

White Paper
On
SeizeChain: An Approach to Secure the Seizure
Procedure

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Abstract

Since its inception, smuggling has been a major concern for Bangladesh, which is not a rare thing in many other densely-populated countries all over the world. To tackle smuggling, law enforcement officials seize goods from the border areas regularly. Following the seizure of goods, particular procedures are conducted based on the nature of the seized or confiscated goods. The existing system for seizing goods and managing their records is entirely manual. A potential loophole of this manual process is that there remains a possibility of getting the seized goods and associated records changed during the overall seizing and managing process, which we confirm through our field studies with domain experts. To address this issue, the technological intervention appears to be a solution removing the manual processes that appear to be vulnerable to the potential loophole. Here, traditional client-server-based technologies are likely to be less appropriate, as a loophole-less seizure process demands immutability, consensus, security, faster settlement, etc. These aspects leave us with only one option of adopting Blockchain. Accordingly, in this study, we have proposed a novel system for the border seizure process by leveraging Hyperledger Fabric, a permissioned blockchain. Our proposed system brings together all of the stakeholders involved in the seizure procedure, such as the BGB, the police, and customs, and will equip all of them with the necessary technical support to conduct the seizure more efficiently and securely from their responsibility perspectives. Our system is designed to track confiscated products from the beginning to the end, i.e., the time they are seized until the time they are destroyed. Additionally, in our system, we adopt QR codes using QR code generating devices and utilize them as labels for seized goods to facilitate tracking of the items throughout their lifetimes as seized ones.

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Current Scenario

Bangladesh is a country bordered on three sides by India. They share a 4,096 kilometers long international boundary, making it the world's fifth-longest land border [1]. Additionally, it shares a border with Myanmar. The border is guarded by BGB (Border Guard Bangladesh). One of their responsibilities is to stop the smuggling of goods. The smuggling is mostly one way, from India to Bangladesh [1] or from Myanmar to Bangladesh. Among the smuggled goods, there are clothes, cattle, cellphones, and drugs like Phensedyl, Weed, Yaba, etc. In January 2022, BGB confiscated narcotics worth more than 2 billion BDT [2].



Fig. 1) BGB out on regular patrols. 2) BGB team with seized drugs

The current process of seizing goods starts with setting out on patrols. There are two types of patrols, regular and special. Teams of 5-6 members set out on regular patrols in the border areas. Additionally, they have informants. When informants provide information on smugglers, special patrols are conducted. After seizing the goods, they are delivered to the patrol team's sector. They are now processed according to the nature of the good and whether somebody was comprehended or not. If the seized goods are not harmful and have monetary worth, such as clothing, cattle, gold, or illegal money, they are handed over to customs. If an individual is apprehended with the goods, customs will create evidence from the goods and present it to the police. Following that, they hold auctions attended by representatives of the BGB, police, and civil service. The goods are sold off and the money is deposited into the national treasury. Now, when someone is caught with the goods, the BGB hand them over to the police and files a case. If the smuggler got caught for smuggling drugs like Phensedyl, Yaba, Weed, etc., that too is handed over to the police. If no one is apprehended, BGB stores the drugs for a period. Following that, the BGB establishes a board comprised of higher authorities, including senior officials, magistrates from the civil service, etc. They crosscheck the records of the seized goods and destroy them, usually by setting them to fire. When the drugs are handed over to the police, they also follow the same approach. They also preserve some of the seized goods as proof to present before the court.

