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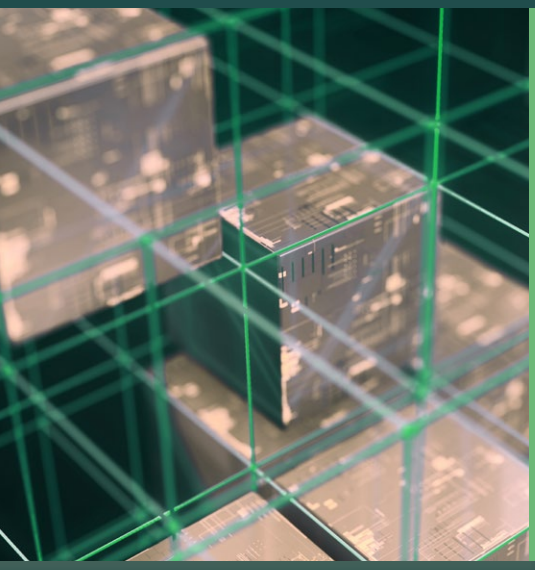

November 2020

Blockchain Interoperability

Towards a connected future

The Digital Investor

Redefining Finance for the New Economy

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Abstract

Interoperability is the ability of software to exchange information between different ecosystems. In the case of blockchains, it has the potential to break the silos and to create a network of blockchains. It is a catalyst for broader adoption of blockchains and crypto-currencies.

In this article, we provide a broad overview of blockchain interoperability, looking at the opportunities it creates, the challenges it faces, and its value accrual mechanism before describing the different solutions. Finally, we briefly present the Polkadot project, an ambitious and promising interoperability solution.

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1. Introduction

More and more people are considering blockchains as safe and promising. Thousands of projects relying on different blockchains have emerged in the last few years. They have specialised in payments, smart contracts platforms, data storage solutions, supply chain management, to name a few. These blockchains are either public or private and have made different choices in terms of security, scalability, and decentralisation, each with unique governance and a specific consensus algorithm.

As a result of all these choices and goals, there are no universal standards for blockchain developments. The blockchain ecosystem is heterogeneous, and the potential of this technology remains untapped if they operate in silos. For instance, we cannot trigger a payment (supported by blockchain A) after delivery occurred (according to supply management blockchain B). The reason this cannot happen is that blockchains are not interoperable.

Interoperability is "the ability of computer systems or programs to exchange information" according to the Oxford Dictionary. In the current setting, blockchains work mostly in a silo, limiting the possibilities offered, their use, and finally their adoption. Imagine how "successful" would the internet be if WhatsApp were not interoperable with your smartphone camera, Facebook with YouTube, and Amazon with a credit card payment system?

Soon, we can extend interoperability to a broader set of assets and activities. These activities can be - a blockchain land register enabling you to pledge your ownership rights on a borrowing/lending platform to get a mortgage; or your digital identity secured on a chain allowing you to unlock your bank account and get access to the social security system.

The current blockchain ecosystem looks like a thousand island archipelago with each island as a separate blockchain project. It is a complex landscape tough to navigate. Interoperability allows blockchains to communicate, to exchange data, and value. Interoperability could break silos and act as a catalyst for mass adoption of cryptocurrencies.

In this article, we provide a broad overview of blockchain interoperability, looking at the opportunities it creates, the challenges it faces before describing the different solutions. Finally, we briefly present the Polkadot project, an ambitious and promising interoperability solution.

In the next Digital Investor, we will dive deeper into different interoperability solutions and explore their value accrual mechanisms.

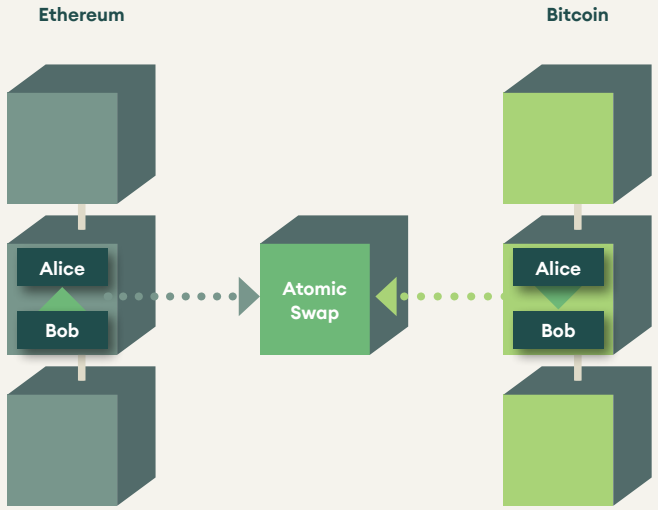
2.
Opportunities

Interoperability would facilitate the communication and exchange of value between blockchains. In this section, we present different functionalities that emerge with interoperability.

