Chronicle Accelerate (XCL) Platform
Where HFT and AI meet Blockchain
White Paper
Version 1.1, 26th Jan 2018

Executive Summary/ or mission statement

XCL (Chronicle Accelerate) is a new cryptocurrency project that, learning from the previous Blockchain implementations, aims to solve the issues limiting adoption by building an entirely new protocol that can scale to millions of transactions per second, delivering consistentp sub-second latency. Our platform will leverage AI to control volatility and liquidity, require low energy and simplify compliance with integrated KYC and AML support.

The XCL Story

Founded by Peter Lawrey, XCL leverages the development expertise and software framework of Chronicle Software. First developed in 2012, Chronicle Software are the leaders in delivering open source, Java based, low latency messaging. These components have been downloaded by hundreds of thousands of developers and used in hundreds of companies to enable the development of complex low latency applications. We have also worked closely with some of the world's leading financial services companies to develop core equities trading, foreign exchange and payment systems. These systems are distributed and operate at microsecond latency with throughput of millions of records per second. In short technically this is all we do, and the team cumulatively has over 100 years' experience in this domain. Peter is considered to be the premier Java expert on low latency, his blog "Vanilla Java" has had more than 4 million hits.

Initially, Chronicle Software was focused on a making a single machine faster and creating microservices with latencies of around 20 - 50 microseconds including recording every event in and out of the service. Services are designed to be highly asynchronous to minimise the impact of latency. Now with higher performance hardware at a reasonable cost we can achieve latencies in the order of 100 microseconds across multiple machines.

What is XCL?

The XCL platform combines low latencies (sub millisecond), IoT transaction rates (millions/s), open source AI volatility controls and blockchain for transfer of value and exchange of value for virtual fiat and crypto currencies. This system could be extended to other asset classes such as securities and fixed income. It uses a federated services model and regionalized payment systems making it more scalable than a blockchain which requires global consensus.

The aim is to add cryptographic signatures and verification to reduce the need for trust between nodes, and distribute to thousands of clusters of nodes using a federated model. Our experience in building highly asynchronous systems gives us expertise in creating transactional services without the need to total ordering. This adds complexity to the state model but can dramatically reduce the latency of those transactions and increase throughput.
Instead of attempting to support all possible transactions with a general turning machine, we are looking to start simple and optimise for common financial transactions widely performed today with the view that new contracts can be added to particular services.

Motivation behind the project

As experts in developing industry-leading financial systems used commercially and internationally by enterprise, the teams understanding of the intersection between finance and high-performant technology lead to conceptualising a future defining paradigm for a modern financial system when the software community first started realising the power behind the blockchain distributed ledger.

The ideas behind XCL were formed from a mixture of this understanding and conceptualisation, combined with focusing on the flaws that the founding projects in this space are still fighting.

Being a team of financial I.T experts, consulting to enterprise has helped grow a strong reputation and built a wide network which will assist us in honouring our commitment to progress into international regulated markets in a compliant manner.

We believe that by enabling a banking class Blockchain protocol that can scale to the same levels of the most used payment platforms like Visa, we can enable the mass adoption of crypto currencies and other Blockchain applications.

Our intent is to provide a protocol and framework that can be leveraged by the Blockchain community to pay and exchange in and across both crypto and fiat. This will also significantly reduce the transaction costs, opening the market to an increased base of users for simple everyday banking activity. The federated model allows additional chains to be added providing specialised customised micro-services to the ecosystem.

In addition to our framework we will deliver applications that can be used in conjunction with our protocol to deliver extended capabilities such as secure wallets applications can quickly be deployed, linkage to digital payment applications enabling everyday transactions to be completely digital and currency independent.

The design of the system started with the assumption that it will get hacked, however we aim to make it so there is very little value to the hackers to do so, and a low impact if the system is breached, for example having a private user database storing KYC information that is encrypted so that even if someone was able to obtain a copy, it would have little value. The only way to decode such a database would be to know each user's password.

