard of the customer or the vendor. Nevertheless, customers can check vendors general statistics when they view the vendor profile. General Orders and contracts statistics are returned back by checking the target account in the orders and contracts tables and the status of each and returning the results back to the requester. Using AWS DyanmoDB SDK lambda functions can query the data simply from the database and filter on the attributes.

3.6.2 Orders Table related endpoints

Create new order

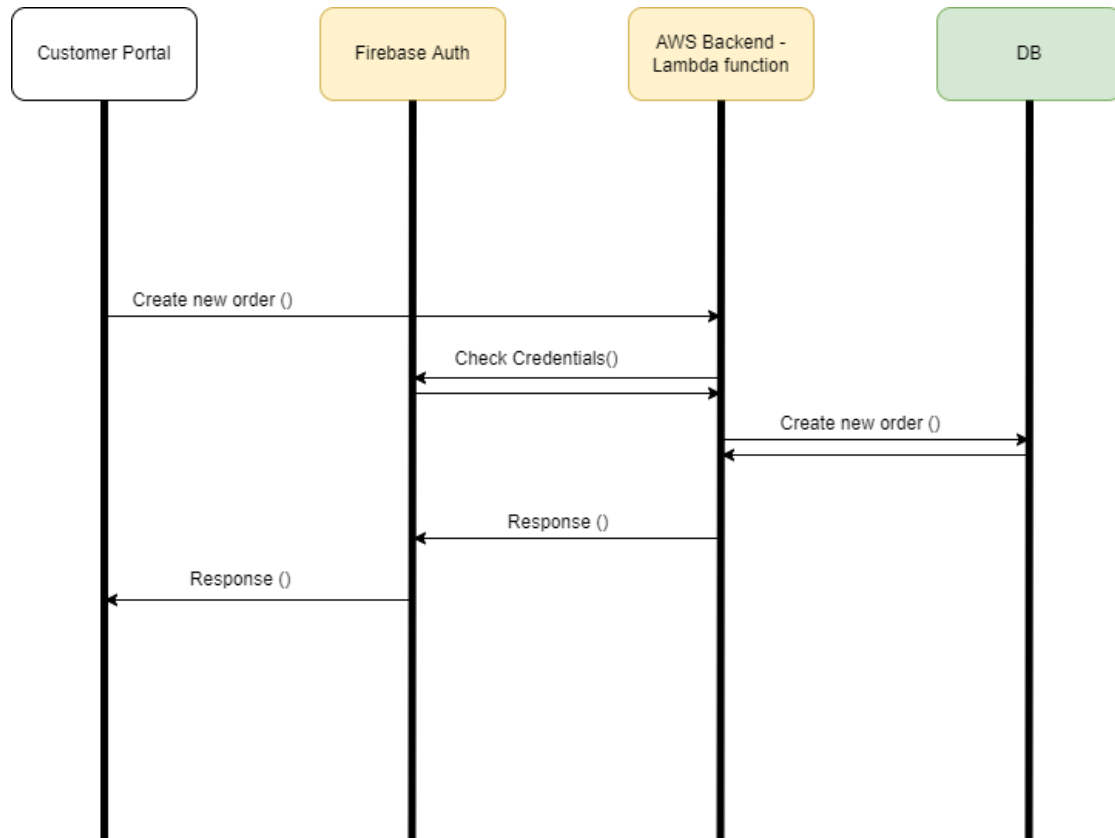


Figure 3.18: Create new order Sequence Diagram

3.18 Creating new order is allowed only for customer accounts and admin accounts when they place an order on behalf of a customer. Upon receiving the request in the lambda function checks the authentication token of the requester with the Firebase Auth service and check the user account type with the database. Upon checking the account_type of the requester, the new order is placed with all its fields checked by the lambda function itself. In cases any error arises it will be sent back to the user application.

Fetching order details

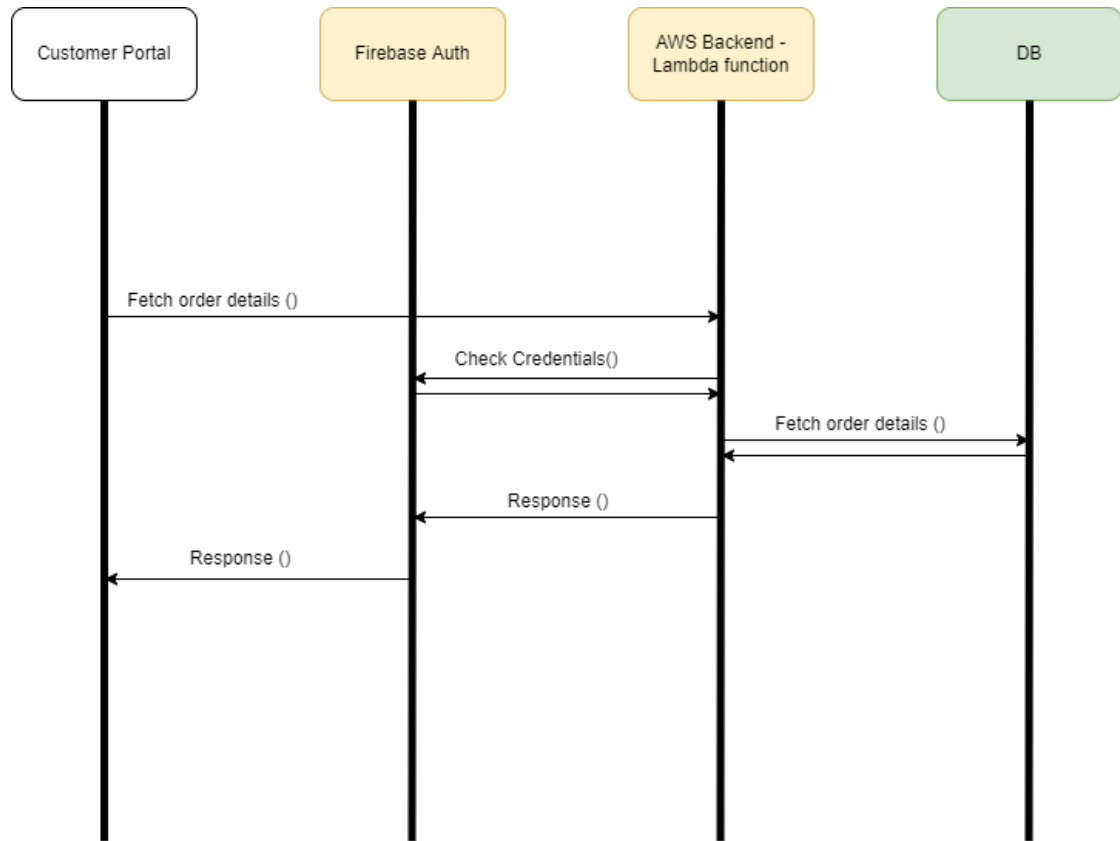


Figure 3.19: Fetching order details Sequence Diagram

3.19 Fetching order details is allowed for the customer who created the order itself. If the order is open for bids, all vendors in the market can have access to the order details to place their bids. Nevertheless, if the order is assigned to a vendor then only the customer and the assigned vendor accounts have access to that order.

Update order details

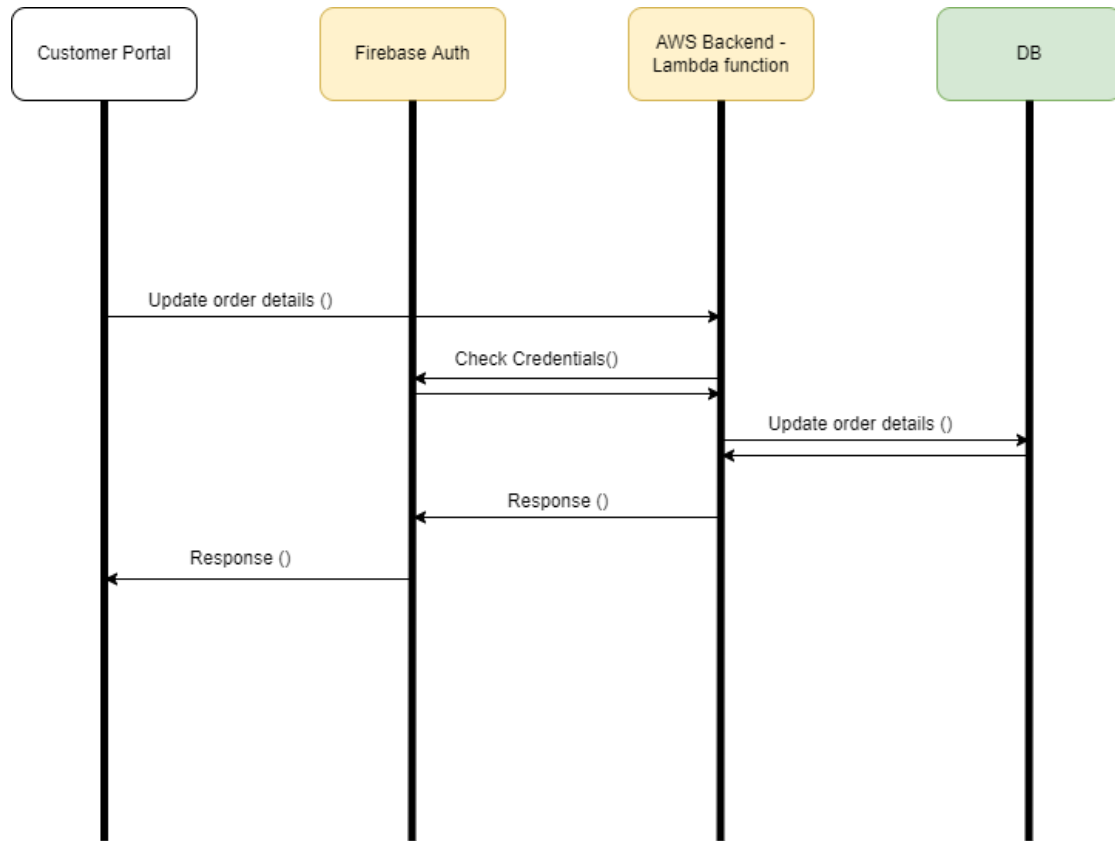


Figure 3.20: Updating order details Sequence Diagram

3.20 Updating order details has limitations. It is possible for users to update their order details if it is within 12 hours from placing their orders. However, admin accounts are allowed to update the order details anytime. Upon receiving the request by the lambda function, the requester token is checked with the Firebase Auth service, and user uid is fetched. the user account is checked from the database and according to the timestamp of the order the update is granted to rejected. Accordingly the response is sent back the requester.

Create new attachment for an order

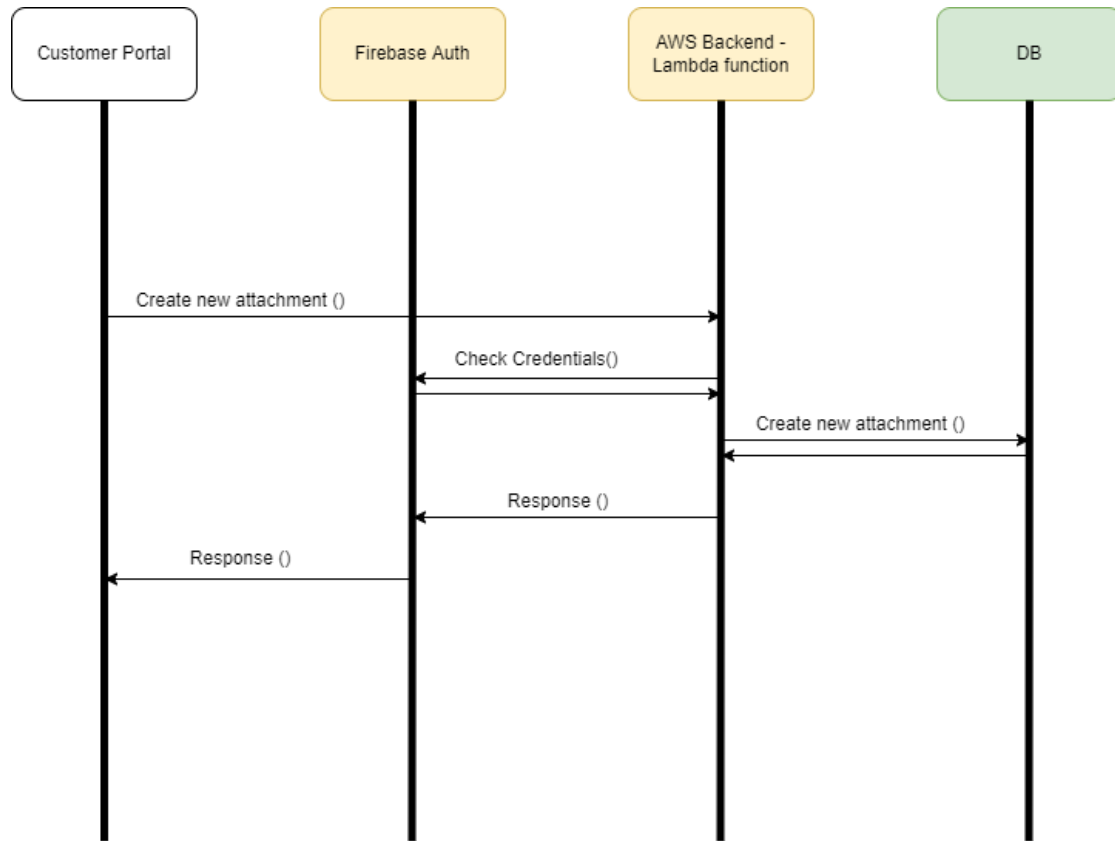


Figure 3.21: Create new attachment for an order Sequence Diagram

3.21 Creating new attachment is possible for customers by default and admins as long as the order is still in progress. Nevertheless, assigned vendor also can add new attachments to the order. The endpoint triggers lambda function that checks the user token and check their access for the order and its status. Upon checking and validating the access right, the new attachment is added to the order. Once the attachment is added it is already viewed in the order details. Moreover, a new status update is added for adding new attachment.

