Vivekanand Education Society's Institute Of Technology, Mumbai

Autonomous Institute affiliated to University of Mumbai, approved by AICTE

Department Of Computer Engineering

CERTIFICATE

OF EXCELLENCE

This is to certify that

Blockchain based NSP (Kushl Alve)

OF Second year HAS WON 1ST POSTION

IN TECHNICAL PAPER CONTEST " **BUZZPRO '24** "

CONDUCTED ON 22ND MARCH 2024

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Blockchain based Intelligent Disbursement in National Scholarship Portal

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***Abstract*—The National Scholarship Portal (NSP) serves as a crucial platform for managing scholarship disbursements for numerous applicants across the country. However, in the digital era, the national-level portal faces challenges such as non-automated systems, complex application processes, physical verifications, non-transparent, authentication frauds, delays in scholarship disbursement, and data security. This research proposes a blockchain-based solution to address these challenges. By using the blockchain technology, the paper aims to create a tamper-proof system for seamless integration, streamlined application processes, robust verification methods, meticulous scholarship eligibility and selection criteria, thorough tracking mechanisms, secure authorization procedures, and stringent compliance measures. This study emphasizes the transformative impact of blockchain in scholarship management and highlights its ability to build trust and accountability in educational finance.**

***Keywords*—National Scholarship Portal (NSP), Scholarship, Blockchain, Smart Contracts, Aadhaar Card Number, Tax Deduction and Collection Account Number (TAN), Permanent Account Number (PAN), One Time Password (OTP), Unique Transaction and Reference Number (UTR No.) Unique Identification Authority of India (UIDAI), Income Tax Department (ITD), Educational Institutions.**

I. Introduction

In the contemporary digital landscape, the administration of scholarships through platforms such as the National Scholarship Portal (NSP) [2] has emerged as a pivotal mechanism for facilitating financial assistance to countless applicants nationwide. However, despite its significance, the NSP encounters multifaceted challenges inherent to its operation within the evolving technological milieu. These challenges encompass a spectrum of issues ranging from procedural inefficiencies to concerns regarding data security and transparency. The emergence of blockchain technology presents a potential solution to these challenges, offering a way to transform the scholarship management system [11]. By leveraging the immutable and decentralized nature of blockchain, this study aims to propose a solution that enhances the efficiency, transparency, and security of the NSP. Through the integration of blockchain technology and smart contracts [11, 14], the suggested approach aims to overcome existing obstacles and create a fairer and more efficient process for distributing scholarships.

II. Literature survey

This section summaries the literature survey performed during the ideation phase of the paper. It covers the concept of Blockchain Technology, Smart Contracts, and Limitations of the Existing System.

A. *Blockchain Technology [1]*

Blockchain is a decentralized ledger system that "utilizes the collective resources of a vast peer-to-peer network for transaction verification and authentication." These transactions are organized in chronological order within blocks, which are securely linked together using cryptographic techniques and permanently stored on the blockchain, forming an unchangeable sequence. The blockchain exists in multiple copies distributed across participants worldwide, with updates occurring simultaneously. This design guarantees that no individual entity can alter the ledger without the agreement of the majority within the network, thereby ensuring its integrity and security.

B. *Smart Contract [5, 6]*

Smart contracts are like computer programs designed to do certain things when certain conditions are met. They usually work on systems called distributed ledgers, like blockchain. Smart contracts help automate agreements, making sure everyone involved knows what's happening quickly, without waiting for someone else to get involved. They also make workflows smoother by starting the next step automatically when needed, free from intermediary intervention or time delays. Additionally, they streamline workflow processes by

automatically initiating subsequent actions upon meeting predetermined conditions.

C. *Limitations of the Existing System*

Current NSP faces many limitations that cause hindrance in paving the way for fair and accessible education. These limitations include a Non-Automated System, Lack of Transparency, Complexity in the Application process, Unnecessary Document uploading & Paperwork, Delay in Scholarships, and the portal offers only Government Scholarships, with the restriction of one Scholarship application at a time, Insufficient Support Services, opacity in decision making, Data Security Concerns.

III. Proposed methodology

The proposed system incorporates smart contracts that operate within the framework of NSP and performs transactions between the stakeholders providing transparency, security and immutability.

A. *Relevance of Hybrid Blockchain [12]*

A hybrid blockchain integrates features from both public and private blockchains, providing advantages like decentralization and transparency from public blockchains, alongside the control and privacy features inherent to private blockchains. Within a hybrid blockchain, select transactions or data can remain private within a restricted participant network, while others are recorded on a public ledger accessible to all participants.

