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Design of Taxation System Based on Blockchain Technology

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Abstract—Blockchain technology is becoming a revolution in the area of the internet. It is considered a driving force behind the next generation of the Internet. It is an unchallengeable and decentralized database that facilitates transparent and auditable management of data over a distributed network. It has the ability to transform industries and services including tax management system. We suggest that the decentralized and programmable nature of the blockchain applications can be used to improve the tax management system to gain greater efficiency in this system. The current indirect tax management system in India is complex and requires to do some activity offline. It also has an overhead of return filing. The blockchain can potentially solve these issues. The use of the blockchain based distributed ledger and smart contracts can reduce the administrative burden for accounting services and there is no need to do anything offline, everything will be done online during the tax payment itself. Using the blockchain, all the transactions are done in real time, therefore no return filing is required. The blockchain technology has the advantage that all the transactions are transparent and tamper-proof reducing any system fraud.

Keywords— Blockchain, Distributed Network, Real-time, Smart Contract, Hash Function, Goods and Services Tax

I. INTRODUCTION

Blockchain can be utilized to make the taxation system simplified. In this case, this Goods and Services Tax (GST) that all we know that, it is an indirect tax which covers various goods and services provided by different kind of service providers or vendors, during the production and the service stages. GST is levied on different goods or services that we procure. GST has broadly two components; the state GST (SGST)/union territory (UGST) and a central GST (CGST). The entire workflow of GST collection and GST management is very complex. Now, see how blockchain can help us in this particular perspective of managing this entire tax management system with the help of a decentralized ledger platform (one of the features of the blockchain).

The tax structure in India is a three-tier federal structure [1]. The government of India (Central Government), all state governments / Union Territories, and local municipal bodies make up this structure.

Types of taxes in India: The tax system in India allows for two types of taxes—Direct and Indirect Tax.

- ***Direct Tax:*** Direct Tax is a type of tax which is levied directly on corporate entities and individuals. The direct is such type of tax which cannot be paid by others or cannot be transferred to anybody else. While considering direct tax, we include income tax, wealth tax, gift tax, capital gains tax.
- ***Indirect Tax:*** Indirect taxes are taxes such taxes which are indirectly levied on the people through selling goods and services. The sellers of the goods and services are supposed to collect the tax which is then submitted to the government bodies by these sellers.

Tax Collection Bodies: In India, there are three bodies which collect the taxes. These tax collecting bodies have clearly defined the guidelines on what type of taxes they are permitted to collect.

- The Central Government: income tax, customs duties, central excise duty
- The State Governments: a tax on agricultural income, professional tax, stamp duty, value-added tax, state excise duty
- Local Bodies: Local bodies, like municipal corporations, waterworks, stamp, and revenue department collect house tax, water, and sewage tax, property tax, etc.

GST: In India, there were three government bodies which were responsible for collecting direct and indirect taxes until 1 July 2017 before the implementation of Goods and Services Act [2]. The GST includes many of the indirect taxes levied by the states/ union territory and the central

government. Some of the taxes GST replaced are given below in fig. 1.

a)

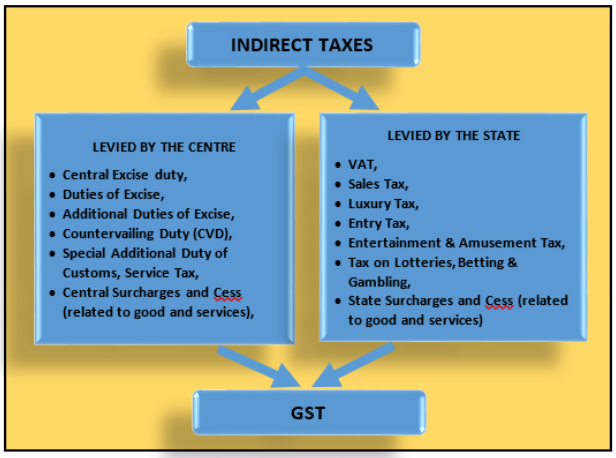

Figure 1: Types of taxes GST

In fact, GST is a multi-level destination-based tax. Multi-level means, because it is levied on each level of the supply chain right from the procurement of raw material to the sale of the finished product to the end consumer. During these levels whenever there are value addition happens during the transfer of ownership, GST is applied.