Hacking a triple-entry accounting system such as blockchain is largely impossible, however arbitrary smart contracts create a large security surface to test in order to reduce the impact of being hacked. Akin to traditional contract loopholes, omissions or unintended behaviour in smart contracts are the attack vector for many blockchains, and we are instead looking to implement contracts which are already common in finance and are well understood.

The XCL Team And Partners

Front End Design

Peter Lawrey
CEO

Peter has over 15 years of experience in optimising high performance systems, including ten years in fine-tuning financial systems. He specialises in low-latency Java, designing, developing and supporting systems for hedge funds, investment banks and trading houses.

Anna Tarrant
Project Manager

Anna is project manager for XCH, working with the team to deliver the best product possible. Anna uses her vast experience and background in politics to assist in communication and the smooth delivery of tasks and timings for XCH.

Lilia Villafuerte
Senior UX Designer

Lilia is a Human Computer Interaction (HCI) professional. As a consultant, she has a wide experience in Financial Services with global clients as UBS, Deutsche Bank and HSBC. She is an expert in design of emerging technologies and part of the European Commission Data Base of Independent Experts.

Back End Development

Rob Austin
Technical Development Director

As a Java developer with more than 20 years experience, primarily on trading and pricing systems for investment banks, Rob has worked as a Java specialist for investment banks focusing on trading and performance critical pricing systems. He is the Technical Director of XCH and Chronicle.

Madhuri Sowmya Podaralla
Technical Lead

Sowmya is the Technical Lead developing the digital wallet application for XCH. She has over 13 years experience in developing Enterprise Web Applications and has been worked for numerous Investment banks in London, designing and developing java based web applications.

Dmitry Pisklov
Developer

Dmitry has been working for investment banks and commodity trading for the last 10 years. As performance has always been Dmitry's passion, the low latency space and XCH is a perfect fit for his unique skills.

Romulus Pasca
Developer

Romulus is a Java developer, with more than 12 years of experience writing distributed software for financial markets. He is driven to create software that is elegant, fast, and reliable.

Mark Price
Developer

Mark is a skilled software practitioner with experience in leading teams, low-latency coding practices, distributed systems design, continuous delivery, monitoring & metrics, automated testing, performance testing and Linux system tuning.

Tony Gonzalez
Developer

Technical Lead / Java Developer with 20 years experience working as a Consultant for global Investment Banks in The City of London focusing on electronic trading.

Advisors

John Bantleman
Entrepreneur and Mentor

John describes himself as a serial entrepreneur having led two Nasdaq IPOs and several trade sales focused on enterprise software.

Sabrina Rai
Compliance and Regulation

Sabrina joins XCH as Head of Compliance and Regulation. Her background as an administrator allows her to work closely with the team as an advisor. Sabrina's key areas of responsibility include complying with appropriate governance and regulations.

Security - NuCyper
A security and encryption platform for distributed systems. Security professionals are advisors, and recommended the high performance elliptical curve cryptography algorithm.

Downloads
XCL is built using open source software which already has a high number of downloads and is used in most Tier 1 and 2 banks.

How XCL differs

The XCL platform directly addresses concerns more recently encapsulated in a paragraph from an article from the IMF -'Central Banking and Fintech-A Brave New World?' (**add footnote https://www.imf.org/en/News/Articles/2017/09/28/sp092917-central-banking-and-fintech-a-brave-new-world**) reading:

"Because they are too **volatile**, too **risky**, too **energy intensive**, and because the underlying technologies are not yet **scalable**. Many are too opaque for **regulators**; and some have been **hacked**."

XCL will address these issues in the following ways:

- A transparent and open-source AI will be used to reduce **volatility**. This AI can allow a free market for small market movements most of the time but either buy back or sell off reserve assets to reduce larger weekly movements.

- The platform supports a KYC chain of verified details and verifiable facts to increase transparency with **regulators**.

- To reduce the chance of **hacking**, the smart contracts will be limited to common, simple, well understood financial transactions. This limits the security surface area. Arbitrary smart contracts could be supported as an additional chain.