Atomic Swap

An atomic swap is an exchange of token ownership on two blockchains. Imagine that Alice and Bob both have bitcoin (BTC) and Ethereum (ETH) wallets and Alice wants to exchange BTC for ETH and Bob wants to exchange ETH for BTC. Interoperability would allow for a peer-to-peer and secure transfer of ownership, as illustrated in figure 1.

Figure 1: Atomic swap



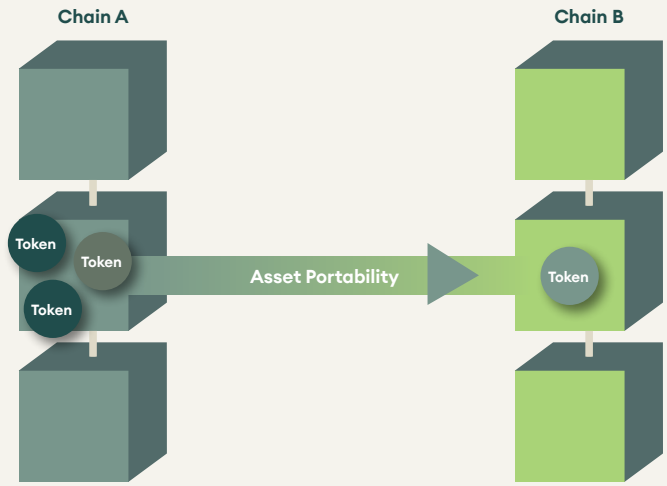
Source: SEBA Bank AG

As the name indicates, it is a swap of assets, and it is atomic. Atomic means that it is either executed fully or not executed at all. It does not allow partial execution, meaning that it is not possible only for Bob to receive the asset from Alice but not the other way round. Atomic swap eliminates the counterparty risk.

Asset portability

Asset portability is the ability to move a token (or a fraction of it) from one blockchain to another whilst maintaining its history in the first blockchain, as illustrated in figure 2.

Figure 2: Asset Portability



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An example of its application would be a healthcare ledger that securely stores our whole health data of patients. A patient may then, fully or partially, send the data to another ledger (health insurance, hospital or the attending physician). It improves the quality of the data as it would be recorded and aggregated on one chain and let the patient retain the ownership of their data.

Cross-chain oracles

Cross-chain oracles allow one blockchain to decide on an event it observes on another blockchain.

1. Say a financial platform A built on Polkadot allows liquidity providers to stake collateral on Ethereum and employs a Chainlink solution to monitor its value. If the value of collateral on Ethereum falls below a threshold, a liquidation will get triggered on platform A.
2. Using a supply management example, one can imagine firm A using its blockchain supply management solution to wait for its supplier to deliver a product. By being continuously informed about its order tracked on the supplier blockchain, firm A can optimally plan its production. The other way round, when the firm A stock of intermediate product provided by the supplier is running low, the system can automatically generate the order. This system can be generalised to several blockchains and firms. Interoperability would then creates one place to interact instead of multiplying bilateral solutions.

Asset encumbrances

Asset encumbrance is the ability to lock up an asset on one blockchain and unlock it if a specific condition on another chain is met. In the earlier example with liquidity providers, interoperability brings atomic transactions which eliminate the counterparty risk.

Collateralised loans are the perfect use case. Imagine you lock assets on a blockchain and get a loan issued on another blockchain; interoperability would eliminate the counterparty risk as both actions will take place atomically.

3.
Challenges

To create communication bridges between blockchains is different from standard Application Programmes Interfaces (API) in vogue nowadays. APIs allow one application to Create, Read, Update, and Delete (CRUD) data in another application. Updating or deleting data on a blockchain is non-trivial as the majority of the network participants must agree with the change. Blockchain design discourages updating history. As it is cumbersome to alter (update) or delete data, blockchains' APIs differ from standard ones as they allow only the CR out of CRUD functions. It implies that when a transaction takes place, it cannot be changed afterwards in case of a mistake. It has two implications. First, there needs to be a guarantee that both legs of a transaction take place simultaneously, or transactions need to be atomic. Second, the transaction inputs must be final.