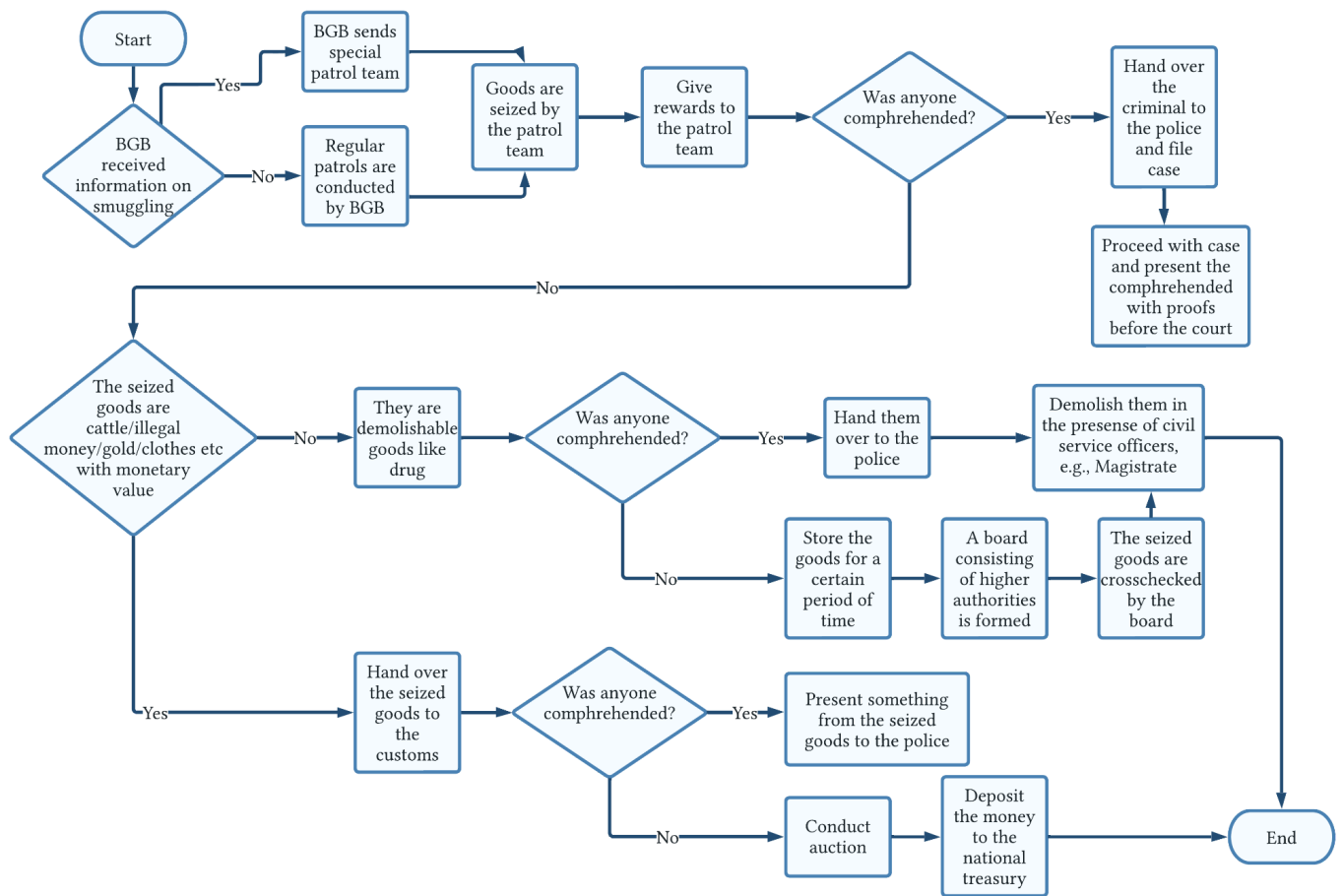


Fig. Current seizure procedure

Problem Identification



Error prone record keeping system



Difficult to maintain manual records using pen and paper



Seized goods and their records are easy to alter



Difficult to cross-check records when one party receives seized goods from the other

Impact of the Problem

The impact of the existing system's problem can be analyzed from the following perspectives, which we shall address briefly.