- Proof of Receipt is designed to reduce the **power** consumption of micro-transactions by allowing any stake holding node to authorize a transaction, supporting **linear scalability** and reducing the fundamental cost of transaction by an order of magnitude compared with Proof of Stake.

- As well as Proof of Receipt, the platform will have many chains running concurrently using a federated model. We believe each chain can support in the order of 100,000 transactions per second and you can reasonably have over 1000 concurrent chains.

- To minimise technical and commercial **risks**, we are looking to involve partners and security experts such as Nucypher.

- The XCL team understands the growing need for **interoperability** in a space where competition is rife, and will have a strong focus on allowing for easy integration of other cryptocurrencies to enter the core platform.

Blockchains at scale

Rather than a chain of blocks, the nodes in a cluster will be building a signed tree of blocks. A tree allows concurrent construction of the transactions, and signing each block (rather than using a hash) provides proof that a node with stake created the block.

By leveraging current financial software built by Chronicle, the XCL protocol will be developed with reference implementations for other applications that will work on their own blockchains, with all the data being aggregated back into the core blockchain that acts as the backbone of the system.

The XCL platform will use Proof-of-stake using a signed tree in order to use orders of magnitudes lower power than Bitcoin requires with Proof-of-work, and using a custom-designed implementation of an off chain network will result in Visa like transaction performance for each chain from the start, and will be able to scale linearly with the number of nodes on the system.

The XCL platform also allows for proof-of-receipt, in which each stake holding node is able to sign a receipt to guarantee a transaction occurred, and who it was authored by. This supports linear concurrency while any node found to be issuing fraudulent receipts will have their stake diminished heavily.

When a transaction occurs, a deposit for fee(s) is associated with it. A node can choose to accept and guarantee the transaction and take the entire fee or it can pass it to the cluster to approve the transaction, sharing the fee with the cluster. Micro-transactions which are guaranteed by a node can accepted in sub-millisecond timings. Large transactions are approved after the block is accepted by the cluster. The rules and risks in the ecosystem will grow organically over time.

This fact will allow for superior scalability and be able to power a future of messaging, payments, Forex and IoT, with millions of devices being able to transmit streams of messages every second.

Federated Model

The XCL platform's federated model allows each cluster of nodes, providing a service type/region/asset combination, to act independently with transfer of value between chains via a main chain facilitated by all nodes. Each node in a cluster will put up a stake and this determines how much it can approve transactions without consensus both within a cluster and on the main chain. While there is a minimum stake required, a larger stake would allow a node to approve more transactions independently of the cluster.
Settlement within a cluster occurs after a short period of time, such as 1 micro week (about 0.6 secs), and with the main chain settling every milli-week (about 10 minutes).

Clusters can provide different services and be responsible for a region if required for regulatory purposes, such as:

- Payments in New York.
- Payments in Lebanon.
- Exchange USD for XCL tokens.
- Exchange XCL tokens for time locked tokens usable in 2020.
- Messaging in London.
- A specialised chain for a custom micro-transaction service.

The client wallet application or web service will automate the movement of value around the system and be interruptible at any stage. A use-case would be:

- Send GBP from a London account to a New York account in USD
- This would require five transactions.

- London account to the GBP/XCL exchange
- Exchange GBP for XCL
- Transfer the XCL to the XCL/USD exchange
- Exchange XCL for USD
- Transfer the USD to the New York account.

At each stage of the process there would be forwarding instructions, and standard protocols to reverse the entire transaction if it failed.
Each account's address will include a region to make transactions within that region more efficient and cheaper. Regions will be based on the ISO-3166 standard. For example an account which is notionally in New York would start with 'usny', e.g. @usny8d7k27dfg, whereas an account in London would start in 'gbldn' which would allow the chain to split as needed, and support more efficient transactions within a chain and the routing of value between chains.

These sub chains have three key uses:

- Improve throughput by increasing the number of concurrent chains.
- Allow different nodes/providers to run different services
  i.e. they can run just the XCL/USD chain.
- Allow nodes running a service to be naturally localised to improve latencies.

Scalability

The design is multi-tier with the high value, low volume transactions requiring the highest security, medium sized transaction happening in real time, and small transaction designed for maximum scalability.