The GST is also applicable to destination-based selling and purchase because the final purchase is the place from government collects GST. If a Chair is manufactured in Lucknow but sold in Dehradun, then the Uttrakhand government collects GST.

GST has three components [2]:

- CGST-CGST stands for Central Goods and Services Act. The central government collects this tax on an intrastate supply of goods or services.
- SGST: Stands for State Goods and Services Tax. The state government collects this tax on an intrastate supply of goods or services.
- IGST: Stands for Integrated Goods and Services Tax. The central government collects this for the inter-state sale of goods or services.

The GST is made up of two parts; the central GST and the state GST, so for example if the GST for Television is 18 percent then the central GST is nine percent and the state GST is also nine percent.

GST is said to be the biggest tax reform that has occurred in post-independence India. It is one nation and one indirect tax which has been levied indirectly on people. As we do not have to pay GST directly to the government but we charge from someone and then we pay. For example, if we purchase any commodity from the market, we pay GST on that commodity to the shop owner that shop owner pays it to the wholesaler that wholesaler pays it to the manufacturer and finally manufacturer pays it to the government. Therefore, this tax called as an indirect tax.

II. RELATED WORK

The blockchain itself is for many industries people think it is going to be completely transformative [3]. People are looking at blockchain for all sorts of applications be it financial services, public sector, retail, insurance, supply chain and logistic, media, healthcare [4][5], and IoT [6], and electronic voting [7], etc. Almost every industry, including business management [8] is looking at how blockchain would make a difference for them. The use of blockchain technology is very important for developing countries, like India [9].

A. Features of the Blockchain useful for Taxation System

There are some exciting blockchain features [10] which are very useful for developing taxation system. These features will make the taxation system more efficient, more reliable and more transparent and secure.

a. ***Decentralized:*** The network is decentralized, means it is a distributed system which does not have a single authority (government or person) looking after the network [11]. Perhaps, a group of nodes maintains the network making it decentralized. This is one of the key features of the blockchain technology that works perfectly and makes the system less prone and breakdown means more reliable.

b. ***Public Ledger:*** Local data available with the individual node is called a public ledger. This is an important term in the context of the blockchain, the concept of the public ledger. The public ledger is something like everyone possess his or her own copy of data [12]. If we think of a database system, a database is nothing but a collection of historical information which is available to everyone. Public ledger works like a database where it contains this kind of historical information which is available to inform everyone and this historical information can be utilized for future computation Public ledger will make the taxation system more transparent.

c. ***Security:*** As there is no central authority, anybody can change information. So, it needs to be more secure. Blockchain technology makes the system more secure with the help of cryptographically secured hash function and the concept of digital signatures [10],

which work as the fundamental building block behind the blockchain technology.

The individual blocks of a blockchain are connected with each other through some hash function. Whereas the digital signature is used for making the blockchain tamper-proof, this means suppose somebody makes a transaction, then he or she will not be able to deny that the transaction has not been made by him or her.

III. METHODOLOGY

A. Blockchain Technology and its Description

The blockchain technology actually came from the financial sector, i.e., the concept of digital currency [13]. There are tremendous applications of blockchain technology along with multiple other concepts. Let us come to the basic concepts of the blockchain. The blockchain is a decentralized computation and information sharing platform which enables multiple authoritative domains which do not trust each other in order to cooperate, coordinate and collaborate in a rational decision-making process. The keyword is decentralized, that is an important aspect of the blockchain. The blockchain is a decentralized database which helps in cooperation between several authoritative domains. The terminology of several authoritative domains is another keyword. The technology is mainly suitable when several parties or individual want to cooperate with each other, and they want to come to a common platform to share the information among themselves. They can cooperate, coordinate and collaborate in the application development process at the business intelligence process.

Think about the blockchain as a public database that is maintained consistently by a number of nodes in a network or system and that nodes do not rely on one another. We realized that by using blockchain technology many of the Internet services [14] that we use today can be implemented. At least most of them and so think about a social network without Facebook, think about renting a cab from a mobile app without Uber or Ola, think about renting a place for your holidays without Airbnb. So what we are mentioning is that, think about a service without anyone in between the service owner and the user of that service. This is amazing because this is exactly the problem that blockchain technology tries to solve which is centralization and so blockchain technology has been designed to provide Internet services in a decentralized way.