It is suitable in NSP because it provides Data Security, allowing sensitive data, such as applicant information and financial records, to be securely stored and accessed by authorized parties only. Scalability, handling large volumes of transactions essential for national-level portal. Interoperability, integrating with the existing system and databases enabling seamless interaction with government agencies, educational institutions, and financial institutions involved in the scholarship process. Immutability, once data is recorded, it cannot be altered or tampered with, providing a reliable audit trail for scholarship transactions and preventing fraud.

B. *Smart Contracts in Scholarship Disbursement System*

This section introduces the implementation of smart contracts in the scholarship disbursement process. Smart contracts, serving as self-executing contracts with predefined conditions and automated actions, play a crucial role in managing various aspects of the scholarship application, verification, selection and disbursement process. The following smart contracts are deployed to streamline and automate the whole process.

1.) *Private Organization Integration Contract*: It will facilitate the integration of the private scholarship from external organizations into the NSP This contract will define the protocols for the submission, verification and selection of the private scholarship, also ensuring the compatibility with existing disbursement process and regulations.

2.) *Scholarship Application Contract*: It will manage the submission of scholarships applications by the applicants by validating the application data and will ensure the completeness of the application. Simultaneously recording the application details on blockchain ensuring transparency.

3.) *Eligibility Verification Contract*: It will check the applicant eligibility criteria against a set of predefined rules that will be set by the Scholarship Organization. It also verifies the applicants credentials such as academic performance, income status etc. It will also flag ineligible applications and notify the applicant.

4.) *Scholarship Selection Contract*: It will implement a fair and transparent selection process based on predefined criteria. It scores and ranks eligible applicants according to specific parameters and selects recipients based on merit, need, or other specific factors.

5.) *Disbursement Authorization Contract*: It will manage the authorization process of scholarship disbursement by validating selected recipients and their eligibility for funds. It also gets triggered and performs the disbursement transactions upon approval from the authorized parties.

6.) *Funds Management Contract*: It handles the allocation and management of scholarship funds & implements mechanism for reallocation and replenishment as required or needed. It tracks fund balances, expenditures, and remaining budget allocations.

7.) *Disbursement Tracking Contract*: It monitors the status of scholarship disbursement transactions. Records disbursement details including recipient information and transaction IDs. Provides a transparent audit trail for fund distribution activities for stakeholders. Facilitates auditing and accountability through transparent reporting mechanisms.

8.) *Compliance and Reporting Contract*: It ensures compliance with regulatory requirements and organizational policies & Generates reports on scholarship disbursement activities for stakeholders. Facilitates auditing and accountability through transparent reporting mechanisms.

C. *Proposed Intelligent Scholarship Disbursement Steps in National Scholarship Portal*

The proposed approach works in sync with the smart contracts for integration, application, verification, selection, authorization, management, tracking, compliance and reporting. (Fig. 1)

First Scholarship Organizations register with the NSP using their Tax Deduction and Collection Account Number (TAN) along with a registered mobile number. NSP verifies this information and initiates the Private Organization Integration Contract. The Smart contract sends the TAN number to the Income Tax Department (ITD) for validation and receives a validity response. Simultaneously, it notifies the Scholarship Organization about the validation response and stores the information, along with a timestamp, in the blockchain ledger. If the TAN number is valid, the Scholarship Organization receives an OTP on their registered mobile number. Upon successful validation, they log in and submit scholarship details, including eligibility criteria, guidelines, and deadlines. Once submitted, their details are stored in the NSP database, and they receive a registration number. These steps are depicted in steps 1-17 of Fig. 2.a.

Next, Applicants who wish to apply for these scholarships register on the NSP using their Aadhaar card number having a registered mobile number. NSP verifies this information and initiates the Scholarship Application Contract. The Smart contract forwards the Aadhaar Card Number to the Unique Identification Authority of India (UIDAI) [3, 8] for validation and receives a validity response. Simultaneously, it notifies the Applicant about the validation response and stores the information, along with a timestamp, in the blockchain ledger. The Applicant receives an OTP on their mobile number, using which they log in and fill out the application details, including their current educational status. Once submitted, their details are stored in the NSP database, and they receive an Application number. These steps are depicted in steps 18-34 of Fig. 2.a.