Tier	Transaction Size	Latency	Proof	Node scalability
Global Weekly	Millions of coins	A week Sun to Sat	Highest Tree	1/log(N) N is large
Global	1,000s of coins Large transactions	A milli-week ~10 minutes	Highest Tree	1/log(N) N is large
Regional	Coins Small transactions	A micro-week ~600 milli-secs	Highest Tree	1/log(N) N is small
Local	Coins micro-transactions	Sub microsecond.	Highest Tree & Receipt	Linear N is small

This uses the following assumptions to improve performance

- By number, most transactions are small
- By number, most transactions can be confirmed out of order.
- By number, most transactions are highly likely to be successful.
- Each tier requires a supermajority of nodes to agree except the “Local” tier.
- Local tier transaction are those which do not require total ordering.

Each tier handles 1000x the round rate of the higher tier. Every 1/1000th round is synchronised with the round above.

With the platform designed as above, we might achieve the following throughputs.

Tier	Cluster Count	Per Cluster Rate	Combined rate
Global Weekly	1	10K / week	10K / week
Global	1	10K / 10 minutes	10K / 10 mins
Regional	10 - 1,000	10 - 100 K / s	1 M/s - 10 M/s
Local	100 - 10,000	100 K - 1000 K / s	100 M/s - 1 Bn/s

The XCL platform would be looking to achieve over 100,000/s transactions for a cluster of ten 500 W servers. This translates to around 50 mWs or 14 billionths of a kWh per transaction. A ratio of over ten billion times more efficient than Bitcoin at time of writing.

Proof of Receipt

Proof of Stake requires one node in a chain to create all the transactions for that block. This is efficient in terms of power consumption, but is fundamentally serial in its processing.
Proof of Receipt allows any one node to sign for a transaction provided it is within that nodes risk profile. For low value transactions, every node can issue such a receipt giving the platform a linear scalability with the number of nodes.
A region like New York could run a self-contained cluster for payments. This cluster acts like a node in the federated model. It can issue receipts for payments between regions based on an allocation, and follows the same process.
Micro-transactions can be fulfilled by a single node in a regional cluster. Larger transactions need to be performed by a cluster, but no other cluster would be involved. Transactions between regions need to involve the nodes of both regions.
Low value transactions can be confirmed by Proof of Receipt. The node issuing the confirmation is liable if the consensus of node determines the transaction didn’t occur.
If the consensus is that it did occur, the node gets the entire fee for managing the risk.
Transactions which are too large for the node’s allocation or risk threshold will be deferred to the blockchain for confirmation and the fee is shared by all nodes.
Each node is a cluster (for small value) and each cluster (for larger value transactions) has a credit based on their stake. All nodes running a service know the stake of each node running a

service. This could be hundreds to ten thousand nodes (for one thousand chains). At the end of each milliweek, the transfer of value between clusters is settled via the main chain.
At the end of each week, the entire chain is check-pointed, allowing a new node to join without having to play all the events from the start.
Bitcoin has in the order ½ TB of data in its blocks at time of writing, but if you had a chain which sustained 1000x this rate i.e. the rate VISA does, you might struggle to ever join once it has started. As servers can fail, the number of servers might only decrease over time.

Bitcoin currently uses around 0.1% of the world's power production. If the cost per transaction could be maintained (and it is not clear how this could be achieved) a 1000 fold increase would require all the power production in the world.

In summary:

Transaction	Latency	Confirmed
Proof of Receipt (intra cluster)	milli-second	Micro-week (0.6 secs)
Proof of Receipt (inter cluster)	100s milli-seconds	Milli-week (10 mins)
Larger transactions (intra)	0.6 seconds	Micro-week
Larger transaction (inter)	10 minutes	Milli-week
Node hand over (checkpoint)		Each week.

Proof of Receipt is checked at the end of the round to confirm this type of transaction.
Say a node issues a receipt and dies before informing the others. This transaction can be presented to any other node in the cluster for confirmation.
Proof of Receipt ensures the funds are available to the receiver. Those funds either come from the sender or the faulty node's account. This is determined when the chain completes a block and the nodes come to consensus. If a super majority of nodes or a stake agree a transaction occurred, the money is taken from the account holder, if not the node is liable.
Nodes are limited by their stake.