Create new order bid

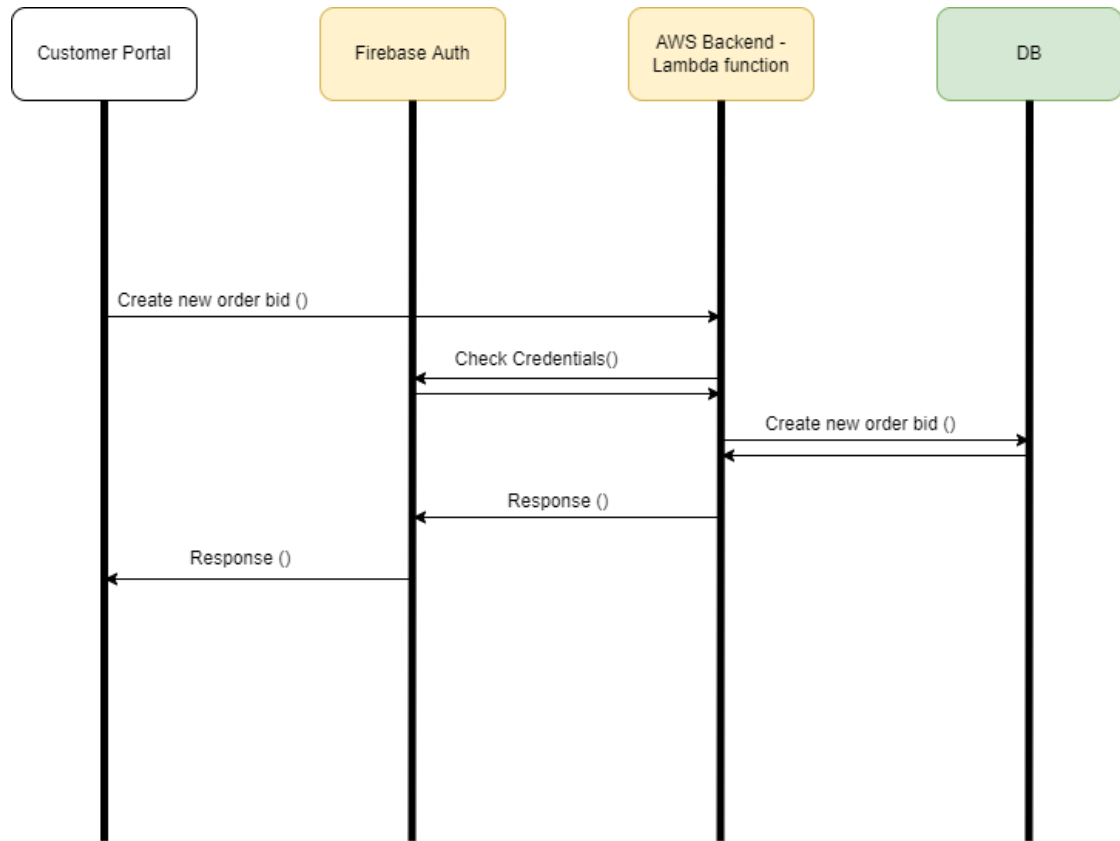


Figure 3.22: Create new order bid Sequence Diagram

3.22 Creating new bid is done by vendor accounts and admin accounts. Vendors can place their bids after checking the order details. Once they submit a new bid, the responsible endpoint receives the request and triggers the lambda function responsible. Accordingly it checks the authorization token, order status, and user account to assure that it is a valid vendor account and it is a valid bid. Then the bid is stored within the order itself and the customer can view.

Update order accepted bid

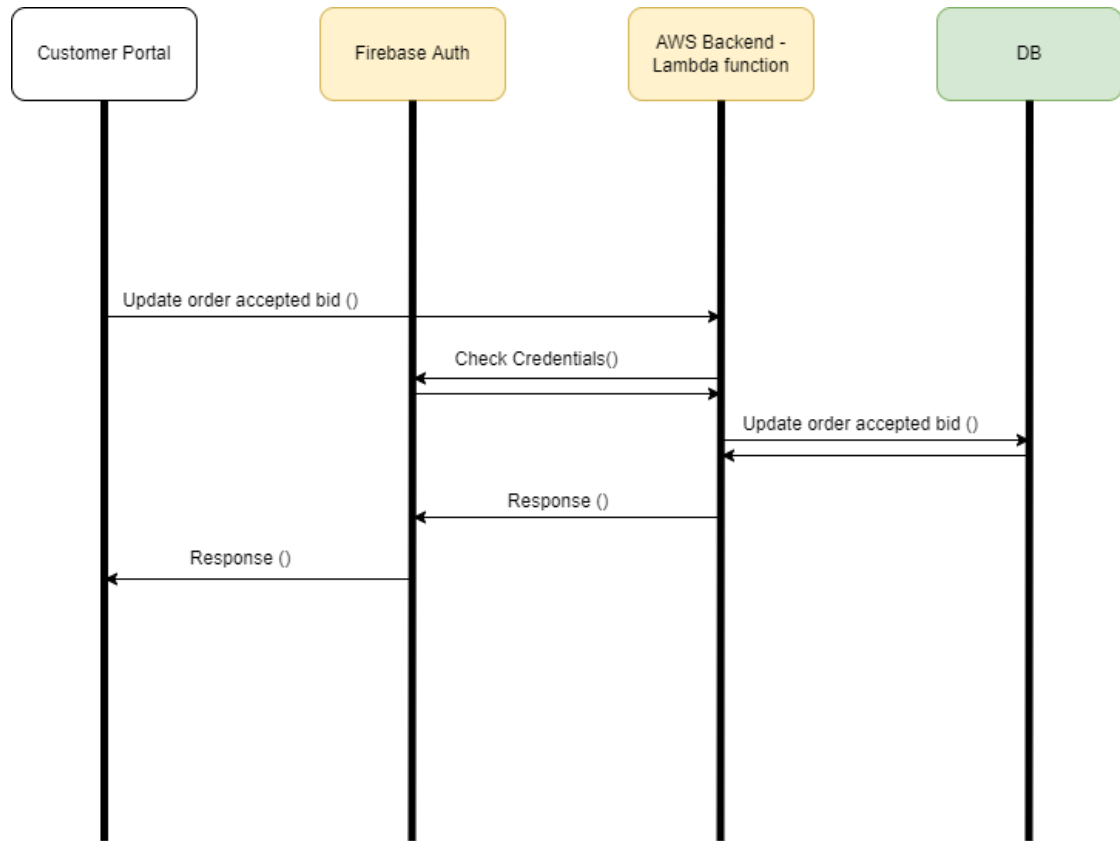


Figure 3.23: Update order accepted bid Sequence Diagram

3.23 Customer who has requested the order can view the list of bids from the order details, and assign one of the vendors to the order. The assignment process goes by sending a request of the selected bid to the responsible endpoint, and accordingly it checks the validity of that step and assign the selected vendor to the order itself and updating the status of the order accordingly. Upon updating the status of the order, the order is no longer available for the other vendors or in the market.

Fetch list of orders

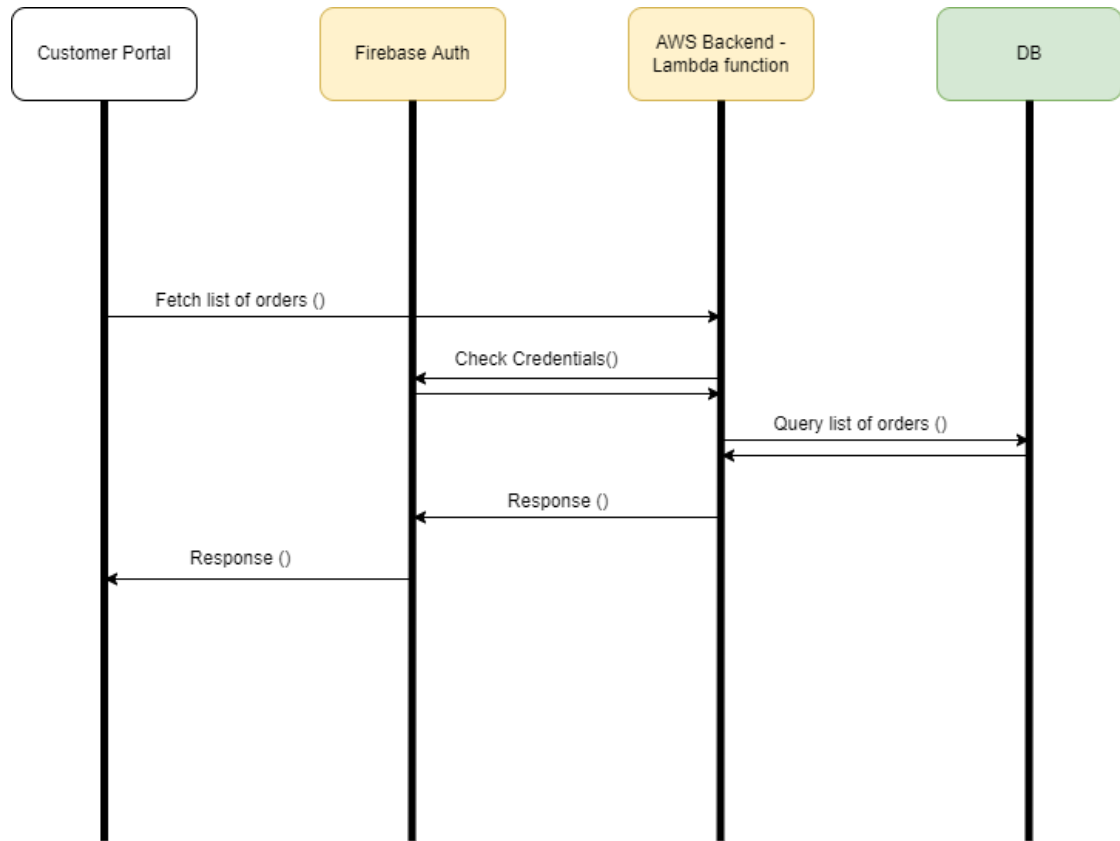


Figure 3.24: Fetch list of orders Sequence Diagram

3.24 Customers and vendors can fetch their list of orders. Upon requesting a query is executed from the lambda function to the Dynamodb using its SDK. The resulted list of orders is returned back.

