Unit 4 Case Study: R3 Distributed Ledger

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BLCN 533 A01 - Finance and Blockchain

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September 24, 2023

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Sometimes we get so caught up in buzzwords that we stop seeing things clearly. R3 is the central company in this case study from the Harvard Business School course-pack (Yan et al., 2019). They calls themselves a distributed ledger company, and while they are certainly inspired by innovations from the likes of Satoshi Nakamoto and Vitalik Buterin, they want to focus on things a little differently than the crypto-punks of the past. Founders and managers at R3 avoid using the work blockchain much, but their underlying product, Corda, shares many similarities with IBM's Hyperledger Fabric (HLF). While Corda relies on Kotlin instead of Golang for smart contract development, both Corda and HLF have pluggable consensus layers and make use of more private modes of participation, which has significant impact on the way consensus is achieved. Corda and R3 are setting trends in the Fintech space, and some of R3's distributed technology characteristics pair well with federated aggregation schemes well for a distributed ledger that is scalable, economical, confidentiality focused, and legally compliant, while also taking into consideration the crytopunk's vision of a disintermediate, democratized, and decentralized trading system.

1. How does Fintech compare to regular banking?

Regular banking is an established and entrenched way of managing transactions in markets. The traditional banking system's ledgers have been keeping the flow of money going around well enough that supply chains, paychecks, business accounts, consumers and the like have been able to transact with one another relatively normally. Money is able to flow around well enough, but there are limitations. Firstly, banks don't really trust one another, so reconciling data between two bank's ledgers is not automatic - it takes time for banks to agree on

a shared transaction set. Secondly, most back-office functions or research departments are treated as support functions since they do not generate revenue directly for the bank. This is where FinTech comes in contrast. Nakamoto set the groundwork for the first wave of a Fintech revolution back in 2008 and by 2017, Fintech had grown to be known as the Web 3.0 movement and took the world by storm. During the time of this essay, there are two distinct types of FinTech companies - those that want to be competitors to financial services and those that want to collaborate with it. Nakamoto and Bitcoin intended to replace the banking system with its FinTech product, but R3 was interested in leveraging the underlying technology of Bitcoin to strengthen the existing financial services system.

2. Discuss R3 and its distributed technology mission.

R3 did not want Corda's design team to fixate heavily on building blockchains. Instead, they wanted to focus on codifying agreements between firms. The individual firms act as state objects, which transition their input states bases on the governing contract code and associated legal prose. The CTO of R3, Richard Brown, did not want all data to be routed to every participating node in the network, but rather only the nodes that need to view or validate an individual transaction. Integration and interoperability are also pillars in its design, which is typical of private or hybrid blockchain environments. Many of Corda's underlying technology provides many of the same benefits that other private blockchains provide, but the notary services and the way pluggable consensus is handled makes it particularly versatile for implementing certain federated blockchain varieties that are interoperable.

3. What are some of the applications of Corda as well as strategies for growing and expanding?

The notarization services in Corda are particularly interesting. Since each notary is capable of having its own consensus mechanism, there needs to be some special work involved to solve the transaction races that could occur. This is an asynchronous problem in nature and the transaction races need to make sure they preserve privacy. Herlihy & Rajsbaum (1995) published an early paper formally describing early decision tasks through the principles of algebraic topology. This early definition of consensus has paved the way for future research, which has used these formal definitions to push what consensus protocols are capable of. Meldman-Floch (2018) uses Herlihy & Rajsbaum techniques to potentially model an internet of blockchains. Essentially, a notary can act as a simplicial complex, which is a node that has to sign the relevant transactions while keeping track of the hash rates of all other notaries. Building on this notary architecture could help Corda grow to be the operating system for finance they hope to be, since it could become relatively easy to prevent fraud in the network while also respecting the privacy of other nodes. Meldman-Floch's notion of cohomology allows the network to have liquidity, or exchange configuration states between protocol complexes/notaries.

4. What are some of the emerging markets that FinTech has impacted?

On May 2018, R3 helped facilitate a Letter of Credit (LOC) based trade between two branches of the international food and agricultural conglomerate, Cargill. LOCs are usually expensive for the financial system to issue, but R3 helped manage the entirely of the soybean shipment between branches in Argentina and Malaysia at a reasonable cost.

Sticking with the theme of the rest of this paper, netting and liquidity management services are also springing from the FinTech movement. Fleischman & Dini (2021) describe how blockchains can help implement liquidity-saving mechanisms similar to clearing houses or

other interbank payment/settlement systems. Helping provide liquidity to financial services in need without an intermediary is a good next innovation for Fintech companies to make.

Conclusion

Treating a notary as a simplicial complex should be the next move for distributed ledger innovators around the world. If R3 envisions a world where distributed ledger technology acts as an operating system of sorts for the financial institutions of the world while also respecting the privacy of transacting parties, it is going to need to embrace principles of algebraic topology and cohomology. Efficiently solving transaction races is a mathematical problem in nature and the notaries of Corda could act as effective simplexes to allow for some level of liquidity between blockchains. Cross-chain interoperability, federated aggregations for reporting, as well as quick processing times could all be provided in one elegant protocol.

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