This means it is possible for a node to transfer money from an account which has a balance larger than its own stake, but only up to some percentage of it, e.g.

- Account 1234 has XCL 1,000,000
- A node has a stake of 10 * XCL1K (10,000).
- It can approve transactions of up to 5,000 within a round, however anything larger in total must go to the cluster for a consensus decision.

A cluster in turn is limited in how much it can transfer out at once, up to some percentage of its stake. If this is exceeded, it has to be confirmed by the main chain, and even then it could still be rejected. The transaction may need to be broken up over multiple rounds. This is to provide some protect an account against the misbehaviour of a node or even a cluster.

A large account might need to transfer money in portions in each round, rather than all at once to stay within allocation limited. This is to prevent one node or even all nodes quickly transferring out all the money in a cluster.

The value of money held in a cluster would influence the minimum stake require to join a cluster, as well as the minimum number of nodes in a cluster in order to run it safely. Once a cluster has far more nodes than it needs, it can fork in 2 to improve performance and reduce overhead.
The cost of approving a transaction which is not accepted in consensus could be double (or more) the value of the transaction against the nodes stake.

Proof of Work or Stake have a separate layer between the blockchain and the transactions within it. First a block chain with total ordering is constructed and then determining if those transactions succeeded or not is relatively simple. The drawback is you have to wait for the block in the chain to be built before you know anything.

Proof of Receipt blurs the line between the blockchain and the transactions logic. It allows certain common transactions under certain common conditions to occur in any order, and not require consensus except to prevent fraud.

For example, say you have $100 and you attempt three transactions of $40, the order matters as to which transactions succeed. However, say you have $10, or $1,000, in either case they will all fail or all succeed regardless of the order.

In the IoT world, there will be a large number of very small transactions which can succeed based on a risk assessment alone.

The Exchange

The XCL platform will have its own value exchange chains, which will allow for trading crypto-currencies and fiat currencies, with the ability to hook into various gateways via streamlined API's. These gateways could exist for an easy exchange between XCL tokens and fiat currencies, and the exchange would have different individual blockchains serving as ledgers for specific currency pairs such as GBPXCL.

Each fiat/digital currency/metal supported has an exchange to XCL tokens. A provider could support just one currency of interest. Non XCL to non XCL exchanges could be supported where liquidity is highest.

From these exchanges, the price for any value token to any other token can be determined. The opening price each week would be determined by the volume weighted average of the last N volume traded in the last week(s).

Using a feedback control Artificial Intelligence connected to each the exchange, running open-source, transparent code, the market volatility and liquidity should be controlled by automated buying and selling of currency for XCL tokens.

There will be a Main AI will serve as the 'central bank' for XCL, as well as independent AI's working with each exchange to manage the volatility of that exchange.

The central money supply is in the exchange of XCL1K for XCL. An XCL1K is a coin is notionally worth 1,000 XCL but is likely to be discounted, and is consumed by a node running a service and in return that service node gets 1 XCL token for each milli-week.

If the service node buys XCL1K for 900 XCL, it can get a reward of 1000 XCL and net 100 XCL per week. More nodes increase the price, reducing the reward, less nodes lowers the price increasing the reward.

The XCL1K is also required for proof of stake. If a node is to approve say 10,000 XCL worth of transactions between rounds, it would need to hold at least 20 XCL1K in addition to the 1 XCL1K to run the service (only the latter is turned into coins).

Rather than create XCL1K tokens directly the AI can create new XCL1K2019 tokens to avoid surprising the market with new tokens. These tokens would only be created as demand increases e.g. the price rise by 1% from the start of the week. They would be bought back if the price falls.