3.6.3 Contracts Table related endpoints

Create new contract

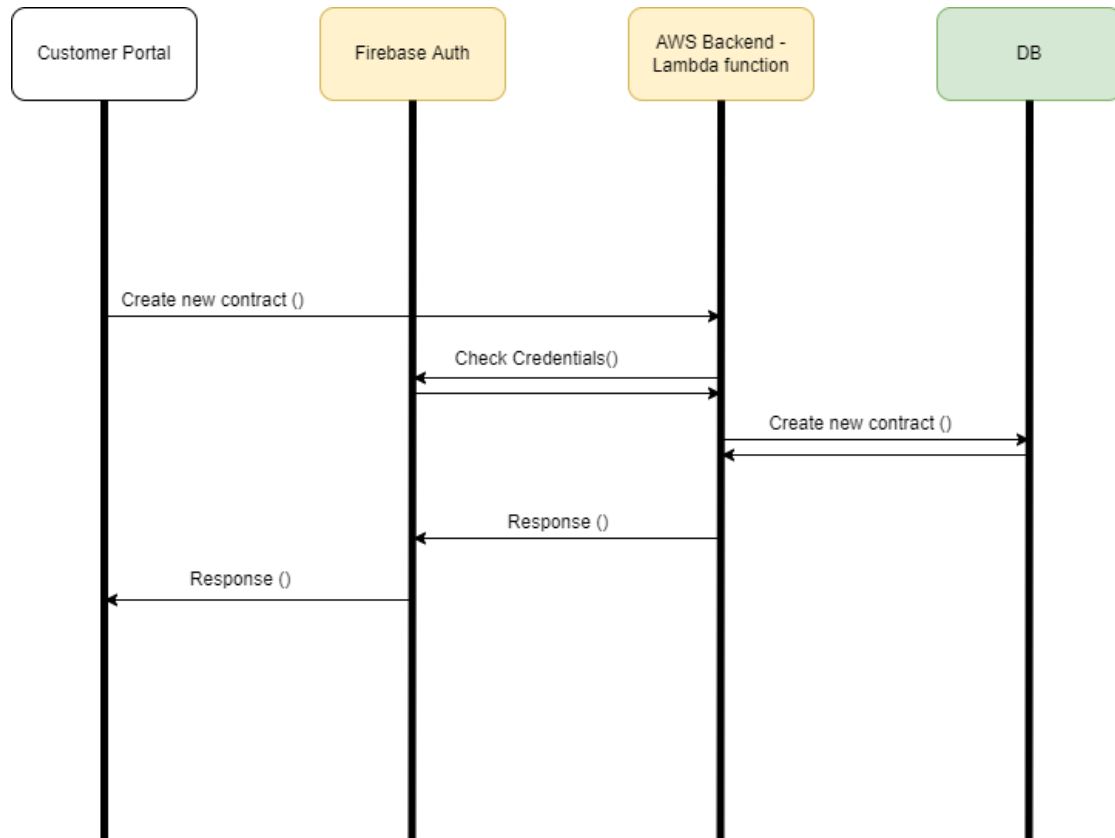


Figure 3.25: Create new contract Sequence Diagram

3.25 Customers can create new contracts. Contracts vary in type flexible contract to fixed schedule contract. Nevertheless, the contract service itself such as FTL and LTL services. Upon creating and defining all required data for the contract creation a request is send from the customer application to the endpoint responsible for the contract creation. It validates the authorization token from the Firebase Auth service, and validates the account_status and account_type. Nevertheless, it also checks that all required fields are defined.

Fetch contract details

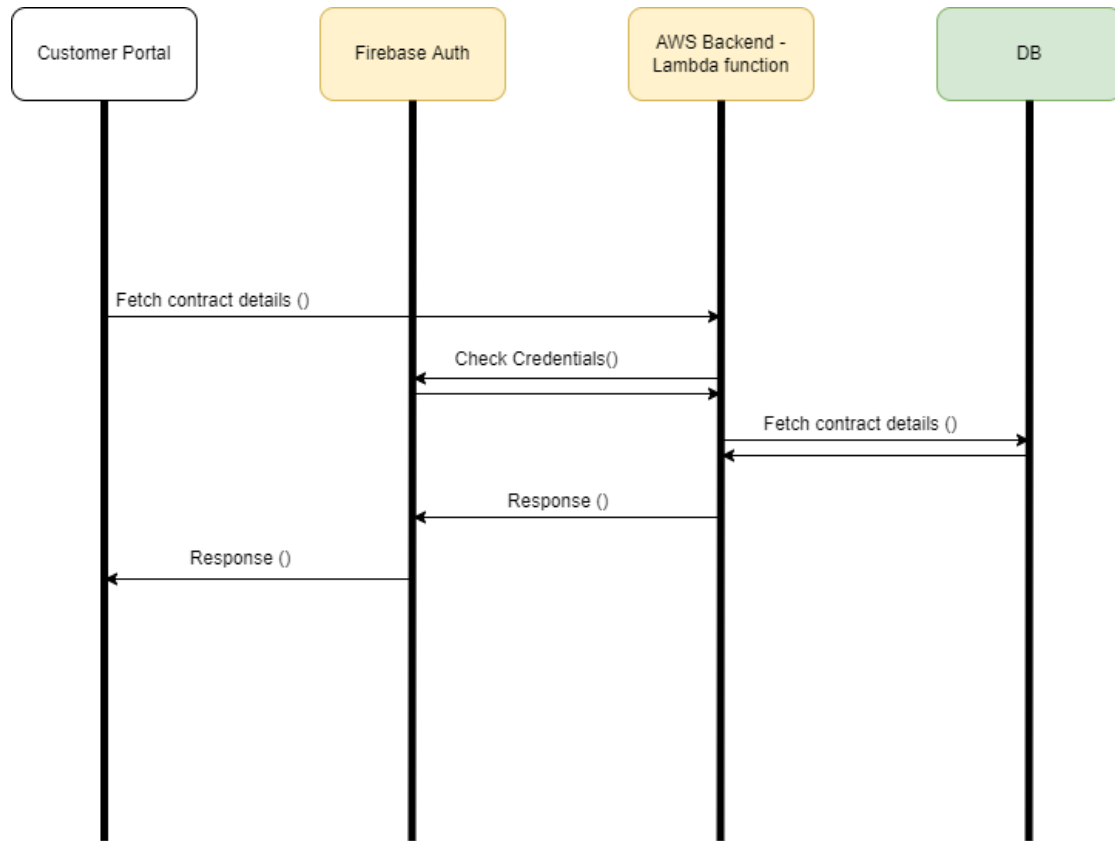


Figure 3.26: Fetch contract details Sequence Diagram

3.26 Customers can fetch their contracts details. If the contract is new and has not been assigned yet to a vendor, then also vendors can view the contract details from the market. However, each view is different before assignment of the contract to a vendor, as vendors can only see the general overview of the order but no access to the updates made or other bids placed or any additional information. Upon receiving the request from the user application, the server checks the authorization token and access right for that user to the requested contract. Accordingly, the response is sent back to the vendor.

Fetch contract details

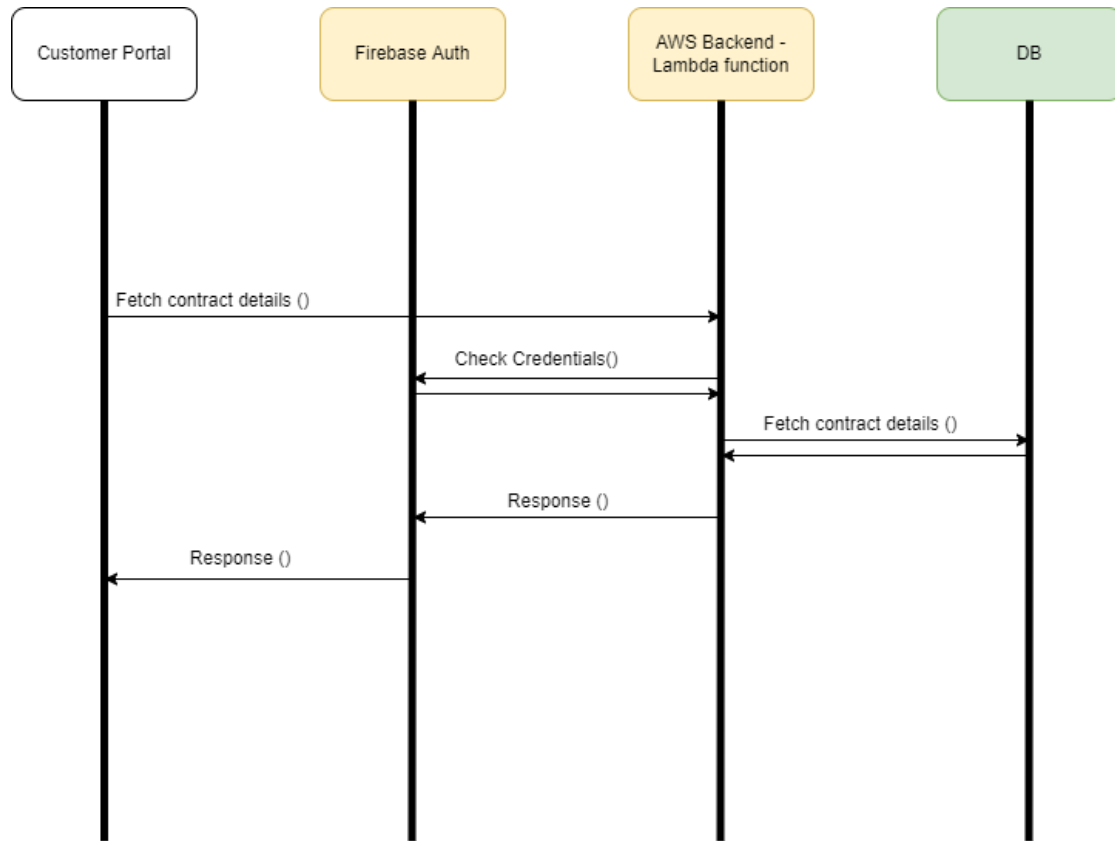


Figure 3.27: Fetch contract details Sequence Diagram

3.27 Customers can fetch their contracts details. If the contract is new and has not been assigned yet to a vendor, then also vendors can view the contract details from the market. However, each view is different before assignment of the contract to a vendor, as vendors can only see the general overview of the order but no access to the updates made or other bids placed or any additional information. Upon receiving the request from the user application, the server checks the authorization token and access right for that user to the requested contract. Accordingly, the response is sent back to the vendor.

Update contract details

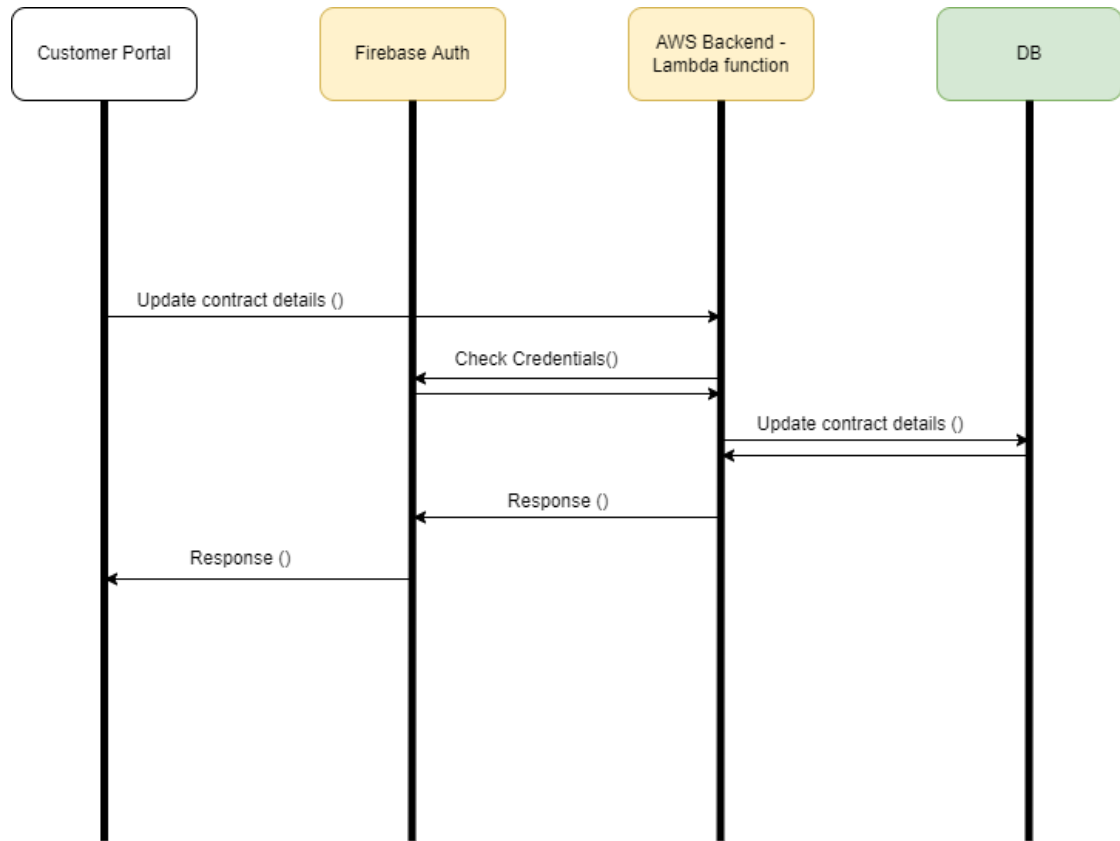


Figure 3.28: Update contract details Sequence Diagram

3.28 Updating the contract details is only possible to the customer, and admin. Contract can be updated at anytime from the customer side as it does not have a limited time. Different contracts can be placed and customers can plan their contracts weeks if not months in advance. Therefore, customer accounts can update the contract information at anytime.