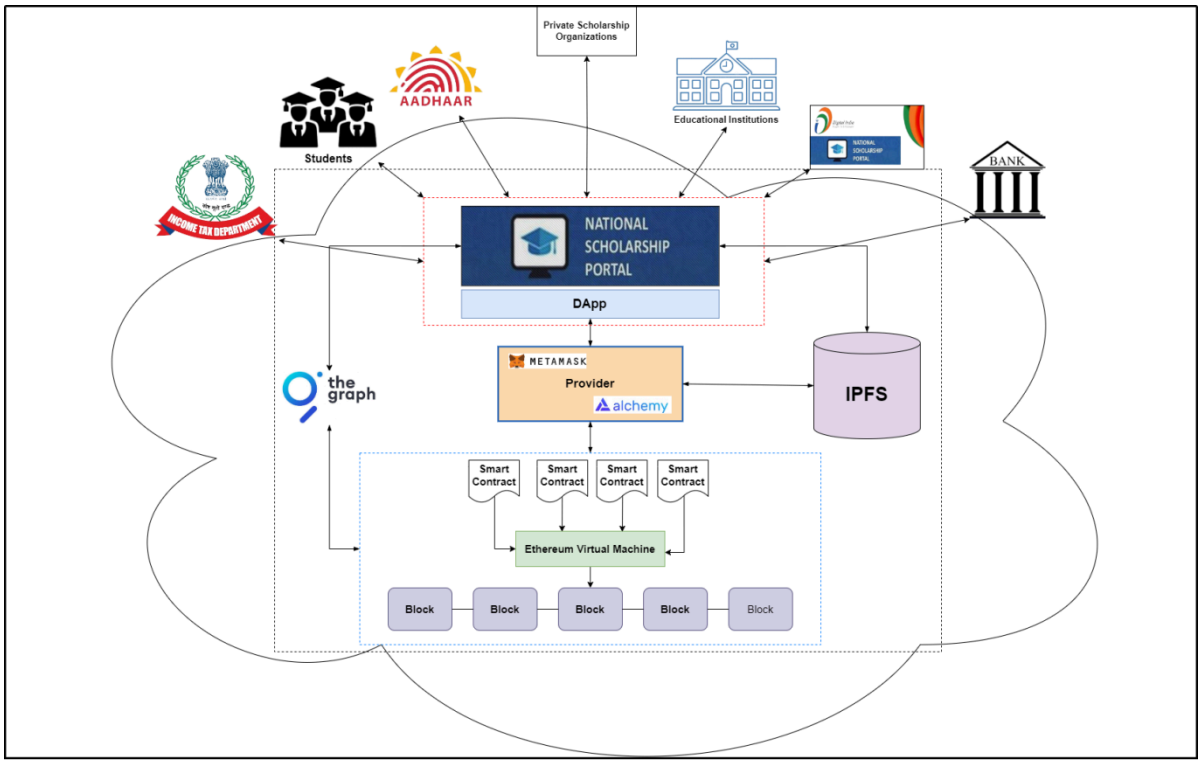

Fig. 1. Block diagram of the Proposed Blockchain based Intelligent Disbursement in National Scholarship Portal

Subsequently, the Eligibility Verification Contract is triggered, which sends the list of applicants to their respective institutions for confirmation of fees and verification of parents/guardians' PAN numbers or income certificates. The received PAN numbers are used to retrieve the income status of the applicants from the Income Tax Department database. Sensitive information such as academic records and financial details can be securely stored on the blockchain, ensuring privacy through encryption and permissioned access. The Scholarship Selection Contract evaluates eligible applicants based on merit, need, or other specified factors. After this process, the eligibility status is notified and stored in the blockchain. These steps are depicted in steps 35-47 of Fig. 2.a.

The NSP initiates the Disbursement Authorization Contract, signaling the commencement of the Scholarship Disbursement Smart Contract transaction. This pivotal contract then requests the list of eligible applicants for fund disbursement, which NSP promptly forwards, accompanied by their bank details, to the Scholarship Organization. Subsequently, leveraging the Funds Management Contract, the Scholarship Organization undertakes the step of sanctioning the disbursement process, thereby prompting the designated bank to execute fund transfers to deserving students. Upon completion, the bank notifies the Scholarship Organization, about the fund disbursal. Following this, the Scholarship Organization informs NSP about the successful scholarship disbursement. To ensure transparent tracking and accountability, NSP activates the Disbursement Tracking Contract, meticulously recording each disbursement detail along with its timestamp on the immutable blockchain ledger. Simultaneously, the Compliance and Reporting Contract comes into play, orchestrating the creation of essential 80G certificates for Private Organizations. These contracts diligently gather fund transfer specifics from NSP, submitting them to the Income Tax Department. Subsequently, the department calculates eligible tax benefits, generating the requisite 80G certificates for the Scholarship Organization. Throughout this intricate process, NSP diligently updates both applicants and their respective institutes regarding the status of scholarship fund disbursement, ensuring clarity and transparency at every stage. These steps are depicted in steps 48-65 of Fig. 2.b.

