



Riksbank e-krona Request for Information

I. Introduction

IBM understands the challenges and opportunities Riksbank faces. The pace toward digitalization is accelerating and Sweden is leading the world towards a cashless economy. As such, electronic money and means of payment currently existing on the Swedish payment market are being entirely run by 'private actors' and are concentrated among a small number of commercial actors, payment services and infrastructures. In the long run, this concentration could "restrain competitiveness" in the market and make society vulnerable. Additionally, customer segments desire digital payment options, there is increased focus and importance on financial regulations, and now blockchain technology provides new opportunities previously unavailable. The Riksbank is responsible for monetary policy with the objective to maintain price stability must make investment decisions now to build future systems and capabilities to promote a safe and efficient payment system. IBM provides the following point of view in response to Riksbank questions regarding 1) a solution for a register-based e-krona 2) a solution for a value-based e-krona and 3) IBM's vision of the most appropriate solution for e-krona and 4) additional considerations.

II. What would a technical solution for a register-based e-krona look like?

In a register-based approach, Riksbank would issue and maintain the record of e-krona on its own distributed ledger. Individuals access their balance of e-krona directly through the Riksbank and can be settled in real time within the closed system. Riksbank would act as custodian of e-krona for all individuals and institutions participating in the network. Conceptually, this would be similar to keeping a balance of accounts held at Riksbank in a database held at Riksbank, but with the additional enhancement of the database being distributed to all parties who should have access, with changes being authorized using well-known PKI cryptographic techniques to ensure all parties have the same, consented view of obligations.

A register-based approach would require distributed ledger dApp interfaces to be made available for individuals, financial institutions, and other regulatory authorities in order to transact with e-krona. This would include, but not be limited to, the creation, maintenance and destruction of user accounts, KYC processes for banked and unbanked individuals, an anti-money laundering and transaction reporting system, and a bank system integration and payment gateway solution. Riksbank would need to rely on intermediaries in order to process cross-border payments.

The impact on the money supply would be minimal, as no additional currency denominations are issued in a register-based approach. Instead, the register based approach is a record of already-issued funds held in custody. Appendix A provides a high-level description of blockchain architecture. IBM welcomes continued discussions on architecture, hardware, software, services and cooperation partners.

III. What would a technical solution for a value-based e-krona look like?

A value-based approach to the issuance of e-krona would be more similar to cash at present as the value would be stored locally, as if they were holding "cash" on their personal devices. This approach is also enabled by a distributed ledger shared amongst participants who should be party to those ledgers. Maintenance of privacy would be paramount, and the choice of ledger platform would be based on that key requirement.

The solution provides a commerce platform upon which financial services firms can develop next generation payment solutions for consumers and businesses without pre-defining the intended range of use cases for a central bank issued digital currency, allowing the Fintech industry to innovative creativity.

IBM is currently building a payments solution which will enable a value-based e-krona. The purpose of this solution is to build for central banks, a payment system that integrates with the existing payment infrastructure, and additionally contains features normally associated with SEK (cash), namely: access, convenience, and trust. It will also manage and reconcile the amount of SEK held on reserve in exchange for corresponding e-krona circulating on the Blockchain.

A Value-based e-krona technical solution design would include an integrated currency management system that combines a defined currency lifecycle with existing in-country banking and payment systems, a Know Your Customer (KYC) rules execution engine, and transaction monitoring and reporting facilities.



At this early stage we did not include architecture, hardware and software and any services and cooperation partners, however, IBM looks forward to future discussions on these topics. Appendix A provides a high-level description of blockchain architecture. IBM welcomes continued discussions on architecture, hardware, software, services and cooperation partners.

IV. IBM's vision of the most appropriate solution for an e-krona

A register-based digital denomination of Swedish Krona ("e-krona") enables the issuance of e-krona on distributed ledger, representing a direct claim on the Riksbank. Cash is the underlying instrument behind all other financial instruments and transactions, therefore it makes sense to first issue a Blockchain-based digital currency as an initial step. This section will describe the overall lifecycle of the proposed e-krona, the business process behind each step in the lifecycle, as well as the technical approach to hosting e-krona on-chain.

Figure 1: e-krona Currency Lifecycle

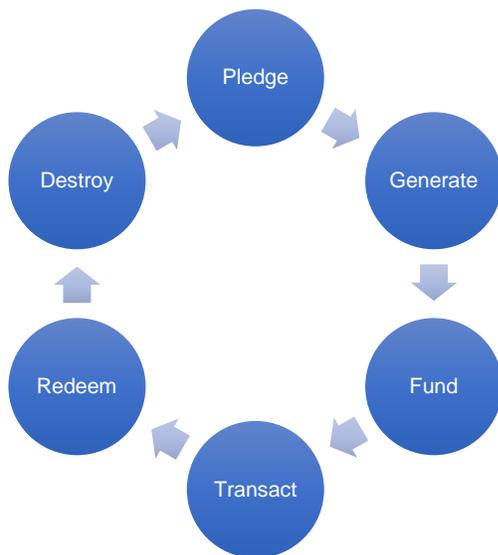


Figure 1 outlines the steps of pledging, generating, and funding, which is the business and technical process for a participant of the network pledging collateral to the Riksbank (or other authorized participant). Upon receipt of collateral, the Riksbank will generate an account on the Blockchain network and fund that account with the appropriate amount of e-krona, at a 1:1 exchange rate.