For instance, if Alice transfers an asset from chain A to Bob on chain B, either Alice's is debited, and Bob credited, or neither action occurs.

Also, a blockchain API requires a waiting period before one can confidently view the response as valid. For instance, bitcoin works on probabilistic finality, not deterministic finality. It means that only after a certain number of blocks (usually 6 for bitcoin), can one say with sufficient certainty that contents of the blockchain are unlikely to be altered, in other words, the information in the blockchain is final. Once a block is final, the data can be bridged to another blockchain in all safety, eliminating the risk of a fork[1].

Besides atomicity and finality, interoperability faces the diversity of blockchains, as we mentioned earlier. As there is no standard, identity and events are recorded differently on each blockchain. An interoperability solution must propose a universal method to read data and to get a sense of it for all types of blockchains.

If an investor thinks that we will live in a world where multiple blockchains co-exist to perform different functions, then there needs something to allow those blockchains to work together. Interoperability solutions fill this gap.

4.
Why should investors care about interoperability?

Blockchains are difficult to design as a well-functioning blockchain requires alignment of incentives of different stakeholders. The complexity of a blockchain's design increases with every added functionality because incentive alignment needs to scale for incremental functionality. And with increased complexity, the attack surface grows as well. Therefore, blockchains are generally good at achieving only specific and limited goals.

If an investor thinks that we will live in a world where multiple blockchains co-exist to perform different functions, then there needs something to allow those blockchains to work together. Interoperability solutions fill this gap.

As of now, money is undoubtedly a use case that public blockchain solves. During this summer, Ethereum showed that blockchains could be good at other aspects such as lending/borrowing, yield automation, and so on. Over 150,000 BTC (worth more than USDbn 2) is on Ethereum blockchain, proving that there is a demand for cross-blockchain asset transfers. Existing solutions allow minting BTC (called as wrapped BTC) on Ethereum with some intermediaries. Interoperability would make these operations easier to perform.

Developers are building interoperability solutions that allow asset transfer between two different blockchains without the need for intermediaries. Seamless portability of assets among blockchains will allow easy access to liquidity and thereby enable liquidity providers to earn yield with less hassle. Thus, interoperability solutions will be able to accrue some value for facilitating the trustless and secure transfer of assets by charging some fee. As the cross-chain transfer volumes increase, interoperability solutions will accrue more value. Therefore, we think that there is merit in evaluating investment opportunities within different interoperability solutions.

[1] This section was largely inspired by the 2019 University of Arkansas Blockchain Center of Excellence White Paper Series "Towards Blockchain 3.0 Interoperability: business and technical considerations" by Mary Lacity, Tach Steelman and Paul Cronan.

