MedBloc: Blockchain for the NZ Healthcare System

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1 Motivation & Project Goal

Currently, in New Zealand, there is no shared electronic health record (EHR) system integrated between major healthcare organisations, such as hospitals, GPs and specialists. Instead, health records are fragmented rather than holistic, as healthcare providers have their own local data storage system to store health information of patients who have visited them. As a result, patients must often repeat their health story when they visit a new healthcare provider, while healthcare professionals lack the access to accurate health information at the point of care, due to how a patient's health information is distributed across various healthcare providers.

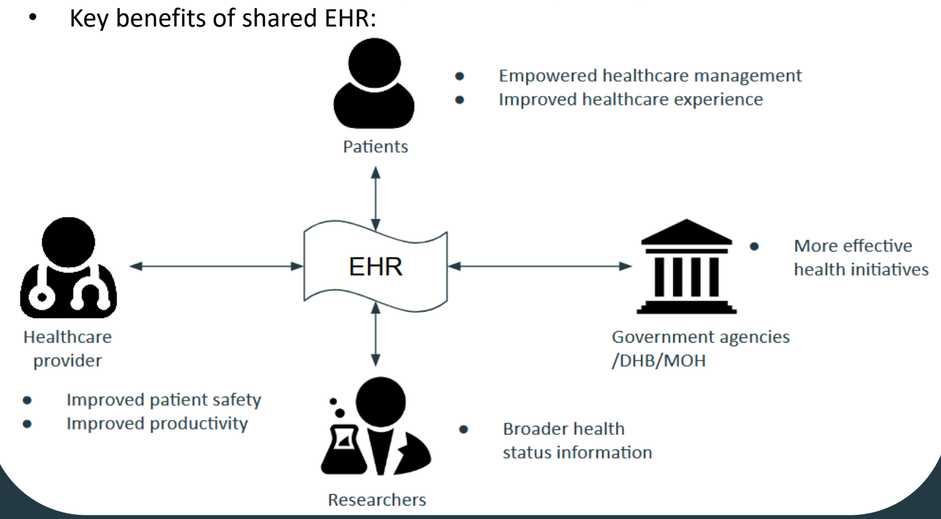
Due to the massive scale of an EHR system and the distributed characteristics of health records, we aim to use Blockchain technology to implement a shared EHR system and assess its viability.

Our Approach

- People-powered shared EHR system
- Health records are stored on the blockchain
- Only authorised patients and healthcare providers can participate
- Health records can be shared with different healthcare providers
- Patients give and withdraw consent over who can access their health records at any time
- Records are encrypted on the blockchain

2 Electronic Health Record (EHR)

- A longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. [1]
- Key benefits of shared EHR:



