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Blockchain as a solution for transparency in food supply chain

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Abstract
Besides other fields that Blockchain can be really useful for, the food supply chain is one that can be updated and brought to modern standards. The proposed solution is a Blockchain based solution for food tracking. The farmers that do the harvest for a food product will use a special app to generate a Decentralized Identifier for that specific batch just harvested. When the products are put in sale for the consumers in the supermarket, a QR code containing the Decentralized Identifier for the batch will be attached to the price bord. With the help of a special mobile application the consumer will be able to scan that QR code and get all the information about the product, all it's journey until arriving at the supermarket. With the app and the Decentralized Identifier scanned, a request to the Blockchain is made and the data is shown to the consumer.

Keywords: *blockchain, decentralization, trust, transparency, supply chain*

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I. INTRODUCTION

Blockchain is one of the key technologies at the moment, very intriguing and with the ability to revolutionize many domains and improve our lives. Now it is still the beginning of this new era and so there is a lot of space for research and new ideas. Besides other fields that Blockchain can be really useful for, the food supply chain is one that can be updated and brought to modern standards.

Nowadays people simply buy their food from the supermarkets not knowing exactly it's origin. It is a difficult process to keep the track of food with every step it takes before arriving in different forms at the supermarkets. There are many entities involved in the food supply chain: farmers, processors, warehouses, distributors, retailers. Some of them even have paper records, which make the food tracking time consuming. But still the food origin is extremely important for consumers, who want to know all the details and also in case of an emergency, when food incidents appear it is vital to quickly identify the affected batches [1].

A food incident is when there are concerns about the safety of a food product and action may need to be taken to protect consumers. Eating contaminated food can lead to foodborne illnesses which are usually infections caused by bacteria, viruses, parasites or chemical substances entering the body. Foodborne pathogens can cause severe diarrhea or even more dangerous diagnosis like meningitis. Chemical contamination can lead to acute poisoning or long-term diseases, such as cancer [2]. An estimated 600 million people, almost 1 in 10 people in the world, fall ill after eating contaminated food and 420 000 die every year [3]. Food poisoning appears when food carries dangerous germs or toxins. Salmonella is the most common cause of hospitalization due to food poisoning in the United States with over 19,000 cases per year [4]. This pathogens can get into food through: improper food handling, unsafe practices on farms, contamination during manufacturing or distributing, contamination in stores.

Now with the way the supply chain works it can take up to a week to identify all the food from a batch that was detected to be contaminated and take it out of sale. This can lead to delays and the consumers can continue to buy affected products if these were not quickly withdrawn. The supermarkets can also decide, as a consequence to a food incident, to throw all the products of a type as a precaution and in this case many good products are being wasted. This is were blockchain can be very helpful. Using Blockchain to have a trusted, transparent, digital food record means identifying the contaminated batches within seconds [5].

Over the past few years there've been a lot of scandals in the food industry and therefor today consumers no longer trust what they are buying. The source of the products has been many times modified by the retailers to obtain a higher price and consumers have been fooled. Because of this many food producers that are actually making concrete efforts to source locally and ethically are not trusted by the consumers. So, a tool that is able to gather information and to showcase it to the consumer is needed also from this perspective [6]. With the way it was conceived, it's records cannot be modified or deleted and this means that can be trusted.

This paper shows how blockchain can help improve the transparency in the supply chain.

1.1 PROPOSED SOLUTION

The proposed solution is a Blockchain based solution for food tracking. Every step in the food supply chain for a product will be set properly in the Blockchain registry. Each batch of the same assortment of food will have it's own unique identifier in the Blockchain and all it's journey from the farm to the supermarket will be documented.

For the proposed solution there are used some Blockchain concepts known especially for their utility in the Identity Management domain, on Self-Sovereign Identity: Decentralized Identifiers (DID's) and Verifiable Credentials (VC). Decentralized Identifiers (DID) are unique identifiers generated by the Blockchain with a specific method, DID Method Create. Verifiable Credentials are the digital representation of credentials, which contain certifiable information about a subject. In the case of the food supply chain, every batch of a food aliment will have it's own Decentralized Identifier. Verifiable Credentials for a batch will be generated on it's way to the final destination using the initially given unique identifier. Many Blockchains have already the tools to ensure the use of Decentralized Identifiers and Verifiable Credentials because of their proved utility in de identity management, so only adapting them to fulfill the needs for food chain will be necessary [9,10].

For this research, in the food supply chain, there were added only three entities: farms, distributors and retailers (supermarkets) that manage the food product. In other cases, there can be other entities involved or can be more than one distributor, but for example porpoises of the idea, the prototype created it is enough. For every other entity involved the process is similar to the one described further in the article.

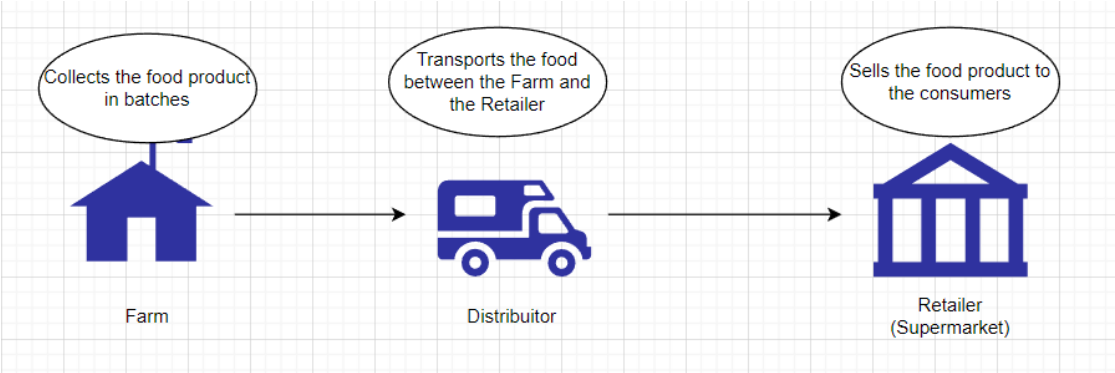

Figure1: Entities involved in the supply chain

Also, because only the farm and the distributor are handling the food until it's arrival at the supermarket, it means that the product is one that is not processed. It could be a fruit or a vegetable, but also a meat type, seafood or others but in the same spirit, in their raw form. The model can be adapted to include food processors, but the main idea remains the same.