D. *Advantages of the Proposed Blockchain based Intelligent System [15]*

The relevance of blockchain technology lies in its ability to address key challenges and enhance various aspects of the scholarship distribution process. It gives the following benefits to the system.

1.) *Transparency and Trust* - Blockchain provides an immutable ledger that records all scholarship transactions transparently. Stakeholders, including students, educational institutions, and government bodies, can verify scholarship disbursements, ensuring trust in the system.

2.) *Security and Fraud Prevention* - The decentralized nature of blockchain ensures that scholarship data is securely stored and tamper-proof. Smart contracts automate the disbursement process based on predefined criteria, reducing the risk of fraud or manipulation.

3.) *Efficiency and Automation* - Smart contracts streamline the scholarship disbursement process, automating tasks such as eligibility verification, selection, and fund allocation. This automation reduces administrative overhead, accelerates the distribution timeline, and ensures timely delivery of funds to deserving students.

4.) *Data Integrity and Privacy* - Blockchain technology ensures data integrity by maintaining a single source of truth for scholarship records. Details can be securely stored on the blockchain while preserving privacy through encryption and permissioned access.

5.) *Inclusion and Accessibility* - Blockchain can enable greater inclusivity by providing a transparent and accessible platform for managing scholarships. It facilitates the integration of private scholarships from external organizations, broadening the range of opportunities available to students.

6.) *Auditing and Accountability* - The transparent and auditable nature of blockchain enhances accountability in scholarship distribution. Stakeholders can easily trace the flow of funds, track disbursement activities, and generate audit reports for regulatory compliance and transparency purposes.

E. *Implementation Plan for the Proposed System*

For an improved version of the Portal we need to plan deployment phases in detail. The four phases for implementation are as follows:

1. Blockchain infrastructure setup and Integration with existing Portal.
2. Smart Contract Deployment for Automated Scholarship Disbursement.
3. Testing and Pilot deployment in selected regions or institutions.
4. Full scale implementation and continuous monitoring for improvements.