B. Blockchain Technology Applications

Before we apply this technology to any use case, first we think about what makes a good blockchain use case and what the common tenants of a blockchain use case are? And it is may not always be easy to using blockchain when it is not supposed to be used. We should not try to solve a problem that does not exist for anyone. A blockchain use case can be identified as a business problem that cannot be more efficiently solved by any other technologies, a business network with people, assets and transactions, or where a need for trust is required.

The blockchain is recommended to be used with use cases which we assume can be solved in a better way using blockchain than that of solving them with any other technologies. As well, there has to be a network of participants involved in some type of transaction or exchanging of something. And certainly, a need for trust among participants is required. If trust is not needed and every participant in the network, trust a single participant with all the information, all the transactions, then probably there is no need for blockchain for that use case. Therefore, it has to involve multiple participants, who do not trust each other but need technology such as blockchain, to install trust.

A tax system is of the type of use case which can be implemented by using blockchain. Because we assume that blockchain can implement a tax system in a better manner than that of other existing technologies. The tax system has a business network. It has a set of participants and promises some information that these participants are exchanging. And certainly, there is a need for trust and security in this system.

C. Possible Challenges And Proposed Solutions For Adopting Blockchain Technology For Taxation System

Let us start with an example; say, we want to purchase a pair of shoes. Now whenever we want to purchase a shoe, it has multiple workflows at the various stages of the production. So, initially, the tanner needs to produce leather. Once the leather has been produced, then these leathers come from the vendor. We require other raw materials for producing a shoe; like textiles, synthetics, rubber, and foam, etc., all these at different stages. Now, the production of the primary material starts followed by components of shoe production and finally finished shoe production. These finished shoes then go to some shopping center or some shopping mall, from where we purchase a pair of shoes.

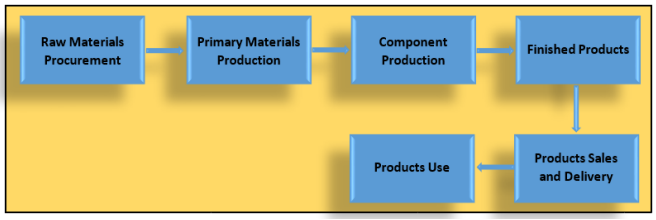

Figure 2: Stages of production of goods

Now, the question comes that at different stages of this production how the government will levy a tax on individual components. This GST although makes this taxation process more governed. But the entire stages are bit complicated. Say for example, what happens that whenever the tanner is selling the leather or vendors are selling the other raw materials, they are providing a certain tax to the government then the production house which converting the raw materials to the primary materials for shoes, they are levying certain taxes. There are companies which are producing components for shoes, they are levying certain taxes. And that way whenever the entire shoes are being produced by another company, which are purchasing these raw materials from different other vendors or different other companies, they are providing individual taxes to individual companies. And all these things are getting added to the price of our shoes. Now, whenever we are purchasing the shoes, during that time we also provide a certain tax on the base cost of shoes. In GST, the idea is that this tax is levied at every stage of the production, but ultimately only the final consumer will provide or they will give the entire tax. And the intermediate tax will be refunded back to the corresponding production house and the corresponding companies.

So, for example, whenever a company is producing raw materials, and they are using that raw materials, or they are selling the raw materials to some shoe company, in that case, the tax which is already levied on the raw materials that will get refunded back; because the entire tax will then will be levied on the final customer or the final consumer which who is consuming the shoes. So, it is just like that the final consumer who is consuming certain goods or certain services, they will provide the tax, not the intermediate one who are providing or who are actually collecting that raw materials and producing the shoes.

The GST is levied at every step in the production process [1]; however, it is refunded to all parties in the chain other than the final consumer. So, the final consumer will pay the entire GST; whereas, the intermediate production houses and the companies, the intermediates at the chain, they will get refunded of the amount of GST that they produced, or they provide whenever they purchase the raw materials.

Then again, the entire things become complicated, because the collected GST over a particular product, that is getting distributed among the state government and the central government as per the Indian GST rules. For example, if the initial raw materials were produced in Uttar Pradesh, then the Uttar Pradesh government is subjected to get certain tax out of it, from that state component of the GST, the SGST component. On the other hand, the central gets its own component of the GST which is the CGST of the central component of GST. This way whatever tax amount is being collected from the entire GST procedure that needs to get distributed among multiple states and the central government. And this makes the entire procedure very complicated.