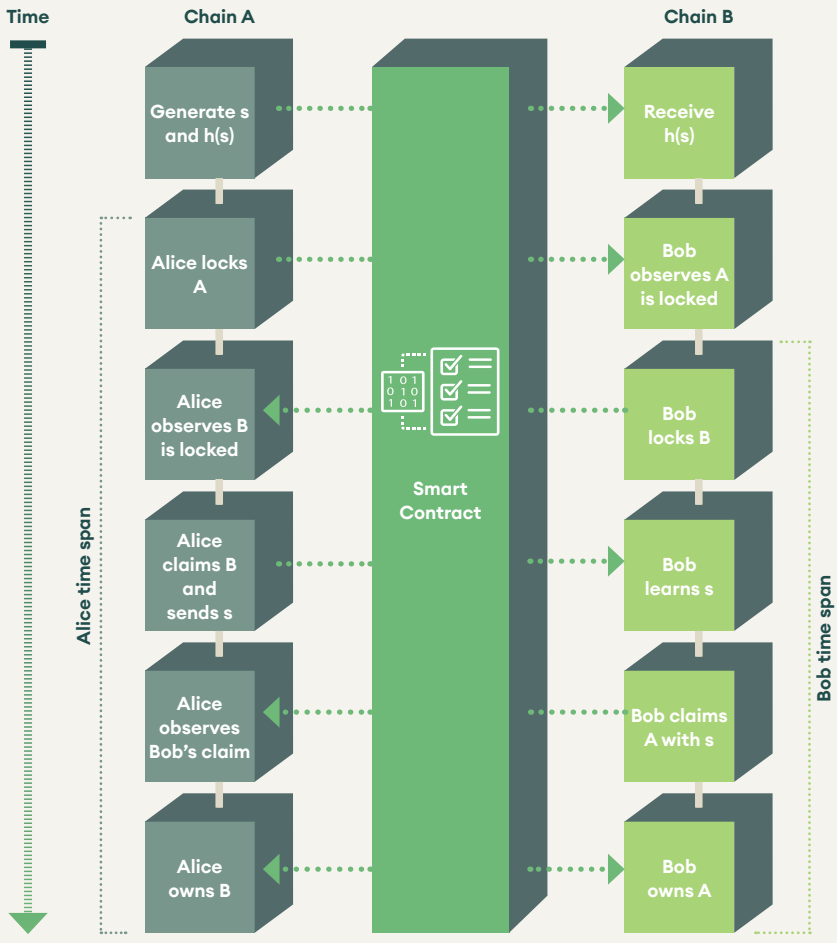
5.
Solutions

From a high-level perspective, there are three ways to design interoperability solutions. The one that interests us the most is the general sidechain/relay solution as it offers the maximum flexibility. We also describe two other solutions, Hash-time locked contracts (HTLC), and notaries.

Hash-time locked contracts

Hash-time locked contracts (HTLC) are smart contracts that link two chains bilaterally, creating only cross-dependency between the two. As the name of this solution suggests, HTLC uses hash and time locks to secure a transaction between two blockchains. Imagine Alice wants to exchange and an asset A on chain A with Bob whose asset B is on chain B. To start the process, Alice generates a secret s and sends the secret's hash h(s) to Bob. In a second step, Alice locks her asset in a smart contract. Bob then observes that asset A is now locked in the smart contract and locks his asset B in the same contract. Alice sends a transaction to claim asset B and the secret s. As Bob knows the secret as well, he is now in a position to unlock asset A and takes possession of it. If the secret is not transmitted correctly (or not received) and no one can claim any asset, after a predefined period, the assets are unlocked and given back to their original owner.

Figure 3: Hash-time locked contracts (HTLC)



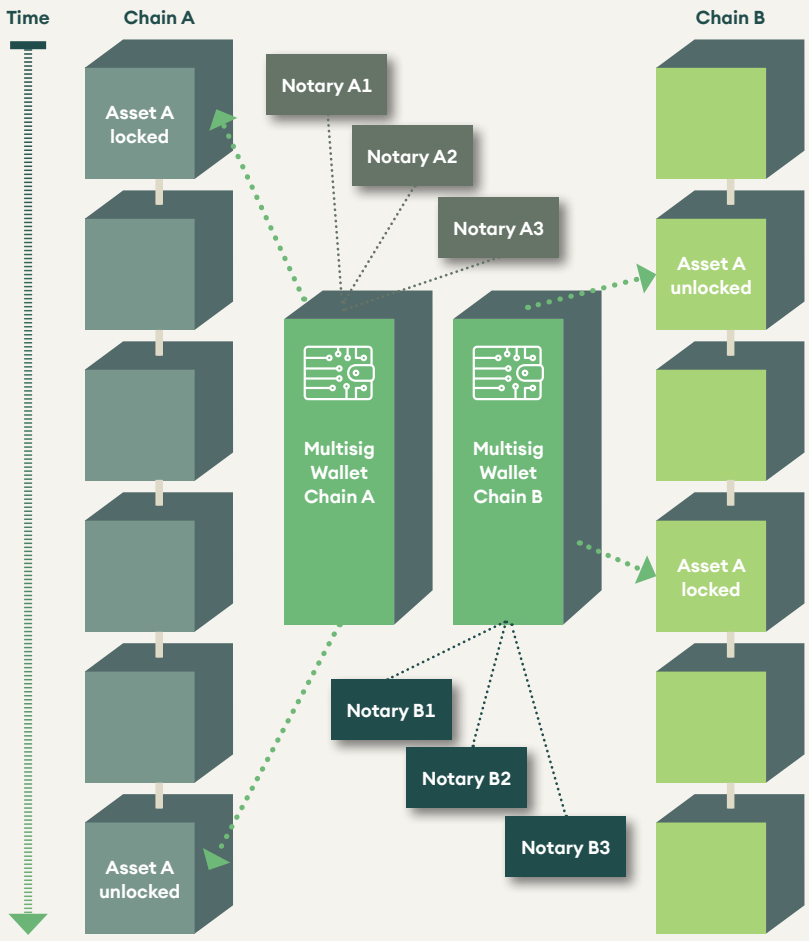
Source: SEBA Bank AG

HTLC is an elegant solution that uses decentralised smart contracts to create a trustless platform for interoperability. One of the significant limitations of the HTLC is that it does not allow for assets to move from one chain to another; it only permits for a change of ownership in different chains, like an atomic swap. Besides, it is a bilateral solution working for Chain A and B in our example. Therefore, it would require n(n+1)/2 smart contracts to connect n blockchains.