Create new attachment for a contract

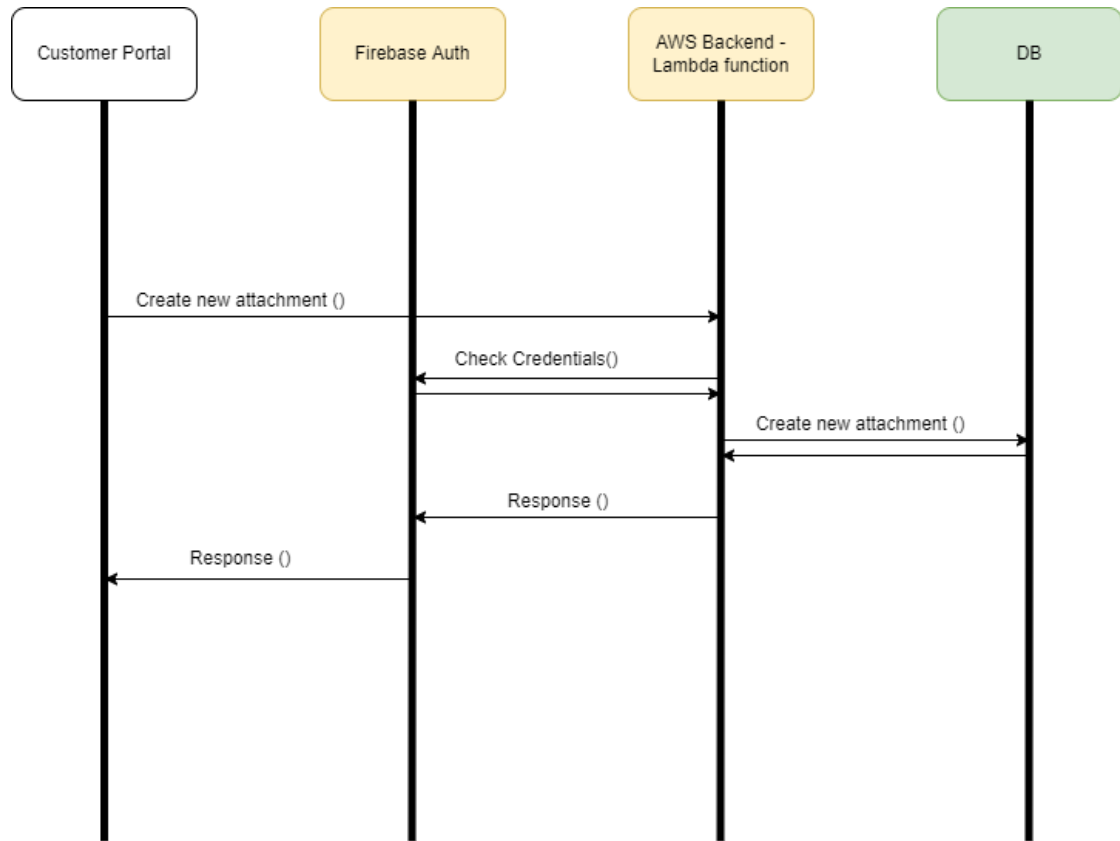


Figure 3.29: Create new attachment for a contract Sequence Diagram

3.29 Creating new attachment is possible for customers by default and admins as long as the contract is still in progress. Nevertheless, assigned vendor also can add new attachments to the contract. The endpoint triggers lambda function that checks the user token and check their access for the order and its status. Upon checking and validating the access right, the new attachment is added to the contract.

Create new contract bid

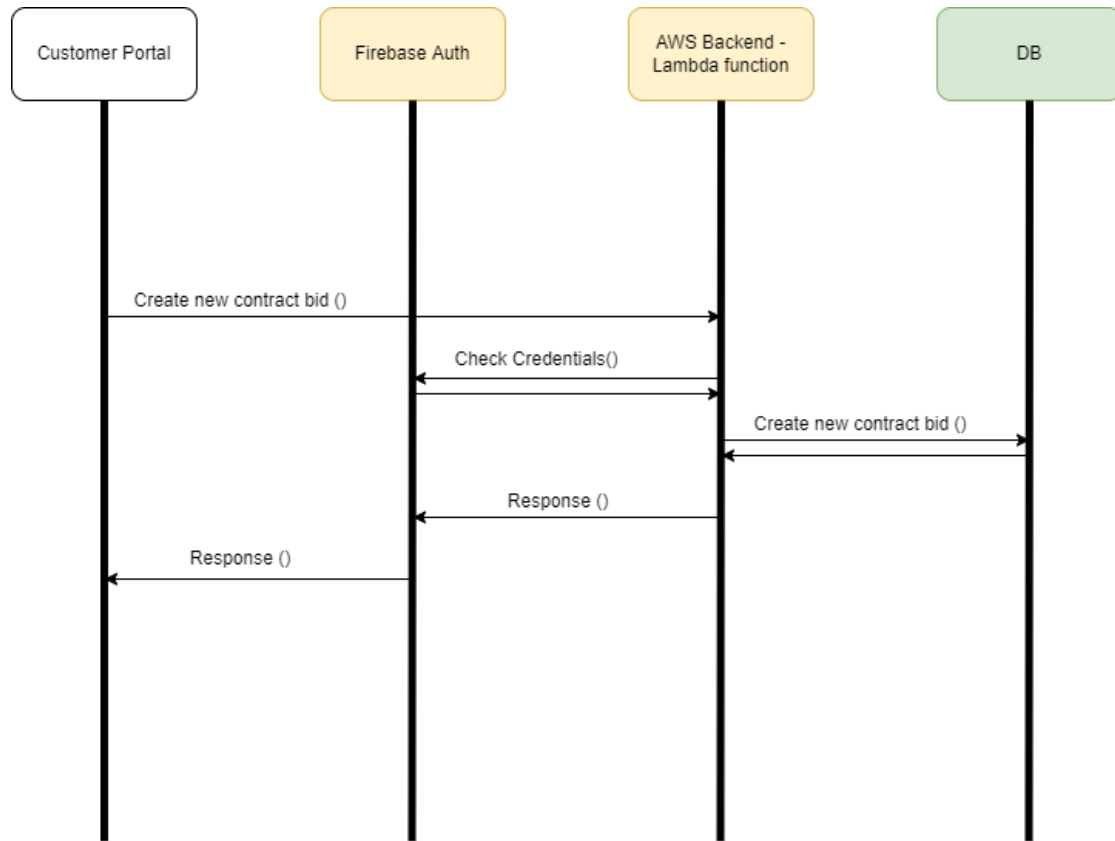


Figure 3.30: Create new contract bid Sequence Diagram

3.30 Vendors can create new bids for the contract as long as it is not assigned to any vendor and is still open. As the window of placing bids is bigger here compared to orders, it is possible to consider adding update feature for the bid that was placed by a vendor, currently it is possible to update a bid from the admin side only. Upon receiving the request, validation of the authorization token takes place and check for the account_status and possibility of adding the new bid. Then a response is sent back to the sender.

Update contract accepted bid

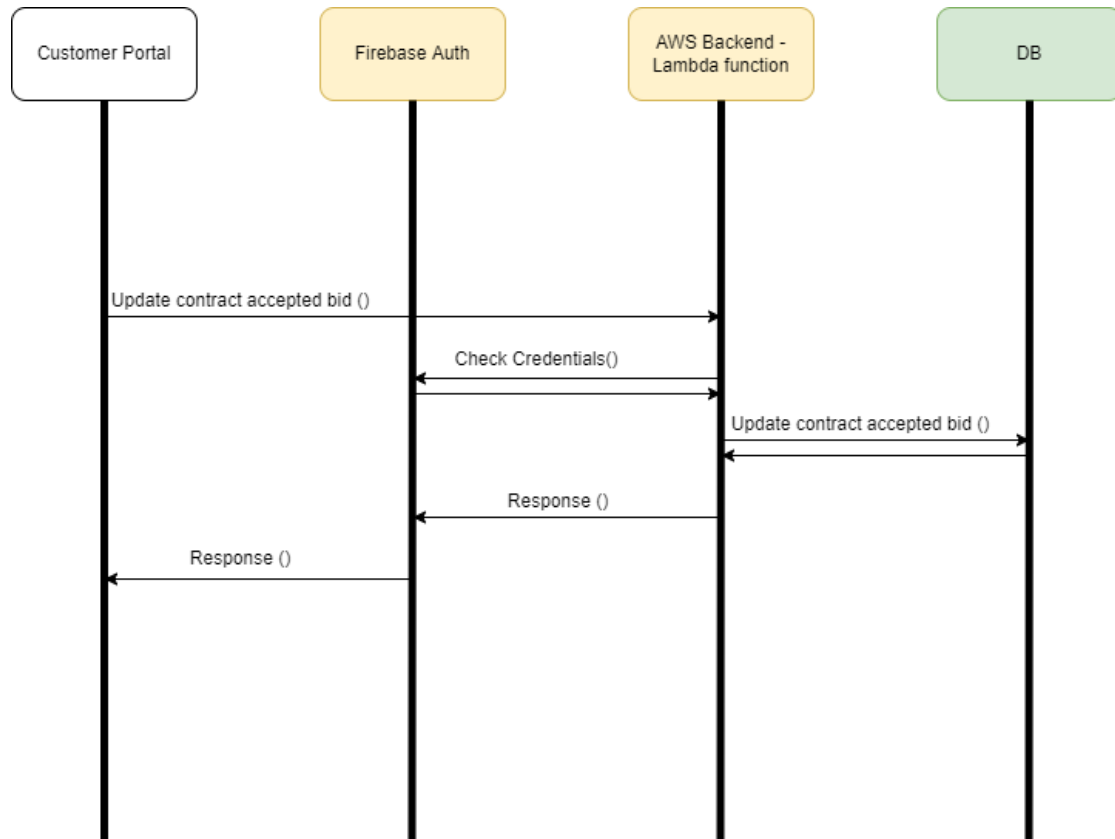


Figure 3.31: Update contract accepted bid Sequence Diagram

3.31 Customers can accept any of the placed bids on the contract. Upon accepting the bid, only the customer and the assigned vendor have access to all contract details including the activity feed of the contract that keeps track of all updates made on the contract and at what time and by whom.