- **Social impact:** One of the most seized goods is a variety of drugs. If the seized goods get altered easily, these drugs will be spread throughout the country. Drugs will be more available causing

drug abuse. The current process is vulnerable to corruption. There are chances that corrupted officials collaborate with potential smugglers. Thus, this might make younger people in the border areas get involved in smuggling.

- **Business impact:** In the current system, the seized goods and their records can be altered easily. When corrupted officials alter the goods that are expected to be sold in an auction, the national treasury doesn't get the money as expected. Moreover, smuggled goods hamper the amount of tax collected. BGB members are rewarded when they seize goods and it depends on the quantity of the goods. In the current system, it is easy to either make mistakes in maintaining recordings or alter them to demand more reward than one deserves.

Solution

Proposed System

After the BGB patrol team seizes things, they will record the details of the seized goods in the ledger. A smartphone application and a portable printer will be provided. The app will be used to generate a QR code and record all the information. The QR code will be attached to the seized goods. The QR code will contain all the information about that consignment. For instance, if one hundred cows are confiscated, a new record will be created, a single entry for the hundred cows. Each cow will be tagged with an identical QR code. The seized goods will then be transported to the sectors where they will undergo cross-checking and be stored. Here, the user will add a new entry. Additionally, they will scan the QR codes included on the confiscated items. Discrepancies will be immediately reported to a higher authority if they are discovered. Similarly, when customs, police, and magistrates receive the goods, they will create new entries. The life cycle will end when the goods are destroyed under the supervision of the magistrate or sold at auction by the customs. Consequently, they will add a new entry to the ledger. The higher-ranking authorities will have read permission and be able to prepare reports in a variety of timeframes.

Why Does This Work?

Our proposed system would monitor seized goods throughout their entire lifecycle. Due to the immutability of the records, it will be impossible to alter them. Even if someone alters the items after receiving them, the other system participants will hold them accountable. Suppose, for instance, that the patrol team captured 100 cows and accurately entered the data into the system. After receiving the cows, the sector commander of the BGB chooses to keep one for themselves. Now, if they report receiving 99 cows, the higher authority monitoring our system will notice and investigate both the patrol team and the sector commander. If they take one and report receiving 100 cows, they will be detected later. Therefore, modifications will be impossible. As we are introducing QR codes, the documents will be easily accessible. Thus, a robust digital system will replace the manual system which will make it easier to maintain the records.

Why Use a Blockchain-Based System?

We have chosen a blockchain-based solution instead of using a traditional database-based application because of the data immutability property of blockchain. In a database based system, it is easy to manipulate the data by those who have access to the system. When the seized goods are being handed over from one entity to another, there is a chance that the receiver steals some of the goods from them and manipulates the database. But in a blockchain based system, it is not possible to manipulate the data. Even if they alter the goods they will be held accountable as the data won't match with the previous records. We have answered the questions from this [Figure](#) to answer whether we need a blockchain-based system or not.

Market

The BGB is in charge of defending Bangladesh's 4,427-kilometer (2,751-mile) border [\[5\]](#). BGB is divided into five regional headquarters and a central headquarters. Under the regional headquarters, there are a total of 16 sectors. The user of our system will be these sectors of the regional headquarters and the police, customs officers, and magistrates associated with these areas. Thus, our market is more or less fixed. However, we think that if we design our system generically then we will be able to use this technology outside Bangladesh. However, for the time being, we shall design keeping Bangladesh in mind. Each month, BGB seizes goods worth more than 1 billion and it is likely to increase over the years. Thus, the proposed system will be more than necessary to keep track of these goods.





Competition


As far as we are concerned, there is no blockchain-based application that can be used to replace the present seizure procedure. Furthermore, we have not seen any adoption of this technology among the law enforcement agencies of Bangladesh. However, among the available blockchain-based system, we have found two of the following somewhat relevant to our system. Both of them are supply chain systems.