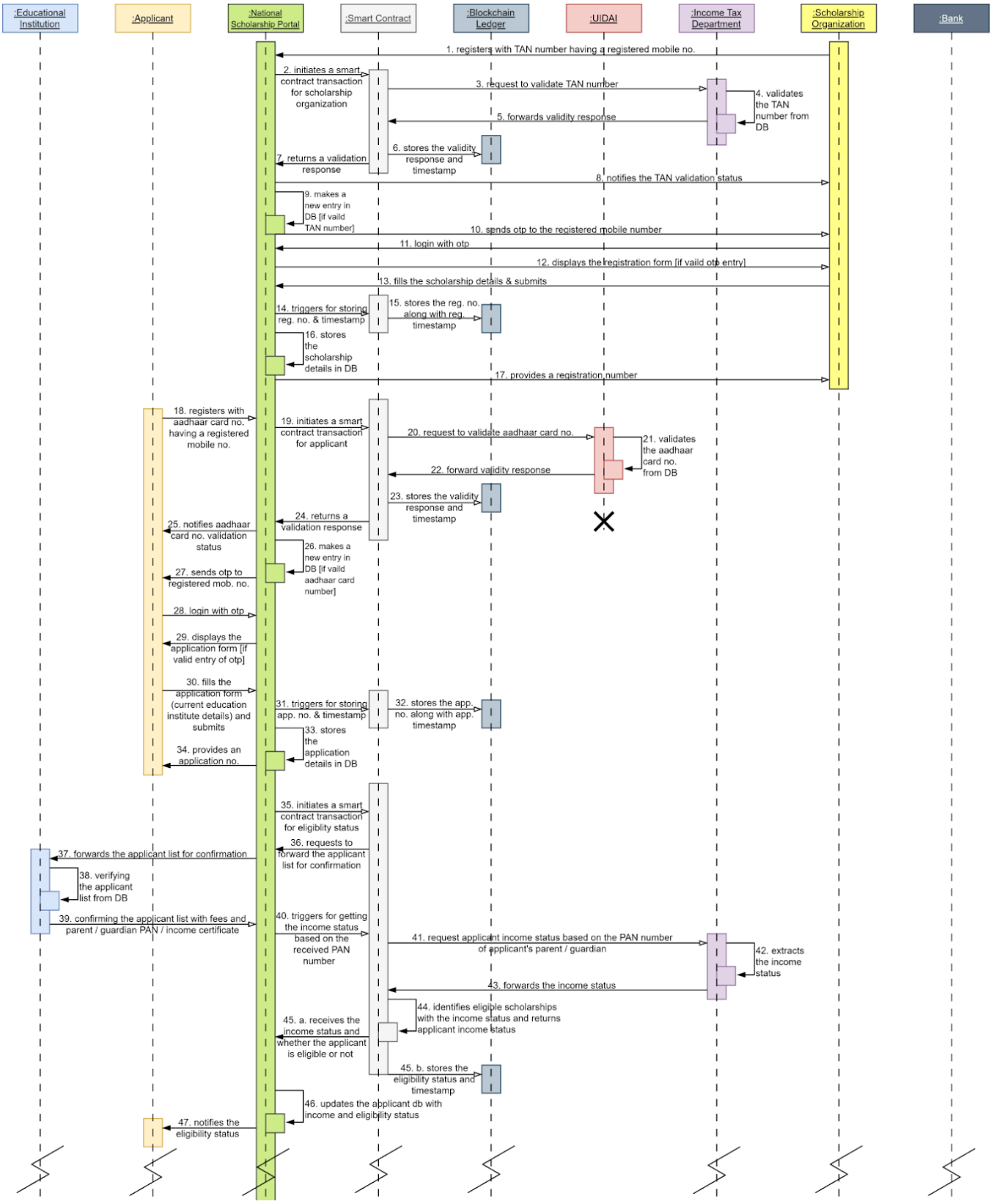

Fig. 2.a. Sequence Diagram for the Proposed Blockchain Based Intelligent Disbursement in National Scholarship Portal [4]