After generation of the account, Riksbank (or other authorized party) will issue a transaction to the network, transferring the appropriate number of e-krona from the Master account owned by Riksbank, to the newly generated participant account. After funding, the public and private keys generated for the account must be delivered to the participant's smartphone or other authorized wallet system.

Redemption and destruction of the E-krona and receipt of the fiat currency it is backed by is roughly the

opposite of the pledge-generate-fund process, though there is no "destruction" of the account – though it is "frozen."

A user experience, built on their mobile device or other means, is developed that allows a participant to "cash out" of their e-krona, in exchange for a credit to their deposit account.

A banked user who pledged collateral from their bank account will see a credit in their bank account, initiated through the existing payment system by Riksbank (or other authorized party). Since participant account information is sent during the pledge process, the act of redeeming those E-krona tokens is to credit that same account.

In order for this to function correctly, Riksbank (or other authorized participant) must store participant account information during the Pledge-Generate-Fund process, and use this information to return the collateral back to the participant through the existing payment network.

The participant's account should be marked as "frozen," with the appropriate attributes. This, in effect, does not allow the participant to transact with their e-krona account once all funds have been withdrawn.

V. What challenges and opportunities IBM envisages, and what is missing?

Each technical solution should support an ecosystem of participants who wish to develop payments applications and to conduct "real" monetary transactions with a new central bank issued digital currency. The level of transformation under consideration for many basic intercompany banking processes can be a source of risk to the financial system and even the economy. Choosing wisely from among the various forms of distributed ledger technologies is an increasingly critical decision for central bank executives. The recent IBM Institute for Business Value publication, entitled Central banks and digital ledger



technology governance, outlines the challenges, opportunities and risks for Riksbank regarding Financial Stability, Governance, Consensus, Operational Risk and Resilience, Regulatory Nodes & Risk Management and Blockchain Risks & Rewards. For more information see [IBV study link](#). As we have learned in previous engagements, our solutions support the Banked, Unbanked, KYC, AML, and Suspicious Transactions with the features below:

- Blockchain Node Hosting Infrastructure
- KYC for Banked Customers (in-country participants)
- KYC for Unbanked Customers (out-of-country participants)
- White Label (RIKSBANK-branded) End User Web Experience and Simple Wallet
- White Label (RIKSBANK-branded) Fintech Registration Web Experience
- Anti-Money Laundering Monitoring and Transaction Reporting System
- Bank System Integration and Payment Gateway Supporting Funding / Redemption of e-kronas from Existing Sweden Bank Accounts

VI. Conclusion

IBM has extensive Blockchain Implementation experience with over 400 POCs. IBM Blockchain empowers clients to digitize transaction workflow through a highly secured, shared, and replicated ledger. IBM Blockchain gives the ability to deploy easily and quickly a permissioned blockchain network to test security, availability, and performance. IBM Blockchain has joined The Hyperledger Project to evolve and improve upon earlier forms of blockchain. IBM® combines industry, process, and transaction expertise with our cloud-based tools and secure blockchain services to establish trusted blockchain networks and solutions. IBM Blockchain offers ready-made industry solutions for a cross section of industries. IBM's has a vast eco-system of partners and will leverage their capabilities to deliver value to Riksbank in the future e-krona solution. IBM Bluemix Garage experts help clients develop blockchain use-case on the IBM Blockchain Platform. The benefits of IBM Blockchain:

1. Increased speed of execution
2. Reduced cost
3. Reduced risk with secure environment
4. Tools to Govern the Network, Develop the Network and Operate the Network
5. Accelerators: IBM Bluemix Garage Method brings together industry best practices for Design Thinking, Lean Startup, Agile Development, DevOps, and Cloud to build and deliver innovative solutions.

We welcome the opportunity to continue discussions with the Riksbank regarding e-krona solutions.



Appendix A: High-level component model for blockchain architecture to support e-krona solutions

Solution Component	Description
Business Application	Web or mobile app that enables the user to execute the business process. This needs a high degree of user centric design.
Smart Contract	This encodes the business process into the transaction that creates the block on the chain.
Chain Code	This is the underlying Fabric that enables the attributes of consensus, immutability, provenance and finality to be realized. We use Hyperledger as our Fabric in IBM
IBM Blue Mix Operating System	The system on which the Fabric runs (e.g., Linux)
Infrastructure	The hardware used to host the software (e.g., IBM Cloud)