D. Implementation of Blockchain in Taxation

Let us see that without the blockchain environment how this GST system works. Whenever we purchase certain things, a GST Invoice is issued by the seller. We (the buyer) pay that bill along with the GST. This information about the GST is entered by the seller to a GST portal that this amount of GST is collected, say, over a fortnight and the seller pays this entire collected amount to the government. At the same time, it happens that the seller is actually working as a production house just like a shoe company which is purchasing multiple raw materials. And whenever they are purchasing the raw materials, the seller also pays certain GST to the suppliers. That way there is a kind of loop. Everyone in the production house, they collect a certain amount of GST and this entire amount of GST goes to the government. Now the task of the government is to make this huge calculation like which part of the GST needs to be refunded back to the intermediaries of this production chain, and which part would be finally, collected and get it distributed among the central government and the state governments. This entire adjustment is done by the government employees who are connected with this tax department. The government tax department has to manually do this entire calculation or with the help of certain software. After doing the calculation they may adjust the amount of GST at individual production stages, and the entire final amount which is being collected gets distributed among the state governments and the central government.

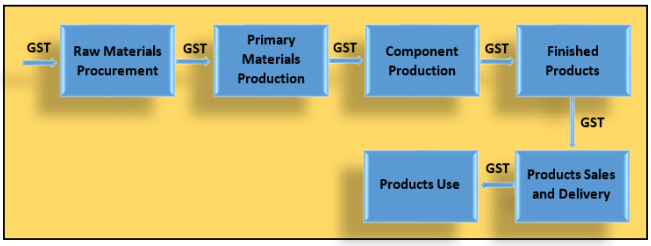

Figure 3: GST at various stages of production of goods

Now, as we see that in this entire process, there are multiple parties, who are involved in this entire process and this type of use case is good to be handled with blockchain technology, because in this use case of the GST system, there are multiple authoritative domains or multiple parties who inherently do not have a trust relationship but they want to come to a common platform. Here we can see that all these individual parties are actually relying on the government. It is not like that certain kind of double spending is happening for the same pair of shoes. It is like that the same pair of shoes when it is sold as a raw material during that time

certain taxes are levied, and whenever it is sold just like a pair of shoes that is another component of the tax is levied.

The complication comes here that everyone needs to trust to the government at least that, whatever adjustment will be there at the intermediate steps of the production, that amount payable will get adjusted, and that will transfer back to the individual organization or the individual companies. This is done by companies that submit GST refund form through which they will get refunded after doing tax adjustment. The tax officers' task is to calculate all these things and then adjust it accordingly.

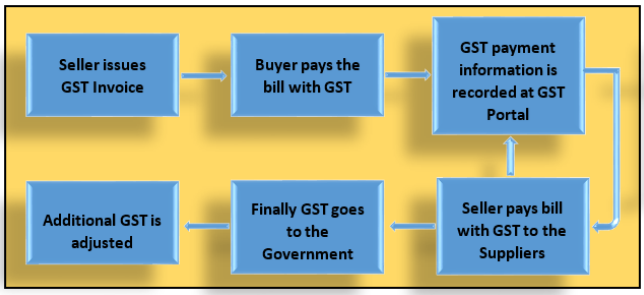

Figure 4: GST without Blockchain

Now in this entire process, there are multiple authorities or administrative domains who are getting connected. And we need to have a trust relationship that whatever additional amount we are paying will be returned back. It is just like that if we are giving the tax to the government then whatever tax we have paid for purchasing the raw materials that will come back to us.

This kind of trust relationship is there and based on this trust relationship the entire GST model works. But what if this trust relationship breaks? So, under this kind of scenario, blockchain can be a platform where we can make a simplification of this entire tax payment process; where all the things will be done automatically with the help of a smart contract [15].

Let us see how it happens whenever we have this blockchain environment, or how we can make this entire process simplified with the help of a blockchain. The GST invoice is being issued by the seller, and the buyer pays the bill with GST. The seller then pays it to the suppliers, and all these payments they are done now with the help of the smart contract platform. This smart contract platform is there in the blockchain environment. The smart contract platform automatically calculates this tax with the help of business executable codes, called Smart Contract, written in any one of the languages; Solidity, Go, JavaScript, C++, Python, etc. because the entire thing is a mathematical calculation based on from where the goods are coming, from where the raw materials are coming, how that raw material is being utilized, and at what level of the production process the taxes are being collected. This entire procedure can be managed with the help of the smart contract [15].