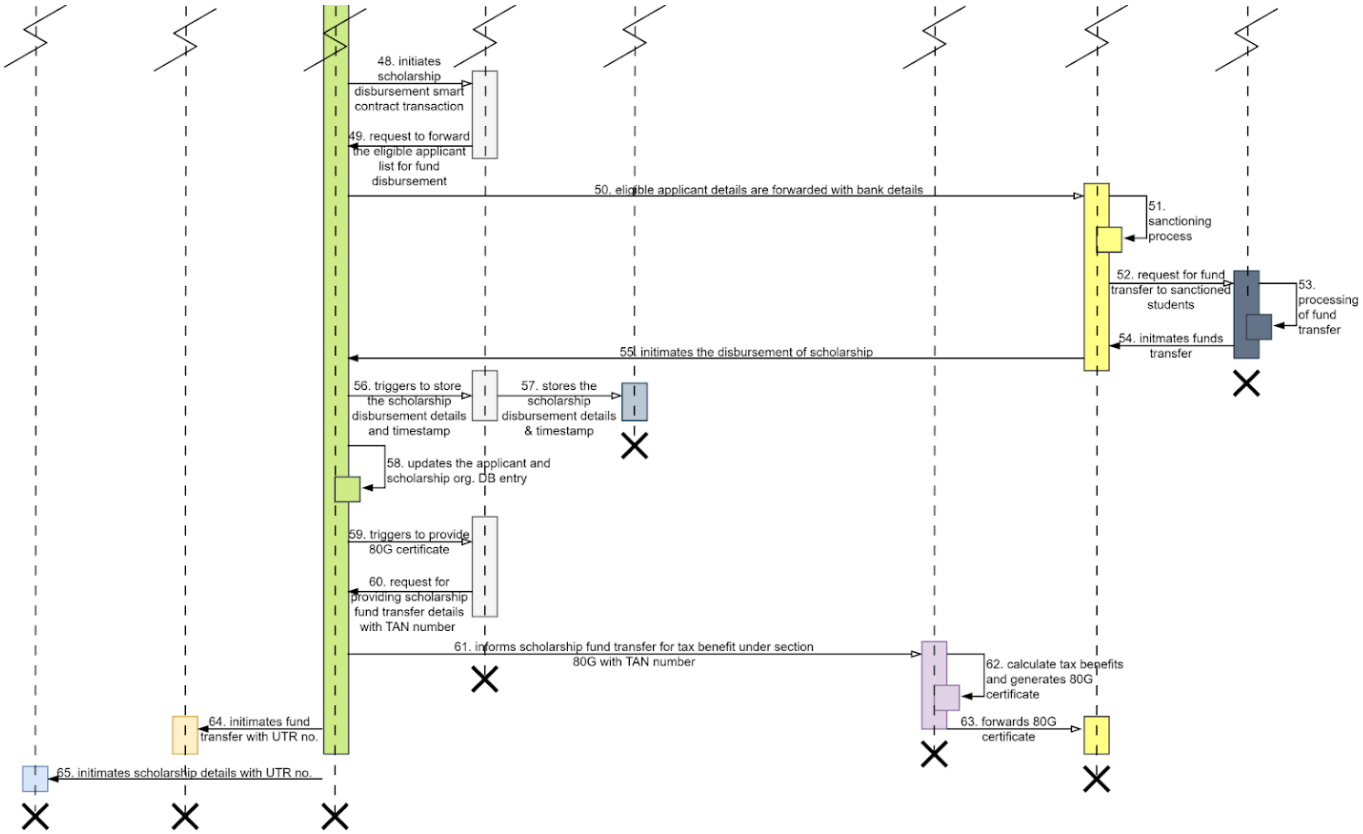

Fig. 2.b. Sequence Diagram for the Proposed Blockchain Based Intelligent Disbursement in National Scholarship Portal [4]

F. *Implementation Challenges [7, 15]*

The challenges that will be faced during the implementation phases are listed and need to be addressed.

- New Technology Adoption.
- Integration Complexity and Cost.
- Data Update Complexity.
- Debugging Challenges.
- Regulatory Compliance.

III. Conclusion

By using Blockchain Technology and Smart Contracts many issues can be resolved by inheriting the features of Security, Transparency and Efficiency. Also, it is essential to acknowledge the challenges associated with adopting new technology and ensure robust mechanisms are in place to address these challenges. This helps the Applicants to bring trust in the process and easily apply for the process thus making the system more accessible, fair, and efficient.