1. **System adopted by Dubai customs:** Dubai customs has adopted a system to get full visibility and traceability over e-commerce supply chains and transactions of companies involved in e-commerce [\[10\]](#).
2. **Seafood supply chain:** There are available applications based on blockchain technology to track seafood. They are traced from the time they are captured to the time they reach the customer's table [\[11\]](#).

Though these two seem similar to our seizure procedure, we can't directly adopt them. We need a private system that will be accessed only by selected organizations. We believe that extensive modification of these applications might be an alternative to our system. So there are no direct competitors and indirect processes may require a lot of modifications. The service we will provide is easy to use and will eliminate the need for manual record-keeping. The only overhead will be for the QR codes that we propose to utilize to strengthen security.

Partners

Partner	Roles	Benefits	Challenges
 BGB	<ul style="list-style-type: none"> - Label seized goods with QR code - Maintain records of the seized goods digitally and let higher authorities verify the data easily 	<ul style="list-style-type: none"> - Keeping records digitally - Digital immutable records will eradicate the necessity of submitting reports to the higher officials - Digital immutable records will help to keep the amount of seized goods un-altered on which their rewards depend on 	<ul style="list-style-type: none"> - Labelling seized goods with QR codes can be hectic for goods like bottles of Phensedyl
 Bangladesh Police	<ul style="list-style-type: none"> - Digitally verify the goods received from BGB - Keep criminal records of the smugglers 	<ul style="list-style-type: none"> - Keeping records of the seized goods digitally - Will help to maintain smuggler profiles grouped by area 	<ul style="list-style-type: none"> - No challenges will be faced in the new system. All they have to do is to keep track of the information digitally instead of the manual one
 Customs Officers	<ul style="list-style-type: none"> - Digitally verify the goods received from BGB - Maintain auction data such as what was sold, what unit, how much was earned, etc. digitally 	<ul style="list-style-type: none"> - Maintaining auction information will get easier - Corrupted officials won't be able to hamper the workflow 	<ul style="list-style-type: none"> - No challenges will be faced in the new system. All they have to do is to keep track of the information digitally instead of the manual one
 Magistrate	<ul style="list-style-type: none"> - Digitally verify the goods received from BGB or Bangladesh Police 	<ul style="list-style-type: none"> - Digital records will make it easier to cross-check the records of seized goods 	<ul style="list-style-type: none"> - Technologically challenged officers, especially the older ones might find it difficult to manage everything digitally

Partner	Roles	Benefits	Challenges
 Regulator	<ul style="list-style-type: none"> - Monitor which sector seized what and the amount of the good - Monitor whether customs is depositing money from the auction properly 	<ul style="list-style-type: none"> - Monitoring will be easy - No external reports will be needed to submit to the regulators. Thus there's no chance of getting altered reports - It will be easy to monitor corruption 	<ul style="list-style-type: none"> - Technologically challenged officers, especially the older ones might find it difficult to manage everything digitally

Risk Analysis

We've devised a mechanism that makes altering seized goods and records almost impossible. Though our system intends to make the current system secure, there might arise some risks that are briefly explained below.

- **Increasing corruption among patrol parties:** The records of seized goods will be immutable. It will be challenging to alter the goods as the records won't be able to change and people, trying to alter them will get caught. However, in order to not get caught, patrol party members, who are the creator of the genesis block, might alter the goods just after seizing them. In later stages, stakeholders who get the seized goods might also get involved with the patrol party, increasing corruption. In order to mitigate this risk, officers of patrol parties need to be under surveillance.
- **Older officers facing difficulties using the system:** Many people from the older generation find it difficult to use newer technology and many high-ranked officials that belong to the regulators are old, we might find it challenging to incorporate the new system. But we believe that this can be overcome by appropriate workshops and training.
- **Partners denying to use the system:** As our proposed system will make it difficult to alter the seized goods, many partners might deny incorporating it only if those partners are influenced by the corrupted officials. However, we believe that the high-ranked officials of our partners are excluded from influence and they will make their subordinate officers use the new system.
- **Costing overhead:** As we will need portable printers to print QR codes, there will be a need for initial investments which might disinterest the partners. Moreover, there will be a lot of data saved, thus the expenditure on the cloud where we will host everything might make the partners concerned.