Notaries

Another way to design interoperability is to get inspiration from real life notary system. Notaries are trusted third parties that facilitate transactions by checking the validity of a transaction and the existence of assets. Transposed to the digital space, notaries consist of trusted signatories of a multi-signature wallet connecting two chains (notice that single notary solutions are also possible). Imagine Alice wanting to move the native crypto-asset of chain A on chain B. Alice would lock asset of chain A to a multi-sig wallet attached to chain A and owned by a set of reputable notaries running a full node. When done, another multi-sig wallet attached to chain B and owned by a group of reputable notaries would unlock asset A on chain B. If the asset can be repatriated from chain B to chain A as well the system is said to be two-way pegged.

Figure 4: Notaries



Source: SEBA Bank AG

6.
Polkadot

Conclusion

Interoperability is the ability of computer systems to exchange information and value. It is a catalyst for blockchain and cryptocurrency adoption as it has the potential to create a network of blockchains by building bridges between them. Relay/sidechains is a general and promising solution, offering more possibilities than Hash-time lock contracts or notaries. Among the possibilities, atomic swap, asset portability and asset encumbrance are set to be used extensively in our view, shaping the digital ecosystem of tomorrow.

While facilitating secure and trustless value exchange, we expect interoperability solutions to capture value in future. Therefore, we think that interoperability solutions demand investor attention.

Polkadot is a blockchain for blockchains; it connects all the blockchains of today and tomorrow. While Ethereum aims to be the platform to build decentralised applications, Polkadot itself is designed for no purpose other than to connect blockchains. It has no inherent application functionality: it is a scalable heterogeneous multi-chain.

Polkadot built its architecture around three elements: a relay chain, parachains (short for parallel chains) and bridges. The Polkadot blockchain is the relay chain; it is at the centre of the ecosystem and relays the information of the parachains. The parachains or sidechains are the existing blockchains attached to the relay chain. They can be the bitcoin blockchain, the Ethereum blockchain or the ones built on the top of Polkadot. Finally, bridges are the gateways that connect the parachains (not built on Polkadot) to the relay chain. Parachains built on the Polkadot do not need a bridge as they have this functionality embedded.

Polkadot introduced the following four participants to make the relay chain, the parachains, and the bridges work together in a trustless environment: Validators, Nominators, Collators and Fishermen.

- Validators are the participants that create and propose Polkadot blocks. They perform most of the security work. To accomplish this, they need to run a full relay chain node and stake a significant amount of DOT, the Polkadot native currency.
- Collators run full node parachains and submit parachains data to the validators. Collators gather information and propose a block to the validator. For instance, a parachain collator focusing on bitcoin will check bitcoin data and propose it to a validator.
- Nominators contribute to the security of the Polkadot network; they risk capital by investing DOT in validators, signalling their trust. In return, they receive a portion of the validator staking reward.
- Fishermen are “bounty hunters” looking for misbehaviour in the Polkadot network. In case they spot provable malicious behaviour, they receive a significant reward.

Polkadot enables blockchains to upgrade themselves without a fork. These forkless upgrades are enacted through Polkadot’s transparent on-chain governance system and create the possibility to upgrade and to avoid hard fork and a potential breaking of a community.

In the next Digital Investor, we will deep dive into Polkadot and other interoperability solutions and explore their value accrual mechanisms.

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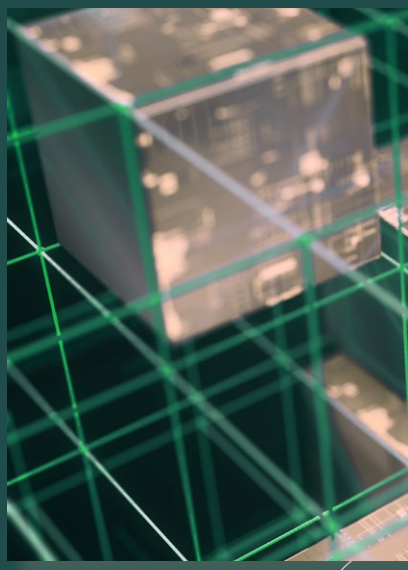

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