The XCL1K2019 tokens become full value XCL1K in the first week of 2019. Also, XCL1K2020 and XCL1K2021 tokens can be created. Creating new coins over time in a staged and indirect manner, makes the money supply predictable on a yearly time horizon.
Conversely, there is a limit to how many XCL tokens the XCL1K exchange can hold so if too many coins are created, the excess coins which the exchange holds are destroyed. E.g. it's cap could be 10,000,000 XCL and 10,000 XCL1K.

Incentives and Governance

Service providers who decide to run a node will be rewarded via a Proof of Stake mechanism. They will be able to purchase a special "XCL1K" coin which will credit the holder 1 coin for every 0.1% of the week the service is run.
The focus for XCL is in financial rewards for running the service. A balance between rewarding providers to encourage them to provide a high quality service and cost to end users must be found. It is of the opinion of XCL that trying to determine exactly how that would work for say 100 years is almost impossible. Instead XCL will use market forces where possible and the open source AI for other key factors to manage the money supply and reward structures.
The Open Source AI will have updates over time, be open to review, and not needing a human to intervene to manage the currency.

Restrictions on bad behaviour.

Nodes are limited by their stake. This means it is possible for a node to transfer money from an account which has a balance larger than its stake but only up to some percentage of that stake e.g. 50%.

For example, say account 1 has XCL 1,000,000 however a node has a stake of 10 * XCL1K or 10,000. It can approve transactions of up to 5,000 within a round, however anything larger in total but go to the cluster for a consensus decision.

A cluster in turn is limit in how much it can transfer out in one go up to some percentage of its stake. If this is exceeded, it has to be confirmed by the main chain, and even then it could be rejected.

A large account might need to transfer money in portions in each round, rather than all at once to stay within allocation limited. This is to prevent one node or even all nodes quickly transferring out all the money in a cluster.

The value of money held in a cluster would influence the minimum stake require to join a cluster, as well as the minimum number of nodes in a cluster in order to run it safely. Once a cluster has far more nodes than it needs, it can fork in 2 to improve performance and reduce overhead.

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Proof of Stake vs Receipt

Proof of Stake requires one node in a chain to create all the transactions for that block. This is efficient in terms of power consumption, but is fundamentally serial in its processing.

Proof of Receipt allows any one node to sign for a transaction provided it is within that nodes risk profile. For low value transactions, every node can issue such a receipt giving the platform a linear scalability with the number of nodes.

Each node has an allocation which is determined periodically e.g. one million times a week or about 0.6 seconds. Within that period, it can sign for transactions up to it allocation based on the stake the node has. The higher the stake(higher the value if the transaction), the more transactions it can sign for. At the end of each period all the transactions are replicated and totalled. If a transaction is deemed by consensus to have not occurred, the node is liable for the money, however if the transaction did occur, the node get the whole fee. Transactions which are larger need to wait for the end of the block adding up to a 0.6 second delay and can only be approved by consensus.

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Micro-transactions can be fulfilled by a single node in a regional cluster. Larger transactions need to be performed by a cluster, but no other cluster would be involved. Transactions between regions need to involve the nodes of both regions.

How is Proof of Work or Stake fundamentally different to Proof of Receipt?

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Power Consumption Estimates

Bitcoin uses around 8 days' worth of US household power consumption or around 250 kWh for each transaction https://digiconomist.net/bitcoin-energy-consumption

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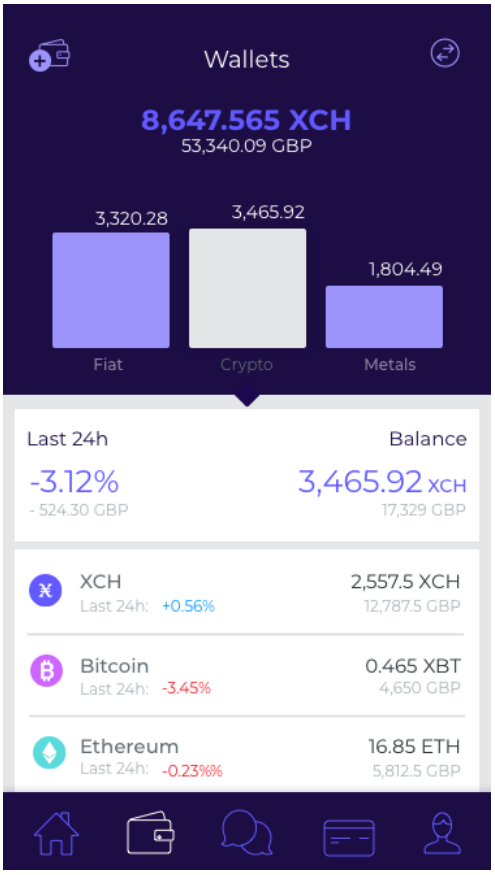
Compliance and Regulation