Fetch list of contracts

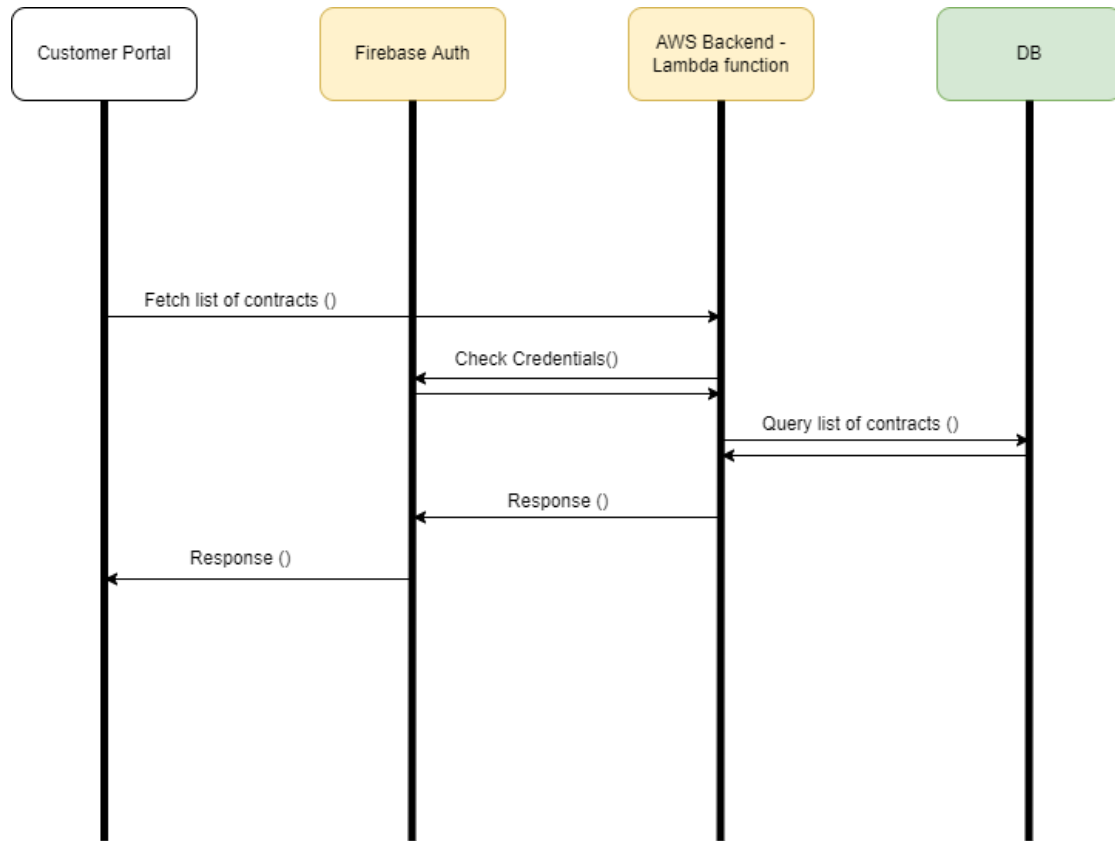


Figure 3.32: Fetch list of contracts Sequence Diagram

3.32 Fetching list of contracts depends if the list requested is the user's list of contracts or the market (currently opened contracts). In case it is the user's list of contracts, a query is made to the database from the server side using the database SDK. Nevertheless, vendors can request the list of opened contracts, in other words, the market contracts. Upon requesting the market contracts a query is made for the contracts that have not been assigned yet.

Fetch list of orders in contract

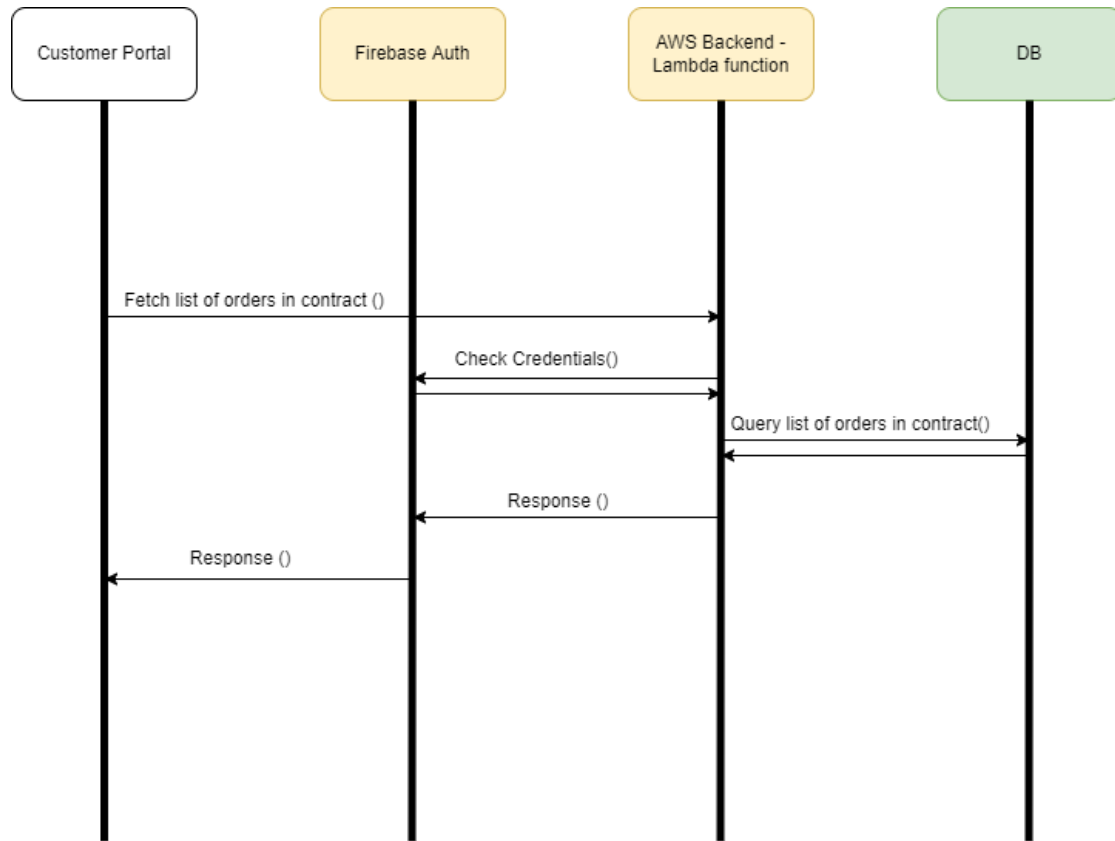


Figure 3.33: Fetch list of orders in contract Sequence Diagram

3.33 Each contract is a container for list of orders. Users of the system can request list of orders that belong to one contract. Upon creating new order, the `contract_id` is given as a parameter is the order is within a contract. And accordingly, if the list of orders in a contract is requested a query is made to the database including that `contract_id` as a filter parameter.

3.6.4 Trucks Table related endpoints

Create new truck

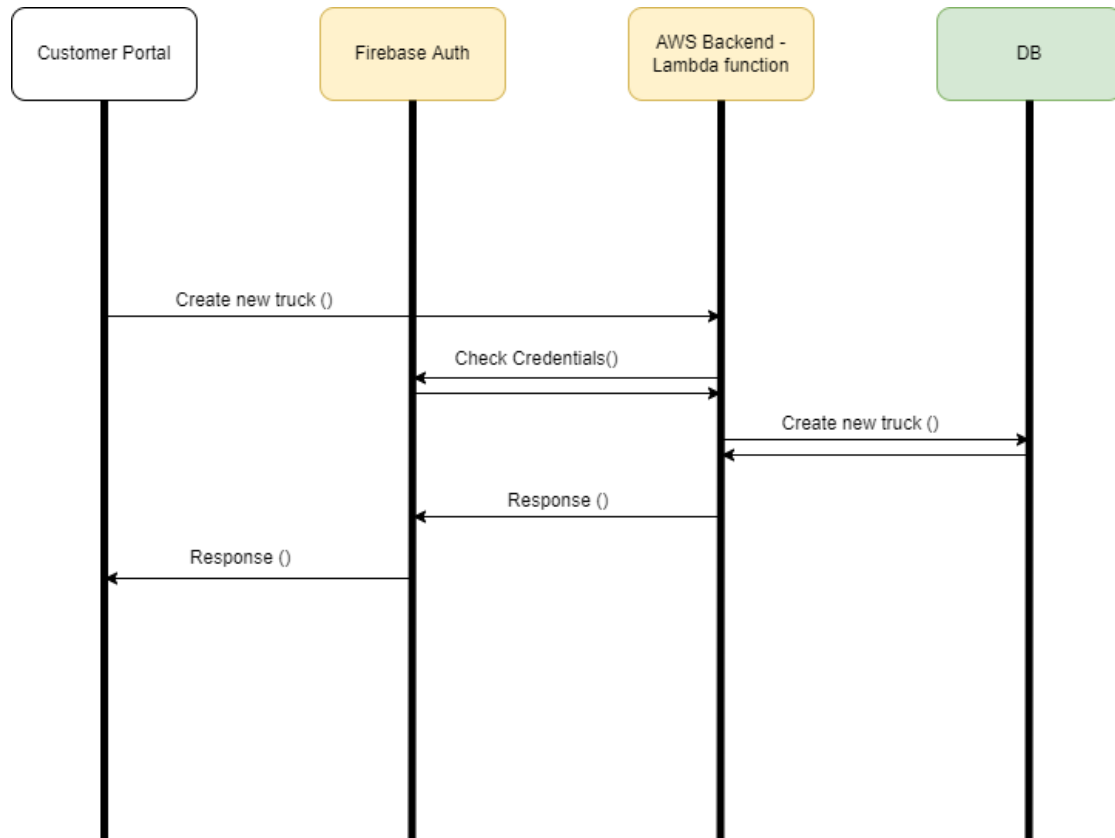


Figure 3.34: Create new truck Sequence Diagram

3.34 Admin accounts can create new truck data. The truck should include the truck_name, notes, charging_rate, and all required information to give a cost estimation for the trip. Upon sending a new request the token of the requester is checked and the account_type should only be an admin account. Upon checking the data is stored in the database as a new truck with a generated id.

Fetch truck details

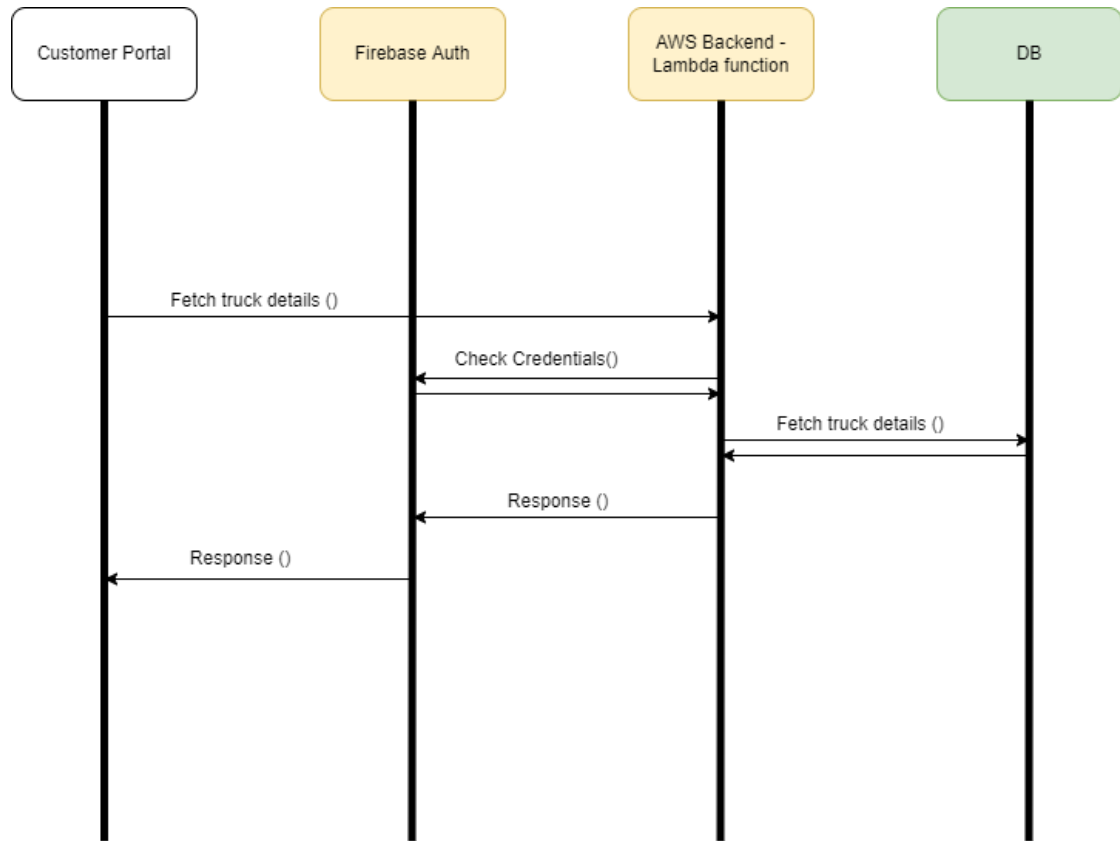


Figure 3.35: Fetch truck details Sequence Diagram

3.35 Fetching truck details can be done by any user of the system. Truck details is sent back from the database. This endpoint can requested from the users applications directly or from other lambda functions within the system.