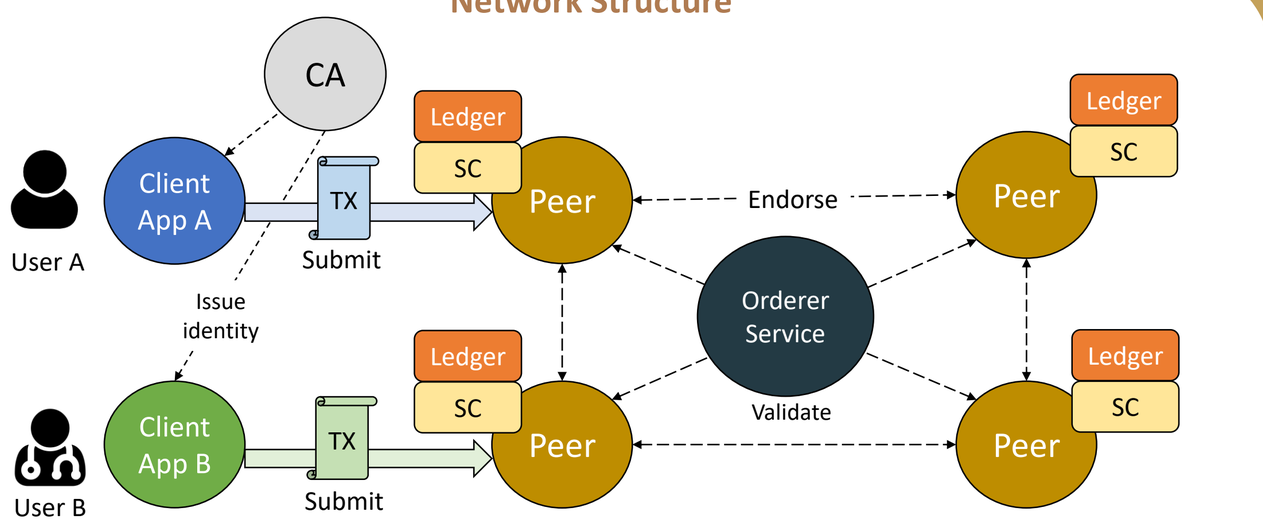
3 Blockchain

- Decentralized database that stores a timestamped list of blocks, each representing a transaction, linked and secured using cryptography. [2]
- Each block contains a cryptographic hash of the previous block's header along with transaction data and other metadata.
- Immutable data storage and tamper-proof.
- Smart Contracts - autonomous programs running on the blockchain network which executes business logic.
- Permission management to control which entities may participate in the blockchain network and to improve scalability and performance.

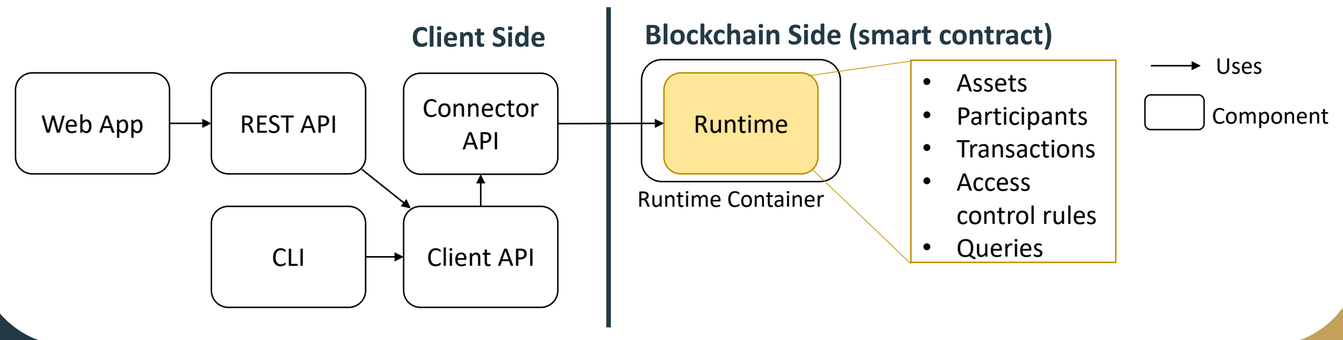
4 Benefits of using blockchain for EHR

Attribute	Benefits [3]
Decentralised	No central management authority. Patient's own and control access to their data.
Immutability	Health data cannot be deleted or changed once it's on the chain. This prevents data from being altered by malicious actors.
Traceability	Provides data provenance. Origins of transactions are completely traceable (who sent and received what), as all transactions are signed.
Robustness/ Availability	Blockchain networks have no single point of failure. Even if a blockchain node goes down, all nodes have a copy of the ledger, so data is continuously available.
Security/ Privacy	Cryptography algorithms can be used to hide patients' identities. It is also used as digital signatures to verify the ownership of patient's health records.