Architecture

The partners will be provided with client applications (website for the regulator, mobile app for the rest of the stakeholders). These client applications will send HTTP requests to the webserver. The webserver will work as a bridge between the partners and the blockchain network. The high-level architecture can be visualized in this [figure](#). The following operations take place in the blockchain part.

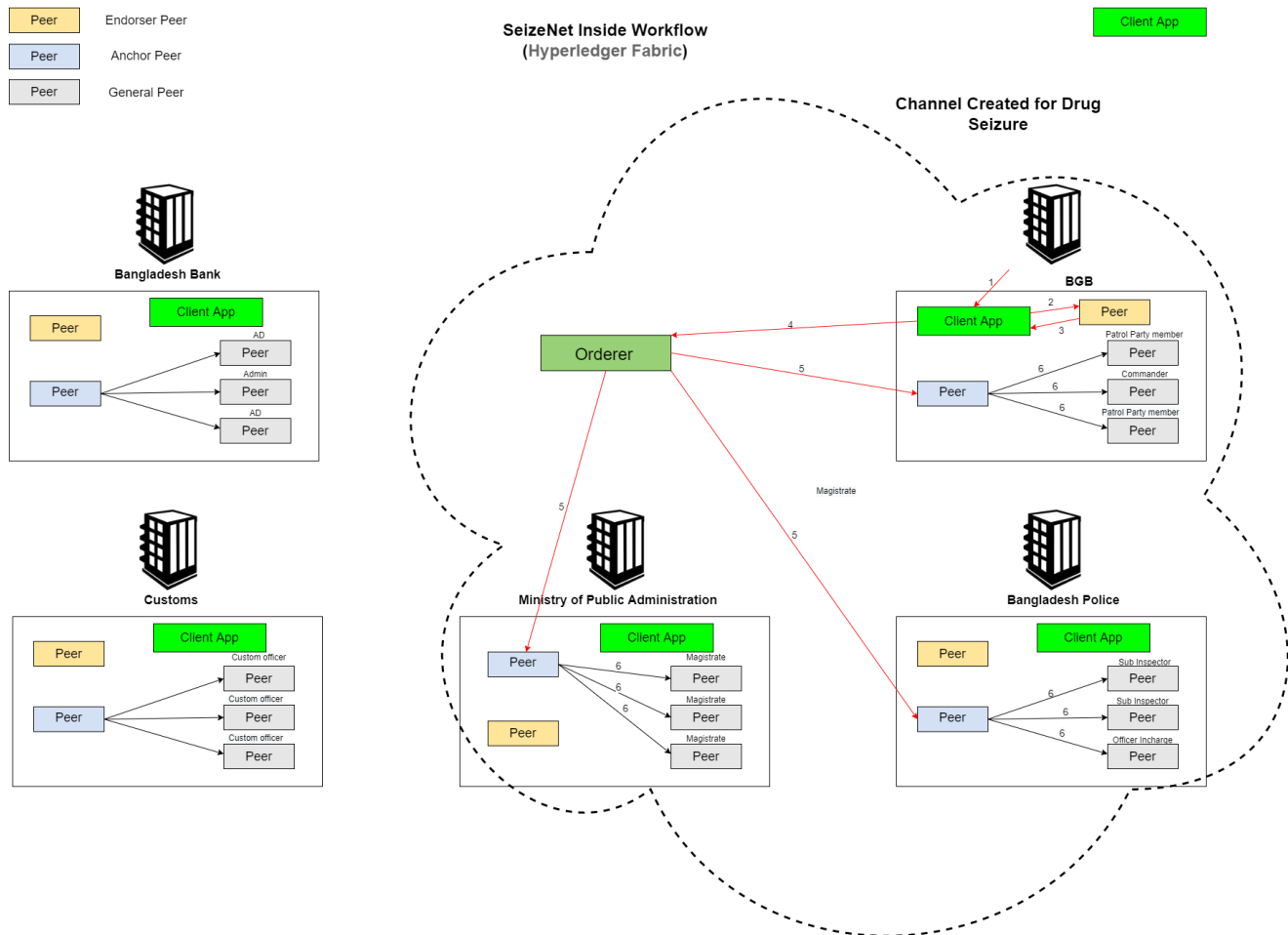


Fig. Operations performed in blockchain part

1. One of the members of the patrol party invokes a transaction request through the client application.
2. The client application of the BGB organization broadcasts the transaction invocation request to the Endorser peer.
3. Endorser peer checks the Certificate details and others to validate the transaction. Then it executes the Chaincode (ie. Smart Contract) and returns the Endorsement responses to the Client. Endorser peer sends transaction approval or rejection as part of the endorsement response.
4. The client now sends the approved transaction to the Orderer for this to be properly ordered in a specific channel and be included in a block.

5. The Orderer node includes the transaction into a block and forwards the block to the Anchor nodes of different member Organizations that are allowed for the channel. There is always a single ledge for a specific channel.
6. Anchor nodes then broadcast the block to the other peers inside their own organization. These individual peers then update their local ledger with the latest block. Thus all the network gets the ledger synced.

Choice of Blockchain