Update truck details

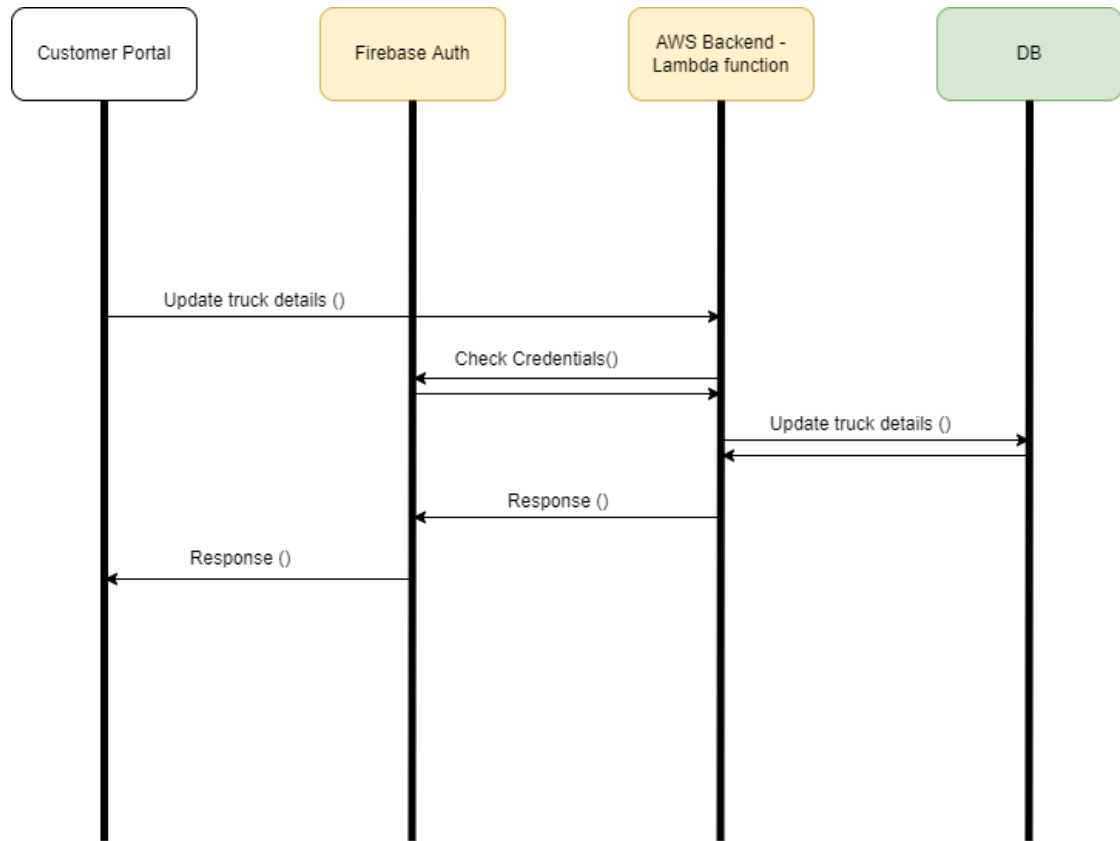


Figure 3.36: Update truck details Sequence Diagram

3.36 Update a truck details is only possible for admins if one of the attributes needs updates. However, if the cost estimation related attributes are to be modified, it is better to change the status of the current truck to invalid and create a new truck with the new adjusted attributes. In all cases, when a new order or contract are created an instance of the truck details is attached to the order or the contract themselves. Upon receiving the request from the admin application the authorization token is checked and the user account type and status are checked. Following that, the truck details is updated and confirmation is send back to the application.

Fetch list of trucks

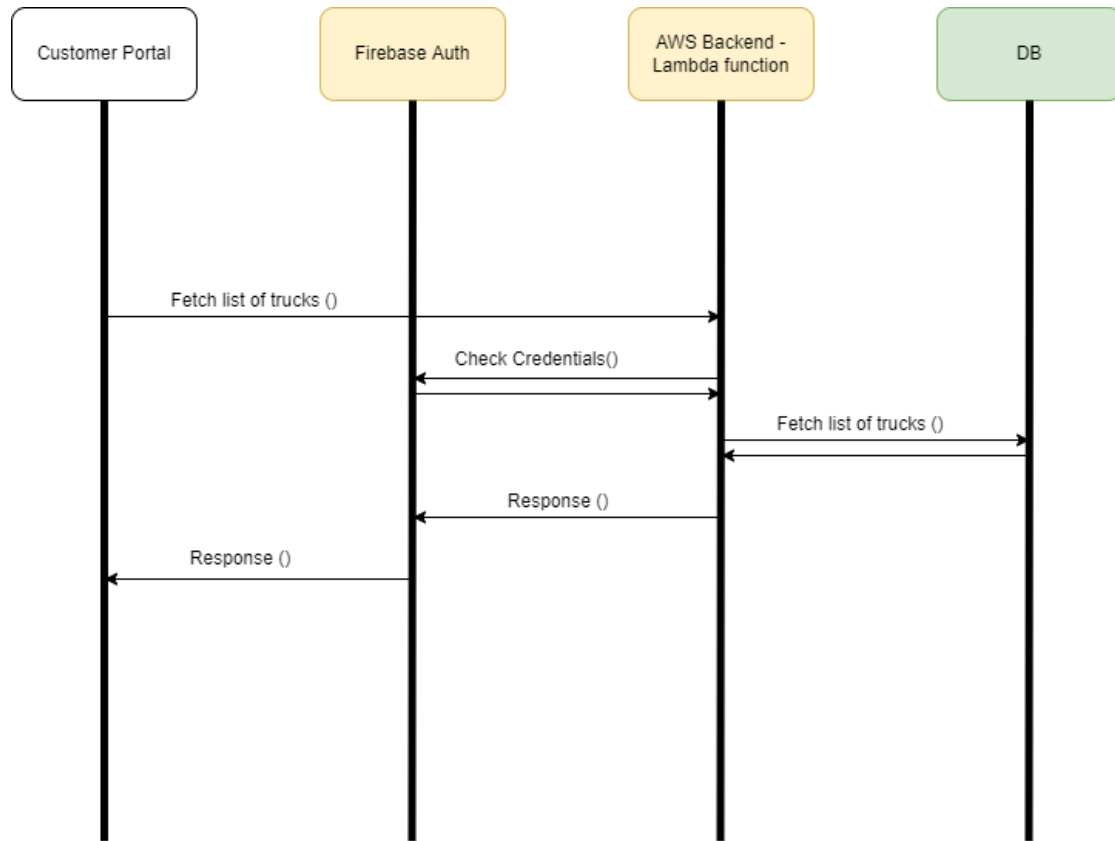


Figure 3.37: Fetch list of trucks Sequence Diagram

3.37 This endpoint is reached by the customer application to fetch the list of available trucks by the system. The truck is available if its status is valid. The server checks the requester authorization token and return back the list of the trucks after querying it from the database using the DynamoDB SDK.

3.6.5 Services

Create new truck

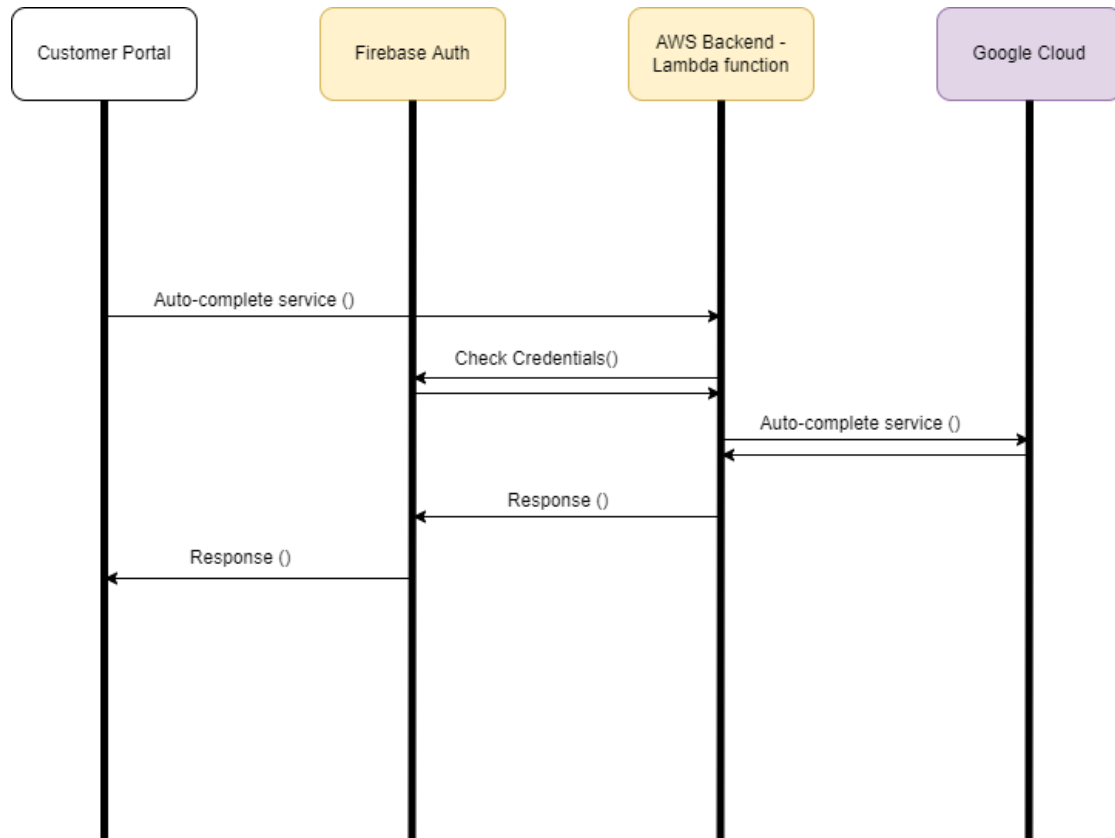


Figure 3.38: Auto-complete service Sequence Diagram

3.38 Auto-complete service is a service provided by google map to auto-complete the address. It is used to help the users to write the pickup address, or any additional stop they want. Upon receiving the request form the customer application or the admin application, the lambda function takes the request and checks the authorization token and using the input text it sends a request to the Auto-complete service by google map api using the api key stored on the server side. Upon receiving the results of the request, the response is adjusted to match what is expected by the customer or the admin applications.

3.7 Real-life testing

The proposed solution was adopted by 12 vendors (carrier companies) with total of more than 300 trucks, and 15 customers. Customers that adopted the platform were from different sectors such as wood, furniture, papers, garments, and more. Approximately 50 orders were placed on the platform, some of which were on-demand orders and others were contract based orders. 2 of those 50 orders were chosen to better illustrate the use case of the proposed solution.

Carrier companies were in different geographical locations. Most of the vendors were in Cairo considering it the capital of Egypt and most of land transport go through. Nevertheless, the second hub was in Alexandria, with its port as one of the most important ports in Egypt and MENA region. Moreover, the other carriers are from Demiatta, Bahaira, and other small cities.

Customers that adopted the solution from Factories and companies were located mainly in Alexandria, and Cairo. Customers have placed their orders on the platform and compared it with other existing solutions they have tried. The following orders are chosen to illustrate some of the use cases, and the advantages and disadvantages of the current developed solution.

3.7.1 Order 1

The order was placed 2 weeks before the pickup date. Different vendors have placed their bids on the order. Accordingly the customer had chosen one of vendors to fulfill their shipment according to the agreed price placed on the system 12,500 EGP. Due to weather some of the trucks that were assigned for this shipment could not departure from their garage 2 hours before the pick up time. Hence, the assigned vendor tried to find alternative trucks but they would cost more (14,000 EGP) on the customer side. Therefore, the customer had chosen to pick an alternative vendor from those who already have placed their bid on that order. The second vendor in order placed 13,000 EGP for that shipment. On the other hand, other existing solutions in the market were offering the same shipment for 14,000 EGP.

Once the reassignment is completed and confirmed with that vendor that they can provide trucks on time, the trucks moved to the pickup address, and deposit of the shipment was paid by the customer to the drivers.

The platform allows both customers and vendors to update the status of the order regularly, and attach any document to it. Therefore, it was easy sharing documents such as driver license, truck license, all tariffs that were paid on the road, and more. Once the shipment was fulfilled and the goods were off loaded from the trucks in the drop off location, the confirmation was sent to the customer and the remaining cost of the shipment was paid to the truck drivers.

3.7.2 Order 2

The order was of a shipment that is moving from point A (Alexandria) to point B (Luxur), nearly 900 KM, and then from point B (Luxur) to point C (Alexandria) nearly 900 KM after 3 days. The order can be defined as two separate orders, the first one is from point A and point B and the other order from B to C. However, it also can be considered as one shipment with 3 days included in the shipment itself.

For this type of shipments many factors play a rule in influencing the cost of the shipment. One of which is the type of trucks needed and availability of those trucks in the drop off region. Another factor is the cost of getting the truck back to its garage after fulfilling the shipment, that in this order is going back from point B to point A after the first shipment either empty or waiting for another shipment in the same route to compensate of the cost spent on the truck moving back. Nevertheless, the cost of drivers staying at the drop off region. Additionally, all previous mentioned factors in the first chapter applies.