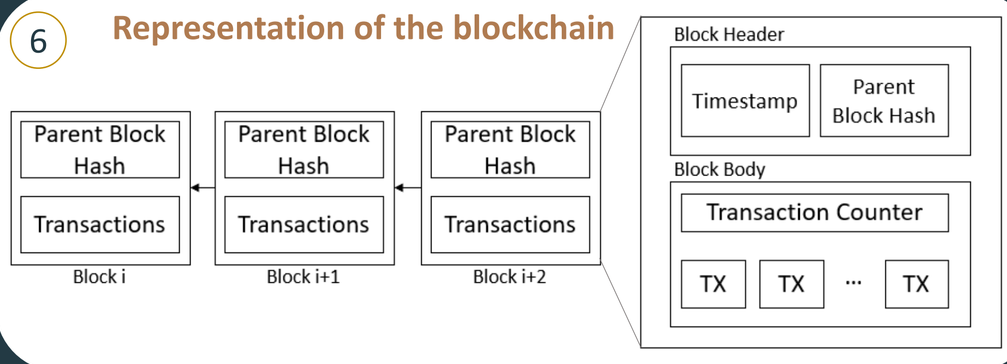
5 Network Structure



Component Structure



6 Representation of the blockchain

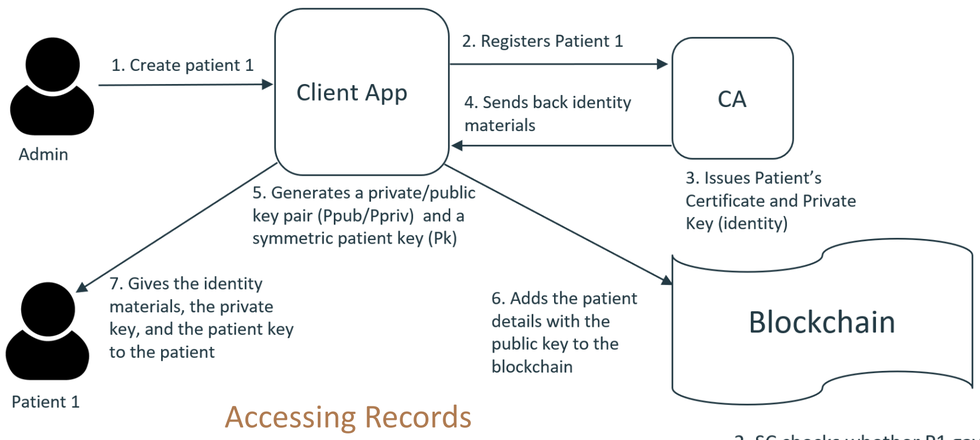


7 Development Tools

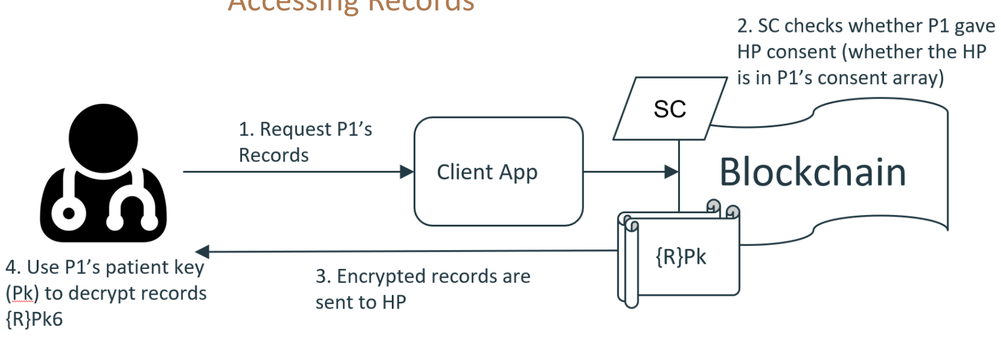
ANGULARJS by Google
HYPERLEDGER COMPOSER
HYPERLEDGER FABRIC
Visual Studio Code