We needed a permissioned blockchain. These data are not accessible to everyone. Even yet, depending on the circumstances, the partners' data accessibility will vary. For example, the police will not be involved in the whole life cycle of seized goods if they are clothes. Thus, the police will be unable to obtain clothing-related data. We compiled a list of ten blockchain frameworks. The list includes Ethereum, Hyperledger Fabric, Hyperledger Sawtooth, R3 Corda, etc. Among the permissioned blockchain frameworks, Hyperledger Fabric appeared to be the most developed and amenable to modification. Additionally, it is administered by the Linux Foundation which seemed quite reliable to us. Consequently, we chose to build our system utilizing Hyperledger Fabric.

Integration with the Current Systems

Our system will not replace the current system. It will modify it slightly. In the current system, everything is recorded manually. We are proposing that our partners use our system to record things digitally. Additionally, we are adding QR codes to label the seized goods which is absent in the current system. Though labeling using QR codes will be extra work, it will make the system more secure. As everything is kept digitally, there won't be any need for submitting custom reports to the higher authorities. Instead, the higher authority will be able to generate reports by themselves.

Asset representation

The seized goods will be considered assets in the system. They will have particular properties including, date of seizure, date of demolition, quantity, unit (e.g., gm for weed, count for cattle), monetary value, seized by whom, who currently have them, etc. When we will develop the system, and do system design, we will add more properties according to the need.

Governance

In our system, some of the partners have both read and write permissions in the system and some have only read permissions. Regulators, who are the higher authority will only retrieve data and monitor the whole procedure. On the other hand, those who manage the seized goods throughout the life cycle of the goods will have permission to add new blocks to the system.