So having taken into consideration the above mentioned initial hypotheses, the first step for a food product is at the farm, where it is being harvested in case of fruits or vegetables. When the farmers do the harvest for a food product they will use a special app to generate the Decentralized Identifier for that specific batch just harvested. Besides generating the Decentralized Identifier, that will serve as unique identifier for the batch all it's way until it will reach the consumer, the farmers will also create a verifiable credential that contains the details about the product: type, date of the harvest, location of the farm, information about the farm and the product. A QR code having inside the Decentralized Identifier will be attached to the batch after the DID and VC generation [11]. From that moment the QR code will accompany the product and it is mandatory to have it. All the other entities involved in the supply chain will scan that QR code in order to add new Verifiable Credential to that batch of product.

The day the batch lives the farm taken by distributor the farm will generate another verifiable credential that will contain the day of leaving the farm and the name of the distributor. The distributor will generate a verifiable credential as well with the route that the products were taken, the vehicle registration numbers, the driver's names and all the details of the shipping.

At the arrival of the batch to the retailer, the supermarket will generate another verifiable credential with the date of the arrival and some details about the conditions, the state of the food products, their compliance. This is an example, of course a shipping can have more then one distributor, but similar for each one will be a verifiable credential generated.

When the products are put in sale for the consumers in the supermarket, the QR code containing the Decentralized Identifier for the batch will be attached to the price bord. With the help of a special mobile

application the consumer will be able to scan that QR code and get all the information about the product [12]. With the app and Decentralized Identifier scanned, a request to the Blockchain is made and the data is shown to the consumer. The data is containing the expiration date, raw material harvest date, information about farm, distributor, about all the entities that manipulated the product in it's way to the supermarket. There are some information that will not be shown to the consumer like the name of the drivers on the transportation vehicle and others not relevant, technical details, these ones are kept only for evidence in case of a food incident.

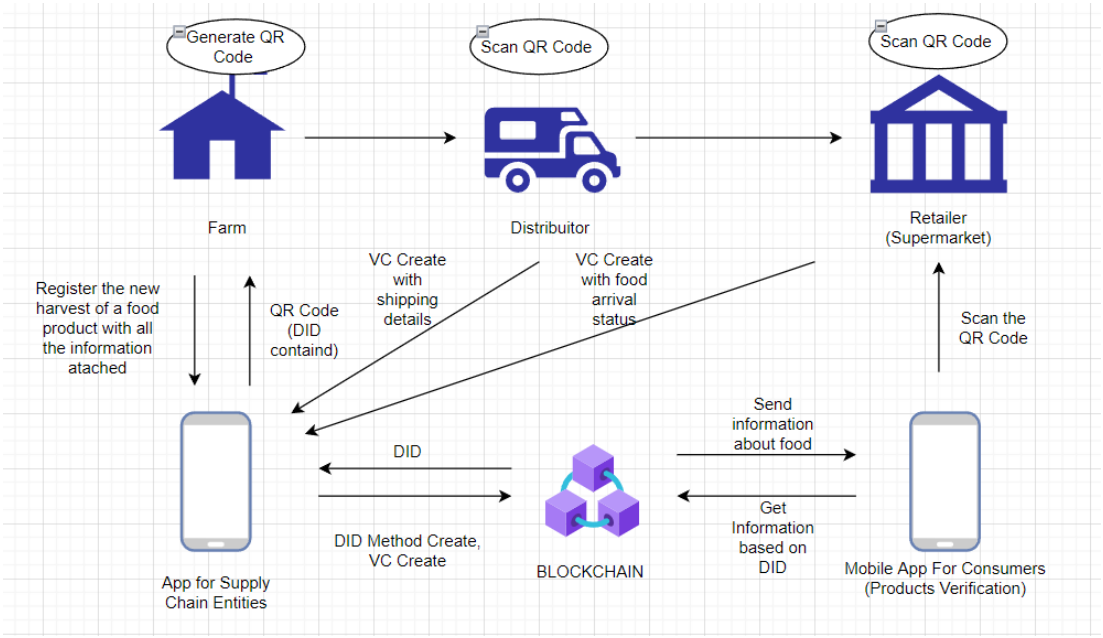

Figure 2: System for transparency in food supply chain components

Consumer now can see the whole history of the product: where does it come from, where is it grown, but also the journey right through to the manufacturing plant. All this information is specific for each batch of product so each time the consumer will scan the product it will not receive the same story.

II. CONCLUSION

The digitalization of the Food Supply Chain is a necessity in a modern society and the most important it is mandatory to ensure the health of the consumers. Blockchain is the right technology for the Digital Food Supply Chain, because it brings the needed trust in data and also brings transparency for the food tracking.

Blockchain establishes trust as the data usually is stored in time-stamped, tamper-proof, immutable, and chronologically connected blocks secured with cryptography and distributed in several nodes. Because the data is distributed and there is no central authority or third party, the process is completely transparent, the stakeholders could rely on the data provided and trace the product from the very beginning.

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