In 2017, with the rise and success of blockchain platforms and cryptocurrencies, governments and regulatory authorities worldwide began considering the economic effects and started implementing ICO specific regulations.
At XCL we are dedicated to stay ahead of the competition by monitoring new and impending regulations worldwide on a daily basis, with a weekly summary of changes. By staying up to date, XCL will be able to provide services adhering to country specific regulations, ensure we are compliant and this in turn will help to reduce costs.

XCL Wallet - Mobile
Note: XCL was called XCH.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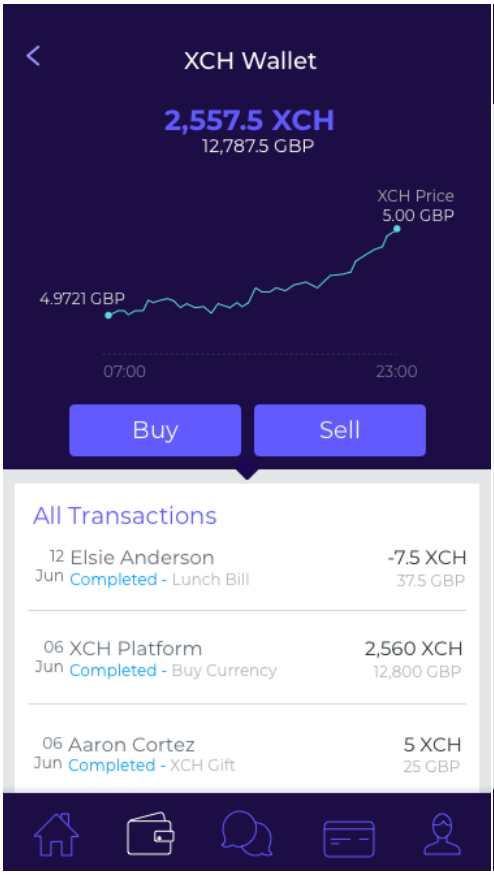
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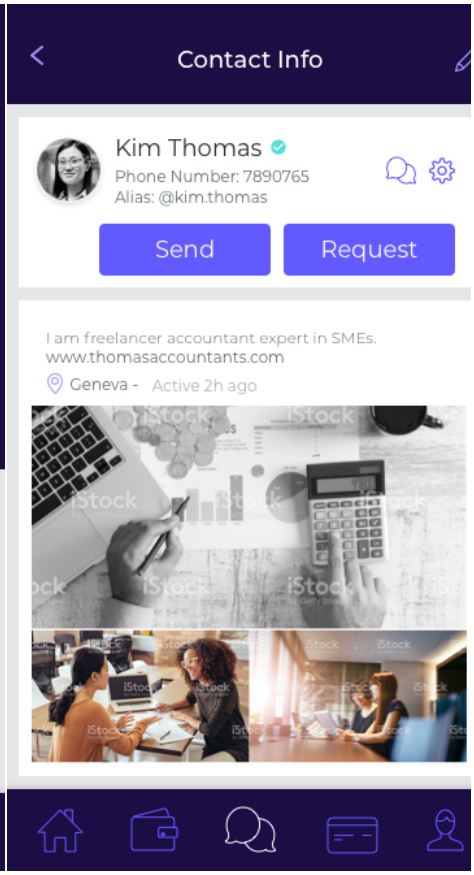
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Kim Thomas
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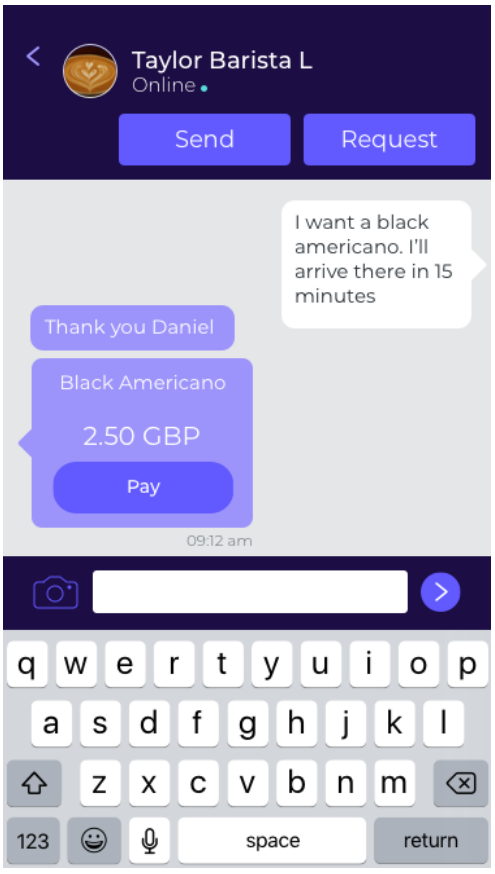
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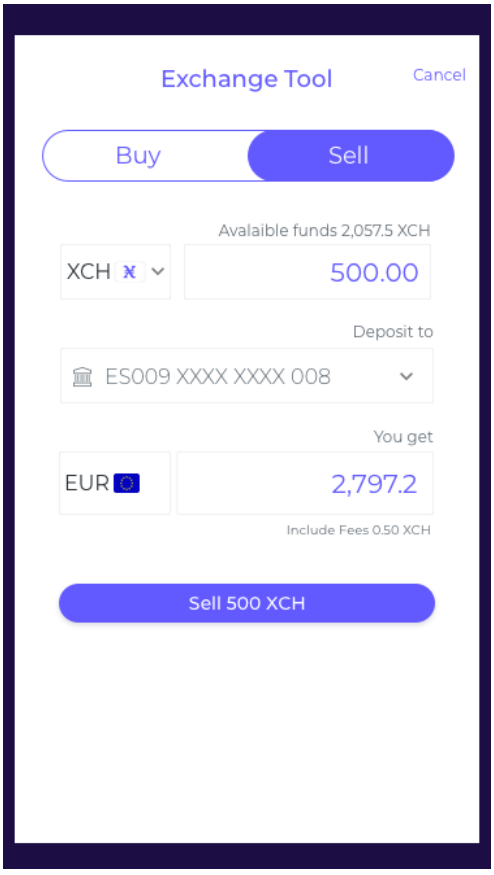
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You get
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Include Fees 0.50 XCH
Sell 500 XCH

Initial Coin Holdings

Token types	Founders/Early Stage	ICO	Main AI	Opening price
XCL		50 M	50 M	£1
XCL1K	30 K	30 K	30 K	£900 (900 XCL)
XCL1K2019	10 K	10 K	10 K	£800 (800 XCL)
XCL1K2020	5 K	5 K	5 K	£700 (700 XCL)
XCL1K2021	5 K	5 K	5 K	£600 (600 XCL)
Total XCL	50 M	100 M	100 M	£0.81 avg

For Early Stage funds, we are looking to sell up to 10 M XCL at a discount and anything not sold is passed to the Founders and Early Stage contributors.

For the ICO **stage, XCL token** will be sold at a smaller discount. Any XCL not sold are discarded.

Regardless of the amount sold, the Main AI will start with 100 M XCL in value to work with.

Road Map

Event	Date
Initial Development	Nov 2017
White Paper released	Jan 2018
Website launched	Feb 2018
Technical White Paper	Mar 2018
Pre ICO fundraising	Mar 2018
Alpha version	Apr 2018
Beta version	May 2018
ICO fundraising	Jun 2018
Launch	Sep 2018