The smart contract will have this set of codes, and that set of codes will automatically get executed by checking that who is paying what, and at what step of the production stage, whether he/she is the person who finally consumes the service or the good, or he/she is an intermediary consumer. The entire chain can be controlled with the help of a smart contract by writing a certain set of codes as per the rules and regulations of the GST Act. This smart contract can automatically do all the adjustments also. If we have purchased certain raw materials, and utilize that raw materials for producing a pair of shoes, then this smart contract will find it out and accordingly do the tax calculation and the additional amount that we have paid for a purchasing the raw materials, that can automatically get adjusted. And the remaining amount which is the actual taxable amount can be directly credited to the account of the government. By this way, the entire process is simplified, and done in real time.

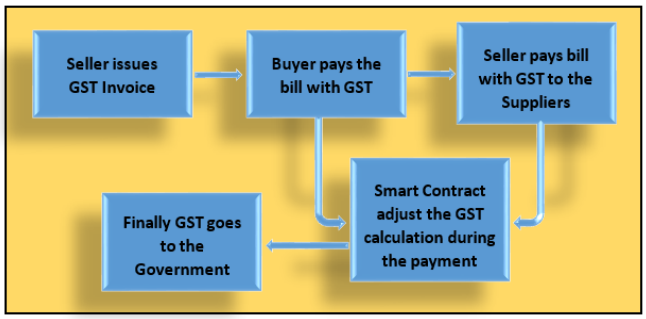

Figure 5: GST with the Blockchain

IV. RESULTS AND DISCUSSION

A. *Key Benefits of Using Blockchain in Taxation System*

That way the blockchain can make this entire process very simplified and at the same time reliable and secure.

a. ***Reliability of The Tax System:*** Reliable in the sense like whenever it is just like that once we have already paid the tax, we need to wait a certain amount of time to get it adjusted. Because the government tax authorities will check the entire ledger, they will find out whether there are certain discrepancies or not, and accordingly, they will find out whether the refund claim that we have made is legitimate or not and then they only will initiate a transfer. But here in the smart contract, everything can be verified automatically in real time. That is the first advantage.

b. Security of The Tax System: The second advantage comes from the fact that it becomes very difficult to fraud anything. Because if we want our tax to get refunded so whenever we are purchasing something say the raw materials, the suppliers say that we purchased raw materials, and during that time we paid a certain tax. We assume that those suppliers are not fraud. And they have to pay the tax there. Now, whenever we are selling the product and if we are not making a correct entry to the blockchain, first of all, we are the person who may have certain kind of loss in terms of the amount that we provided for taxation purpose to the suppliers. On the other hand, the interesting fact comes from this point that this entire entry needs to be there in the blockchain. All the entries are recorded in blocks of the blockchain. All the blocks in the blockchain are connected with the help of cryptographically secured hash function. And all the transactions are made by using a digital signature.

No one will be able to tamper with these entries. It will also give a nice record of all the stages in the production for auditing purpose. The auditing becomes very easy in this case. That way the blockchain can simplify this entire process of tax regulations from manifolds.

The advantage that we have here, during the payment of GST, the blockchain smart contracts can calculate the invoice, based on the tax amount that is already levied during the production process. The smart contracts directly transfer the tax amount to the tax authority, if it is SGST, it transfers it to the state government, if it is CGST it transfers it to the central government, and the refund if any is directly paid to the customer's account. It is not like that we have to wait for a refund, and this entire audit log is there which can be verified to check the correctness.

V. CONCLUSION AND FUTURE SCOPE

The advantages of using blockchain technology that we have here, first of all, the administrative burden for accounting services that is drastically reduced. We do not need to do anything offline, everything will be done online during the payment itself. All the transactions are done in real time. As such no return filing is required, or return filing can be avoided. And the third advantage that we have that all the transactions are transparent and tamper proof. Everyone can validate the transactions, that how these individual goods have been moved from different stages of the production house. It makes the life of auditor very easy. It reduces the chances for fraud and mistakes that may happen. And finally, the auditor will be very happy, because they can see everything from the transaction log, during the auditing time and they can verify whether some frauds have happened or not. Indeed, the smart contact platform itself will help us to prevent many of the frauds or mistakes that can happen during this entire production process.

Smart contracts can be written to implement the proposed tax management system in the blockchain environment. Some other use cases can be tried to implement using the blockchain.

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