Acknowledgement

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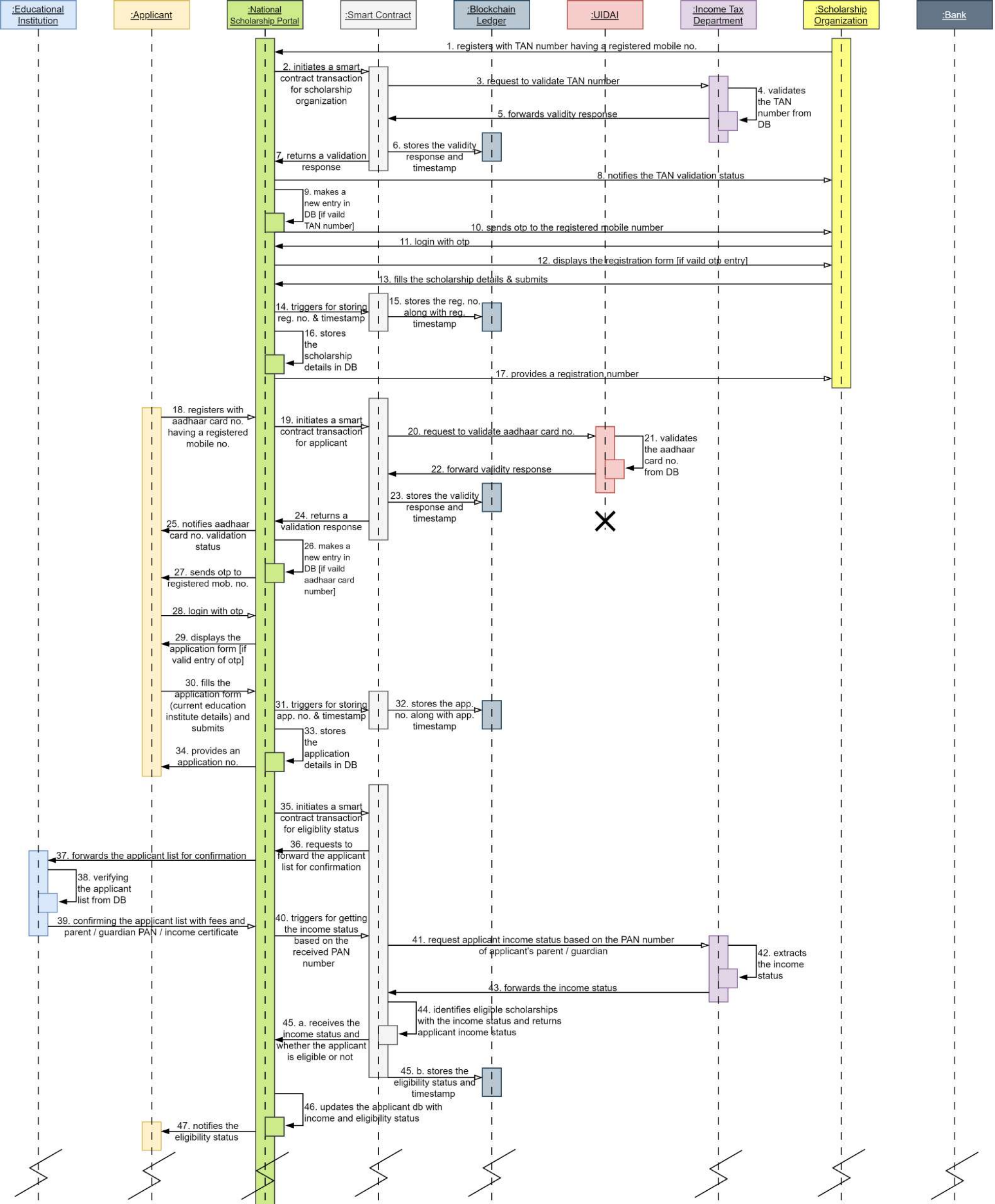
:Educational Institution
:Applicant
:National Scholarship Portal
:Smart Contract
:Blockchain Ledger
:UIDAI
:Income Tax Department
:Scholarship Organization
:Bank
1. registers with TAN number having a registered mobile no.
2. initiates a smart contract transaction for scholarship organization
3. request to validate TAN number
4. validates the TAN number from DB
5. forwards validity response
6. stores the validity response and timestamp
7. returns a validation response
8. notifies the TAN validation status
9. makes a new entry in DB [if vaild TAN number]
10. sends otp to the registered mobile number
11. login with otp
12. displays the registration form [if vaild otp entry]
13. fills the scholarship details & submits
14. triggers for storing reg. no. & timestamp
15. stores the reg. no. along with reg. timestamp
16. stores the scholarship details in DB
17. provides a registration number
18. registers with aadhaar card no. having a registered mobile no.
19. initiates a smart contract transaction for applicant
20. request to validate aadhaar card no.
21. validates the aadhaar card no. from DB
22. forward validity response
23. stores the validity response and timestamp
24. returns a validation response
25. notifies aadhaar card no. validation status
26. makes a new entry in DB [if vaild aadhaar card number]
27. sends otp to registered mob. no.
28. login with otp
29. displays the application form [if valid entry of otp]
30. fills the application form (current education institute details) and submits
31. triggers for storing app. no. & timestamp
32. stores the app. no. along with app. timestamp
33. stores the application details in DB
34. provides an application no.
35. initiates a smart contract transaction for eligiblity status
36. requests to forward the applicant list for confirmation
37. forwards the applicant list for confirmation
38. verifying the applicant list from DB
39. confirming the applicant list with fees and parent / guardian PAN / income certificate