The order was placed as one shipment from A to B and 3 days waiting in the drop off region then moving back from B to C. Different bids were placed on the system, most of which were considering the order as 2 separate shipments and additionally waiting time in the drop off region was considered as additional cost to be added. However, some vendors considered it as one shipment and it has a special cost as the cost of the truck moving back empty and going empty again to pick the goods after 3 days and wasted time is reduced. Hence, that resulted in cost reduction of the overall shipment. The cost was reduced from 42,000 EGP to 33,000 EGP including the waiting time.

Other solutions in the market only offered having the order as two different shipments not possible to add multiple stops with special requirements. Nevertheless, the overall shipment cost was approximately 42,000 EGP.

3.7.3 Real-life test conclusion

3 of the orders placed on the platform were cancelled due to late bid placement by the vendors, and short window for bids from the customer side as the pickup time for the orders was within 12 hours from placing it.

Existing solutions are focusing on one pickup point and one drop off point for on-demand orders. Hence, it limits the type of orders that can be placed on the platform. Traditional method are customized to every single order. Such flexibility can be used for orders such as example order 2 that was discussed above.

Bidding based platform allows the customers to have different bids with different terms placed on their orders and contracts and fit and match which is suitable most to their use cases. Nevertheless, it provides dynamicity and flexibility of changing the prices in case any of the influential factors are changing. It is considered as an advantage to the current solution provided by solutions in the region. However, the main drawback of such technique is the reliability on the vendors to place their bids as soon as the order or the contract is placed on the platform.

Generally the bidding approach can be considered as better than or equal to the quality of existing solutions as it can consider the existing service providers as partners.

4 Conclusion

4.1 Pros and Cons of the Proposed Solution

4.1.1 Pros

The proposed solution allows transparency between vendors and customers which is not visible by the other solutions in the market or limited in the content provided about them.

Nevertheless, it given vendors the flexibility to place their bids and add notes to the bid to make it customizable to the agreement term between the customer and vendor. Moreover, the vendor can place different prices to similar orders in case one of the cost influential factors changed, such as the price of the fuel, tariffs, current locations of the assignable trucks and more.

The platform allows a live status update about the shipment, which is expected from the new digital solutions in the logistics market.

Nevertheless, due to rapid change in the fuel price, it is important to have the option to adjust the cost accordingly. Offering the bidding option allows the vendors to dynamically update the cost of the service upon change. Moreover, they can also offer different agreement terms for orders or contracts that fits the changes in the market itself.

The platform allows customers to keep track of their orders and contracts in real time. The proposed solution allows the customer to check their dashboards where they can find statistics data about the current and previous orders and contracts. The statistics data is updated in real-time.

The proposed solution offers a logger (activity feed), that monitors all status updates made on the order or the contract and if any attachment is added and by whom. It facilitates the quality measurement as it is possible for all stakeholders to check the when the truck arrived to the pickup and when the order was actually picked up and monitor all intermediary status till the shipment is delivered to the destination.

Nevertheless, it allows the stack holders from customers and vendors to enhance their experience.

The proposed solution differs from other existing solutions in the market that it offers an automated way to do the tender on the contracts not just on-demand orders. Furthermore, it allows the vendors to offer different agreement terms that might be a better fit for some customers. Moreover, it can count multiple of deliveries as a contract and fix the cost as illustrated in the second example of order placed on the system.

4.1.2 Cons

One of the main challenges is the adaptability of technology by vendors. Most of the carrier companies rely on the old and traditional methods to conduct the business as phone calls and chats. Although, it is challenging for them to work with technology some times, but multiple of vendors were interviewed and they mentioned that they are willing to hire someone to work on the technology and their accounts if they are seeing that it brings them more business.

Although bidding has so many advantages such as flexibility and dynamicity for vendors, but it requires more time. 3 of the orders placed on the platform were cancelled because of the short window of bid and either no offers were placed or the offers that were placed were high in cost. One potential solution is to fix the prices in case of on-demand order and only open the bids for contracts. Another potential solution is to only allows orders that have bigger bidding window before the pickup time.

Customers might face some different pricing for the same shipment from the same pickup address to the same drop off address. For some customers it is understandable as it is a bidding based platform, so they might not get the same price for the same shipment. However, some customers expect consistency for the prices, which is a challenge between flexibility and consistency. It is counted as one of the drawbacks of the bidding solution. Although, customers can fix rates by setting a contract with a vendor.

4.2 Potential Enhancements

Live tracking of the truck was proposed by some customers as an important feature. It depends on the commodity and the business of the customer, having a GPS tracking of the truck might be important. Nevertheless, currently the status of the order or the contract is updated through the responsible vendor for the shipment, which is possible for vendors. However, facilitating for the truck driver to have an application and update the status from their side is a potential enhancement to the system. Although, it has its own challenges as the adaptability of truck drivers for technology is harder than vendors as carrier companies as discussed in the ICC Digital Trade conference [3].

The proposed solution has other applications. It is possible to use the same model for ocean freight and air freight as done by **FORTO**. Nevertheless, it can also be used in inventory services for factories. The proposed platform can be utilized in any sector that has similar business model where a customer can request quotation from the vendor and automate the tender process.

The cost estimation equation proposed earlier in the thesis, can be enhanced for different applications of the system. Nevertheless, it can also take into consideration the fuel cost as a parameter and measure the influence it might have directly to the cost. As already each truck type consumes a fixed amount of fuel per kilometer, it should be possible to develop a cost estimation function that is adaptable with the fuel price change.

Nevertheless, the cost estimation function developed is tested with other existing solutions in the Egyptian market and validated. Moreover, it was confirmed with vendors that the cost of the shipment is within the specified range of the cost estimation by the introduced equation. However, it is limited to the Egyptian market, the attributes can be adjusted depending on the geographical location as well as the order or the contract.

5 Appendix

5.1 Cost estimation values

The following is a list of cost estimation values to be used for the cost estimation equations depending on the selected truck type and the route length of the shipment.

```
[
  {
    "Charging Rate": 3.5,
    "Discount Distance": 100,
    "Discount Percentage": 0.112,
    "Minimum Charge": 100,
    "Minimum Distance": 0.01,
    "Service Fees Percentage": 0.075,
    "Service Type": "Fixed",
    "Transportation Type": "Tomnaya Opened"
  },
  {
    "Charging Rate": 3,
    "Discount Distance": 100,
    "Discount Percentage": 0.112,
    "Minimum Charge": 80,
    "Minimum Distance": 0.01,
    "Service Fees Percentage": 0.075,
    "Service Type": "Fixed",
    "Transportation Type": "Tomnaya Closed"
  },
  {
    "Charging Rate": 4.5,
    "Discount Distance": 100,
    "Discount Percentage": 0.112,
    "Minimum Charge": 120,
    "Minimum Distance": 0.01,
```

```

    "Service Fees Percentage": 0.075,
    "Service Type": "Fixed",
    "Transportation Type": "Dababa Opened"
  },
  {
    "Charging Rate": 4.6,
    "Discount Distance": 100,
    "Discount Percentage": 0.112,
    "Minimum Charge": 140,
    "Minimum Distance": 0.01,
    "Service Fees Percentage": 0.075,
    "Service Type": "Fixed",
    "Transportation Type": "Dababa Closed"
  },
  {
    "Charging Rate": 7,
    "Discount Distance": 100,
    "Discount Percentage": 0.112,
    "Minimum Charge": 200,
    "Minimum Distance": 0.01,
    "Service Fees Percentage": 0.075,
    "Service Type": "Fixed",
    "Transportation Type": "Jambo 4m Opened"
  },
  {
    "Charging Rate": 7.2,
    "Discount Distance": 100,
    "Discount Percentage": 0.112,
    "Minimum Charge": 220,
    "Minimum Distance": 0.01,
    "Service Fees Percentage": 0.075,
    "Service Type": "Fixed",
    "Transportation Type": "Jambo 4m Closed"
  },
  {
    "Charging Rate": 8.5,
    "Discount Distance": 100,
    "Discount Percentage": 0.112,
    "Minimum Charge": 300,

```

```
"Minimum Distance": 0.01,
"Service Fees Percentage": 0.075,
"Service Type": "Fixed",
"Transportation Type": "Jambo 6m Opened"
},
{
  "Charging Rate": 7.2,
  "Discount Distance": 100,
  "Discount Percentage": 0.112,
  "Minimum Charge": 320,
  "Minimum Distance": 0.01,
  "Service Fees Percentage": 0.075,
  "Service Type": "Fixed",
  "Transportation Type": "Jambo 6m Closed"
},
{
  "Charging Rate": 20,
  "Discount Distance": 100,
  "Discount Percentage": 0.112,
  "Minimum Charge": 1000,
  "Minimum Distance": 0.01,
  "Service Fees Percentage": 0.075,
  "Service Type": "Fixed",
  "Transportation Type": "Trella Faradany"
},
{
  "Charging Rate": 20,
  "Discount Distance": 100,
  "Discount Percentage": 0.112,
  "Minimum Charge": 1000,
  "Minimum Distance": 0.01,
  "Service Fees Percentage": 0.075,
  "Service Type": "Fixed",
  "Transportation Type": "Trella Container"
},
{
  "Charging Rate": 20,
  "Discount Distance": 100,
  "Discount Percentage": 0.112,
```

```
"Minimum Charge": 1000,  
"Minimum Distance": 0.01,  
"Service Fees Percentage": 0.075,  
"Service Type": "Fixed",  
"Transportation Type": "Trella Closed"  
}  
]
```


5.2 Tables schemes

5.2.1 Users Table

```
{
  "uid": "123-asda123-asdaXXX",
  "company_id": "123-asda123-asdaXXX",
  "email": "e01@naqlx.com",
  "phone_number": "01011001010",
  "account_type": "(customer, vendor, support, admin)",
  "account_status": "Verified, Not Verified, Suspended",
  "documents":{
    "commercial_register": "https://...",
    "tax_number": "https://..."
  },
  "company_address": "12 st, Cairo, Egypt.",
  "company_description": "The Company ....",
  "company_size": "5-10",
  "company_logo": "http://...",
  "company_name": "company_x",
  "notification_push_id": "123-asda123-asdaXXX"
}
```

uid: is the unique id of the account that is being used

company_id: if this account is a sub account then the **company_id** is the company main admin account.

email: email of the user

phone_number: the phone number of the user

account_type: the type of the user account. It checks if the user account is customer account, vendor account, or admin account. where each of these have different access to the data stored and access rights defined.

account_status: the status of the account, used to check if the account created was reviewed and verified or not .

documents: is a dictionary that contains files the are stored by the user. by default it has the **commercial_register** as a link to the document uploaded to the storage, and **tax_number**.

company_address: address of the company

company_description: description about the company

company_size: company size

company_logo: link to the logo of the company that is stored in the account creation

company_name: name of the company

notification_push_id: push id of the device that is used by the user to be able to send notifications.

5.2.2 Trucks Table

```
{
  "truck_id": "123-asda123-asdaXXX",
  "truck_status": "valid, invalid",
  "truck_name": "(Jamboo, ....)",
  "truck_arabic_name": "()",
  "notes": "up to 10 tones",
  "arabic_notes": "",
  "image_link": "https://blahbla....",
  "minimum_charge": "150 price",
  "minimum_distance": "10 Km",
  "discount_distance": "100 Km",
  "discount_percentage": " 0.112",
  "charging_rate": "5.5 price/Km"
}
```

truck_id: is the unique identifier for the truck. A truck instance is a truck that has all its properties defined. 2 trucks might share the same name if and only if, the later defined version is the updated version of the initial truck. An updated version is a version that has one or more of the properties updated.

truck_status: identify the status of the truck instance if it is valid or not.

truck_name: name of the truck.

truck_arabic_name: name of the truck in arabic language. Language specific text is defined as a separate property as it was found that translation services does not translate the notes or the name of the truck correctly in the intended language. Therefore, a separate property was defined for three translation.

notes: notes about the truck such as maximum weight, services provided.

arabic_notes: notes about the truck such as maximum weight, services provided in arabic language.

account_status: the status of the account, used to check if the account created was reviewed and verified or not .

image_link: link to the truck image for better illustration of the selected truck in the order or contract.

minimum_charge: minimum charge of the truck. The property is used to calculate the

cost estimation of the truck depending on the distance. The equation 3.3 is used to calculate the cost estimation of that truck.

minimum_distance: minimum distance to impose the minimum charge

discount_distance: minimum distance to apply the discount

discount_percentage: discount percentage to be applied

charging_rate: the charging rate. It depends on the truck type and rate is calculated in EGP per kilometer.