Network Membership Governance

- 1. Member on and offboarding:** We intend to begin with a single sector of BGB, including the police stations, customs officers, and magistrates in that sector. They will administer the seized goods. Over time, the other sectors will eventually be integrated. The regulators will be incorporated from the beginning. To monitor the seizures, high-ranking authorities from the BGB, and Bangladesh Police would be involved. Customs are under NBR and the magistrates are under the ministry of public administration. So, officials from NBR and the ministry will be included too. In addition, Bangladesh Bank will be introduced as a regulator to ensure that customs officials correctly deposit auction proceeds into the national treasury. We propose to keep an IT team for maintenance of the system and further developing it. The team formation should be approved by all our partners.
- 2. Data ownership:** As we have stated earlier that different workflows are depending on the type of the goods, and whether anyone gets apprehended with the goods, the data ownership also depends on it. All the associated partners in the life cycle of the seized goods will have ownership of the data. For example, if the goods are clothes, then they will be handled by the BGB and the customs. Thus only they will see the data.
- 3. Permission structure:** Individuals who deal with the seized goods will have both read and write permission for the data. The regulators will only have read permission. We also intend to introduce a super-admin. The super admin won't have any access to the data but will be able to set the roles of the partners. As the interaction of the partners with the system and data is based on the roles, we need to create roles in the system that will be maintained by the super admin. As the data will be shared by different organizations, we need their consent whether they agree to share the data.
- 4. Regulatory oversight provisioning:** From the regulators, high-ranked officials of BGB, customs, and Bangladesh Bank will have access to the data. We will divide the regulators and set roles so that they can only monitor data that were dealt with by the members they supervise. The regulators will be able to read the data and generate reports and charts.

Business Network Governance

- 1. Common/shared services management:** The common management will be the IT team. In order to maintain the system, we will need an IT team. We have also proposed hiring HCI researchers for certain periods to extract users' feedback on the system. These teams will be formed with taking consent of all the partners.
- 2. Legal and Regulatory Compliance:** BGB, police, customs, magistrates - we have 4 types of people that have different types of jobs apart from the involvement in seizure. They have their rules and regulations, the privacy of the information of things they have dealt with. As we are proposing just to share information regarding seizures, they can co-exist without violating each other's rules and regulations.

3. **Business Operations Structure:** All the partners are government organizations. Thus business is not the primary concern here. Instead ensuring security is prioritized.

Technology Infrastructure Governance

1. **Distributed IT management structure:** We shall host the system in a reputed cloud provider like AWS or Azure. The system will be maintained by an IT team. The super-admin we have mentioned previously will also be handled by the IT team. The cost will be maintained by the government as the partners are government organizations. Not only the network but also the frontend and backend (webserver) need to be hosted. These will also be hosted in the cloud and maintained by the IT team.
2. **Technology assessment and adoption:** Along with the IT team, we will also need a group of researchers. They will research in the context of HCI and analyze feedback on the current system. They will also suggest possible improvements which will be implemented by the IT team once the regulators approve.
3. **Framework for utilizing industry standards:** We will be using Hyperledger Fabric for the blockchain framework. Apart from this, we will have a mobile application, a website, and a webserver that will work as a bridge between the frontend and the blockchain network. For the application, we shall be using Flutter [\[6\]](#). The website will be implemented using React [\[7\]](#). And the webserver will be implemented using Node.js [\[8\]](#). It is expected that the developers in the IT team will adopt all the good practices and might change the tech stack if required.
4. **Risk optimization:** As the network will be deployed in the cloud, we believe that there's hardly a chance of data loss. Well-known cloud providers keep backups of data, thus there won't be any data loss. In order to make the webserver secure, we will need security experts to find any vulnerability of the system.

Valuation

We plan to include every entity involved in the seizure procedure in our system. Our aim is to make the current seizure procedure more secure and efficient rather than direct monetary effect. Though there will be monetary benefits if corruption can be stopped. All our partners will be benefitted from the system we have proposed in the following way,

1. Everything will be recorded digitally, thus maintaining records will be easier than before.
2. As the records will be immutable, corrupted officers will not be able to alter anything.
3. We are introducing labels using QR codes which will keep the seized goods safer.
4. The higher officials will be able to monitor what is being seized and will be able to generate unaltered reports on the seizures.