40. triggers for getting the income status based on the received PAN number
41. request applicant income status based on the PAN number of applicant's parent / guardian
42. extracts the income status
43. forwards the income status
44. identifies eligible scholarships with the income status and returns applicant income status
45. a. receives the income status and whether the applicant is eligible or not
45. b. stores the eligibility status and timestamp
46. updates the applicant db with income and eligibility status
47. notifies the eligibility status
48. initiates scholarship disbursement smart contract transaction
49. request to forward the eligible applicant list for fund disbursement
50. eligible applicant details are forwarded with bank details
51. sanctioning process
52. request for fund transfer to sanctioned students
53. processing of fund transfer
54. initmates funds transfer
55. initimates the disbursement of scholarship
56. triggers to store the scholarship disbursement details and timestamp
57. stores the scholarship disbursement details & timestamp
58. updates the applicant and scholarship org. DB entry
59. triggers to provide 80G certificate
60. request for providing scholarship fund transfer details with TAN number
61. informs scholarship fund transfer for tax benefit under section 80G with TAN number
62. calculate tax benefits and generates 80G certificate
63. forwards 80G certificate
64. initimates fund transfer with UTR no.
65. initimates scholarship details with UTR no.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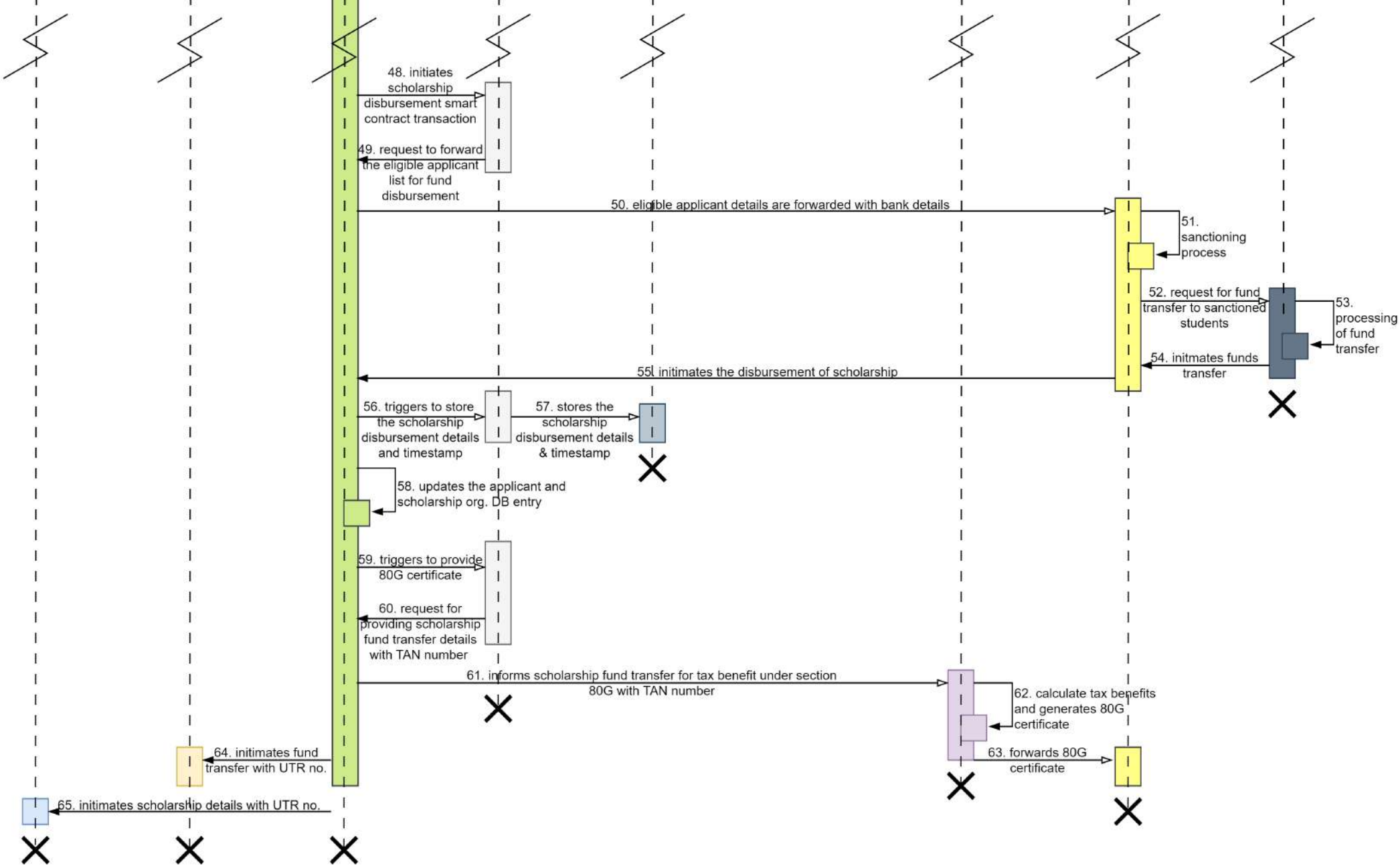
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Private Scholarship Organizations

AADHAAR

Students

Educational Institutions

Digital India

NATIONAL SCHOLARSHIP PORTAL

BANK

INCOME TAX DEPARTMENT

NATIONAL SCHOLARSHIP PORTAL

DApp

METAMASK

Provider

alchemy

IPFS

the graph

Smart Contract

Smart Contract

Smart Contract

Smart Contract

Ethereum Virtual Machine

Block

Block

Block

Block

Block