5.2.3 Orders Table

```
{
  "order_id": "123-asda123-asdaXXX",
  "contract_id": "123-asda123-asdaXXX/null",
  "order_status": "Submitted, Waiting Approval, Completed, ...",
  "order_service": "MultiModel, LastMile",
  "list_of_updates": [
    {
      "timestamp": 169878484,
      "update_title": "Submitted, Waiting Approval, Completed, ...",
      "notes": "Notes about the updte",
      "uid": "123-asda123-asdaXXX"
    }
  ],
  "customer_id": "123-asda123-asdaXXX",
  "assigned_vendor_id": "123-asda123-asdaXXX",
  "number_of_stops": 5,
  "list_of_stops": [
    "addressX",
    "addressY",
    "addressZ",
    "..."
  ],
  "pickup_time": "12.03.2022 13:00",
  "pickup_timestamp": 164648184,
  "notes": "Details about the shipment",
  "sender": {
    "name": "XCustomer",
    "phone_number": "010002020000"
  },
}
```

```
"receiver": {
  "name": "XCustomer",
  "phone_number": "010002020000"
},
"package": {
  "dimension": "23cmX40cmX50cm",
  "commodity": "FMCG",
  "weight": "15KG"
},
"list_of_attachments": [
  {
    "file_link": "http://...",
    "file_type": "pdf, image",
    "uid": "123-asda123-asdaXXX",
    "timestamp": 164648184
  }
],
"truck": {
  "truck_id": "123-asda123-asdaXXX",
  "image_link": "link",
  "truck_name": "Jamboo",
  "truck_arabic_name": ""
},
"quantity": 3,
"list_of_bids": [
  {
    "amount": 2000,
    "timestamp": 164648184,
    "vendor_id": "123-asda123-asdaXXX"
  }
],
"timestamp": 169878484,
"total_cost": 1000,
"service_fees": "200 as number(is deducted from the total cost)",
"carrier_cost": "the price provided by the carrier",
"currency": "EGP"
}
```

order_id: is the unique identifier for the order.

contract_id: the contract that this order belongs to. In case it is an on-demand order the value is null.

order_status: the current status of the order.

order_service: a category for the orders. The order service is a MultitModel if it is a FTL order. The order service is LastMile if it is a LTL.

list_of_updates: list of updates of that order. The list of updates is used to monitor all updates made on the order from status update to communication between customer and vendor, and uploading attachments to the order such as driver license, receipts, tariffs, and more. It keep tracks of when it was updated and by whom it was updated.

customer_id: id of the customer that request the order.

assigned_vendor_id: the assigned vendor for that order. The assignment is done by the customer after the vendor places their bid for that order.

number_of_stops: number of stops for that order. It is a feature that many of the existing solutions don't have.

list_of_stops: list of the stops addresses. defining the route that the truck will go through.

pickup_time: the time for the pick up.

pickup_timestamp: the time for pickup but in timestamp format, used for filtering and visualizations.

notes: any additional notes defined by the customer for that order.

sender: sender information in the pickup location. Sender name and phone number is defined to be contacted by the vendor or the truck driver.

receiver: receiver information in the dropofflocation. Receiver name and phone number is defined to be contacted by the vendor or the truck driver.

package: the package or the commodity that is being shipped. It contains the weight information, commodity, and dimensions.

list_of_attachments: list of attachments links added to that order.

truck: truck that is used in this order. Information about the truck is attached to the order details as in case of updating truck from the list of trucks, or deleting the information of the cost estimation can be calculated from the order within.

quantity: in case of FTL order it is the number of trucks. In LTL order it is the number of packages that are needed to be shipped.

list_of_bids: list of bids placed by the vendors. each bid has the amount per shipment, and notes to define especial terms of agreements such as the cost included or exclude the military/road tariffs or not.

timestamp: the created timestamp of that order.

total_cost: total cost of the order including the service fees.

service_fees: system service fees for that order. It is defined as 10 to 15% of the cost defined by the vendors.

carrier_cost: cost defined by the assigned vendor

currency: currency of that order.

5.2.4 Contracts Table

```
{
  "contract_id": "123-asda123-asdaXXX",
  "contract_name": "Contract 1",
  "contract_status": "Submitted, Waiting Approval, Assigned, Completed, Cancelled",
  "list_of_updates": [
    {
      "timestamp": 169878484,
      "update_title": "Submitted, Waiting Approval, Completed, ...",
      "notes": "Notes about the update",
      "uid": "123-asda123-asdaXXX"
    }
  ],
  "customer_id": "123-asda123-asdaXXX",
  "assigned_vendor_id": " 123-asda123-asdaXXX ",
  "number_of_stops": 4,
  "list_of_stops": [
    "addressX",
    "addressY",
    "addressZ",
    "..."
  ],
  "validity_date": "25.01.2022",
  "validity_date_timestamp": 164648184,
  "contract_type": "Fixed Schedule, Flexible",
  "contract_service": "MultiModel, LastMile",
  "list_of_scheduled_days_encoded": "binary from 1 to 128 (Sun, Sat, Mon, ...)",
  "pickup_time": "12.02.2022 15:00",
  "pickup_timestamp": 164648184,
  "frequency_of_orders": 3,
  "frequency_period": "a week, a month",
  "notes": "Details about the shipment",
  "sender": {
    "name": "XCustomer",
    "phone_number": "010002020000"
  }
}
```

```
    },
    "receiver": {
      "name": "XCustomer",
      "phone_number": "010002020000"
    },
    "package": {
      "dimension": "23cmX40cmX50cm",
      "commodity": "FMCG",
      "weight": "15KG"
    },
    "list_of_attachments": [
      {
        "file_link": "http://...",
        "file_type": "pdf, image",
        "uid": "123-asda123-asdaXXX",
        "timestamp": 164648184
      }
    ],
    "truck": {
      "truck_id": "123-asda123-asdaXXX",
      "image_link": "link",
      "truck_name": "jabmboo",
      "truck_arabic_name": ""
    },
    "quantity": 3,
    "list_of_bids": [
      {
        "amount": 2000,
        "timestamp": 164648184,
        "vendor_id": "123-asda123-asdaXXX"
      }
    ],
    "timestamp": 16987848,
    "number_of_orders": 5,
    "total_cost": 1000,
    "service_fees": "200 as a number (is deducted from the total cost)",
    "carrier_cost": "the price provided by the carrier",
    "currency": "EGP"
  }
```

contract_id: is the unique identifier for the contract.

contract_name: custom name for that contract to be defined by the customer. Contract is a container for list of orders, has fixed cost agreed upon between customer and the assigned vendor. Many customers fix routes and contracts, therefore, having a custom name for the contract is to be specified by the customers.

contract_status: the current status of the order.

list_of_updates: list of updates of that contract. The list of updates is used to monitor all updates made on the contract from status update to communication between customer and vendor, and uploading attachments to the order such assigned agreements. It keep tracks of when it was updated and by whom it was updated.

customer_id: id of the customer that request the order.

assigned_vendor_id: the assigned vendor for that order. The assignment is done by the customer after the vendor places their bid for that order.

number_of_stops: number of stops for that order. It is a feature that many of the existing solutions don't have.

list_of_stops: list of the stops addresses. defining the route that the truck will go through.

validity_date: validity date of the contract, which is the last date that this contract is applied between customer and vendor.

validity_date_timestamp: timestamp of the validity date used for calculation and query.

contract_type: the type of the contract whether it is a fixed scheduled contract which has a specific days and pickup time. Or it is a flexible contract that has a quotation per month or week. Nevertheless, a lease agreement is also possible as a contract type.

contract_service: a category for the contract. The order service is a MulitModel if it is a FTL order. The order service is LastMile if it is a LTL.

list_of_scheduled_days_encoded: list of scheduled days in case the contract type is a fixed schedule contract. The selected days for that contract as encoded for better usage in integrer number (binary encoding).

pickup_time: the time for the pick up.

pickup_timestamp: the time for pickup but in timestamp format, used for filtering and visualizations.

frequency_of_orders: frequency of the orders in case the contract type is flexible contract. The frequency is defined to be the quotation defined per period for that contract.

frequency_period: frequency period of the contract. To be defined in case the contract is a flexible contract.

notes: any additional notes defined by the customer for that order.

sender: sender information in the pickup location. Sender name and phone number is defined to be contacted by the vendor or the truck driver.

receiver: receiver information in the dropoff location. Receiver name and phone number is defined to be contacted by the vendor or the truck driver.

package: the package or the commodity that is being shipped. It contains the weight information, commodity, and dimensions.

list_of_attachments: list of attachments links added to that order.

truck: truck that is used in this order. Information about the truck is attached to the order details as in case of updating truck from the list of trucks, or deleting the information of the cost estimation can be calculated from the order within.

quantity: in case of FTL order it is the number of trucks. In LTL order it is the number of packages that are needed to be shipped.

list_of_bids: list of bids placed by the vendors. each bid has the amount per shipment, and notes to define especial terms of agreements such as the cost included or exclude the military/road tariffs or not.

timestamp: the created timestamp of that order.

total_cost: total cost of the order including the service fees.

service_fees: system service fees for that order. It is defined as 10 to 15% of the cost defined by the vendors.

carrier_cost: cost defined by the assigned vendor

currency: currency of that order.

Bibliography

- [1] Ahmed Hussein Ali, Ani Melkonyan, Bernd Noche, and Tim Gruchmann. Developing a sustainable logistics service quality scale for logistics service providers in egypt. *Logistics*, 5(2):21, April 2021.
- [2] E M H Awad. Measuring logistics performance in ports: a case of alexandria in egypt. *wmu.se*, 2021.
- [3] ICC Digital Trade Conference. No title. <https://app.swapcard.com/event/icc-digital-trade-conference-2022/plannings/RXZ1bnRWaWV3XzMzNjAxMw==>. Accessed: 2022-7-22.
- [4] Allen Dennis. *The impact of regional trade agreements and trade facilitation in the middle east and north Africa region*. The World Bank, January 2006.
- [5] Islam El-Nakib, Charles Roberts, and Gary Colquhoun. Can egypt enhance freight logistics with comesa?, 2009.
- [6] K A Helmy, M Y Elmokadem, A Bary, and M El-Sayeh. The impact of logistics performance on competitive advantage: The case of freight transportation in egypt. *Journal of WEI Business and Economics* April, 7(1), 2018.
- [7] K A Helmy M Y Elmokadem A Bary and M El-Sayeh' The impact of logistics performance on competitive advantage: The case of freight transportation in egypt. *Journal of WEI Business and Economics* April, 7(1), 2018.
- [8] F. Ibrahim. <https://naqla.xyz/index.php/2022/03/07/egyptian-logistics-platform-naqla-raises-10-5-million-in-pre-series-a/>. Accessed: 2022-7-22.
- [9] Tarek Ismail and Amira Fouad Ahmed Mahran. The relationship between logistics performance and customer loyalty in manufacturing companies using (3PLs) services in egypt. *The Academic Journal of Contemporary Commercial Research*, 1(1):38–74, December 2021.
- [10] PWC. <https://www.pwc.com/gx/en/transportation-logistics/publications/africa-infrastructure-investment/assets/egypt.pdf>. Accessed: 2022-7-22.

- [11] Dr. Emad El Saey. Logistawy – supply chain influencer. <https://logistawy.com/>. Accessed: 2022-7-22.
- [12] R Safadi. *MENA Trade & investment in the new economy: [the Fourth Mediterranean Development Forum MDF4]*. Cairo: The. American University in Cairo Press, 2003.
- [13] Samir Saidi. Freight transport and energy consumption: What impact on carbon dioxide emissions and environmental quality in MENA countries? *Econ. Change Restructuring*, 54(4):1119–1145, November 2021.
- [14] El Sayed, M. S., and El Garhy A. https://www.aast.edu/pheed/staffadminview/pdf_retreive.php?url=17675_153_12_INVESTIGATING. Accessed: 2022-7-22.
- [15] technavio.com. 3PL market in egypt by end-user and service - forecast and analysis 2022-2026. <https://www.technavio.com/report/3pl-market-industry-in-egypt-analysis>. Accessed: 2022-7-22.
- [16] Egypt Trade. Egypt - trade agreements. international trade administration | trade.gov, 2021.
- [17] Trella.app. No title. <https://trella.app>. Accessed: 2022-7-22.