Distribution

Our strategy is to launch minimally and gradually expand our system's usage. The following is what we intend to do,

1. **Deploying the system:** We will host our system (the software's backend) on the cloud, ideally on Amazon Web Services. Additionally, we will distribute applications to our partners. We propose to develop both mobile applications and a website, with the mobile application being used by BGB patrol teams and the website is used by other partners to engage with the system. Additionally, portable printers will be required to print QR codes created by the mobile application.
2. **Training of the partners:** As indicated previously, we will begin minimally. As such, we shall begin with a specific sector of BGB. We will also include the local police, customs officers, and civil service officers. Finally, we will incorporate Bangladesh Bank, High ranked officers from the BGB, Bangladesh Police, and Customs to monitor the system. We will demonstrate how to use the system to all of our partners by organizing workshops.
3. **Conducting surveys and improving the system:** After a few months, we will run surveys to evaluate our partners' feedback. We will conduct semi-structured interviews and use thematic analysis [\[3\]](#) to elicit our partners' perspectives on the system. This will enable us to employ a user-centered design approach [\[4\]](#), in which we will adapt our application in response to user feedback. We will conduct surveys following each iteration of the system upgrade to get input. Finally, we will expand the usage of our system in all the sectors of BGB at the borders.

Appendices

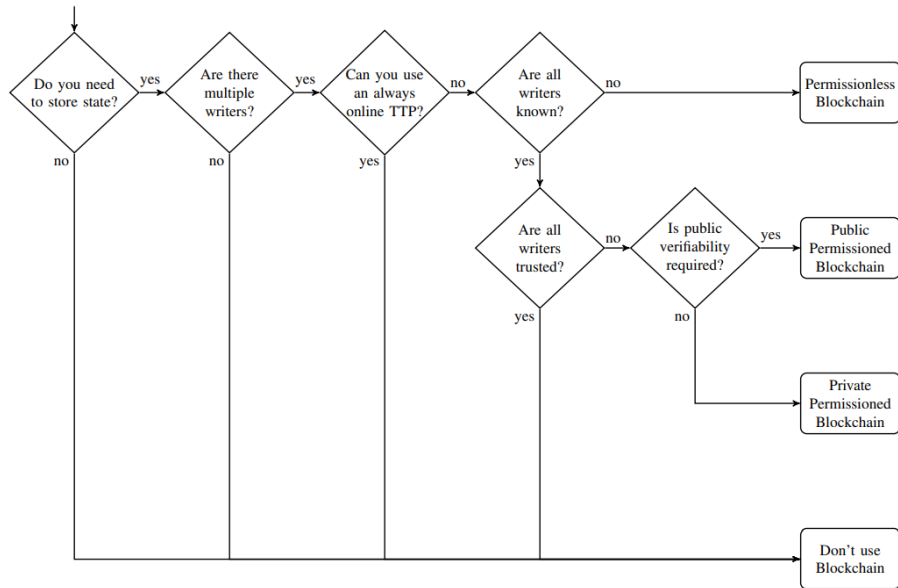


Fig. Why we need blockchain [9].

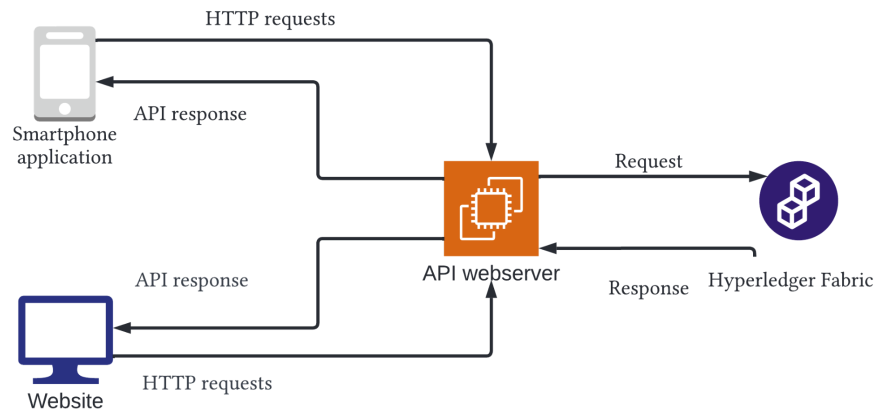


Fig. High-level architecture of the proposed system

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