8 Process Flows

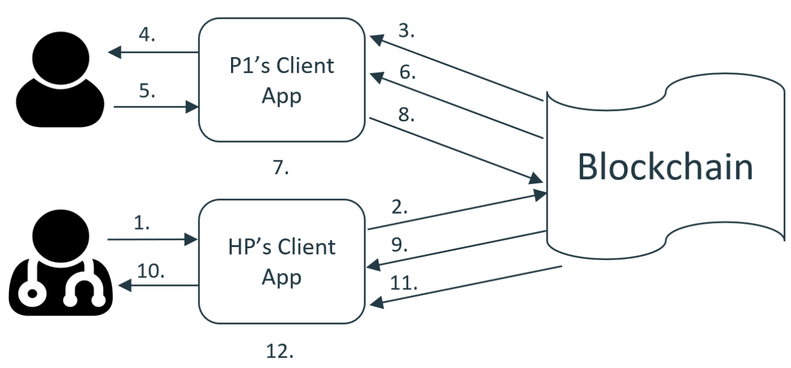
Patient Creation



Accessing Records

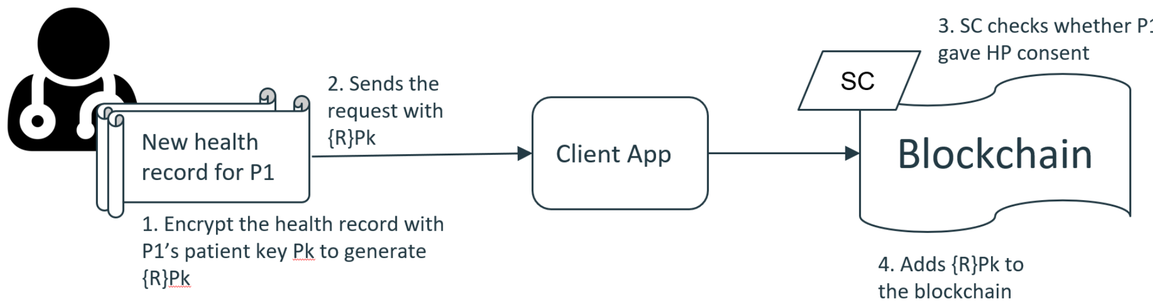


Record Sharing



1. Request P1's Patient Key
2. Send request
3. Relay request
4. Receive Request
5. Provide Patient key (Pk)
6. Retrieves HP's public key (HPPub)
7. Encrypt Pk with HPPub, make (Pk)HPPub
8. Stores (Pk)HPPub on the blockchain and add HP to a consent array in the patient participant object
9. Notify record sharing event
10. Notify HP about record sharing
11. Retrieves (Pk)HPPub
12. Decrypts (Pk)HPPub using HPPriv to get Pk

Adding Records



Conclusions

- Current NZ health system has many problems which could be resolved by establishing a shared EHR.
- Key attributes of blockchain technology can make it suitable for building an EHR system.
- Introduced a blockchain-based EHR system which provides patients and healthcare provider's easy access to secured health records.
  - Captures patient's consent
  - Encrypts health data before it is sent to the blockchain
  - Easy-to-use front end for patient's and healthcare provider's to interact with the blockchain

Future Work

- Implement secure authentication.
- Improve front-end web app.
- Test performance and scalability of the system.
- Deploy blockchain nodes on the cloud.

References

- [1] C. Reid and G. Osborne, "Strategic Assessment: Establishing the Electronic Health Record," 2016.
- [2] X. Xu, C. Pautasso, L. Zhu, V. Gramoli, A. Ponomarev and S. Chen, "The Blockchain as a Software Connector," in *2016 13th Working IEEE/IFIP Conference on Software Architecture*, 2017.
- [3] T.-T. Kuo, H.-E. Kim and L. Ohno-Machado, "Blockchain distributed ledger technologies for biomedical and health care applications," *Journal of the American Medical Informatics Association,* vol. 24, no. 6, pp. 1211-1220, 2017.