



Network for next generation of B2C applications

Development Plan



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CTO

APEX Network

Chinapex

Dear APEX Community,

What we have here is a development plan overview for the APEX Network, its blockchain technology, and its ecosystem. At APEX we have a unique approach of building out our blockchain project - we believe that three fundamental aspects must go together to ensure long-term success of the project 1) the technology itself and the extent in which it can solve the problem it was set out to tackle 2) speed to market and the real-world adoption rate of the technology (and the levers you set and create that act as catalysts) and 3) the actual value delivered in a timely manner (in other words long-term sustainability of the project).

Note that this paper is not a whitepaper, in that it is not meant to focus on outlining to the audience the technical workings of the blockchain itself, but rather is intended to demonstrate a development plan with long-term use case and viability for growth. At APEX Network and Chinapex, we also approach technology in an agile manner in which technical design is improved with fast iterations on an ad-hoc basis.

Best Regards,
Richard Wang

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Background

Abstract

The business to consumer (B2C) market is one of the largest global mega-verticals, with B2C ecommerce (excluding brick-and-mortar) alone expected to reach a size of \$3,940 billion by 2022. Other than core business competencies, differentiation strategies, supply chain, product offerings, and competitive strategy, a large part of the success of a B2C enterprise has to do with managing the customer lifecycle - this includes marketing, branding, CRM, customer experience optimization, and maximizing customer lifetime value (CLV).

The next generation of best practice B2C lifecycle management hinges upon 2 main areas: data and B2C interactions. Despite the proliferation of big data, marketing technology, marketing channels, and artificial intelligence, customer data and customer engagement remain ridden with problems. In the aspect of consumer data, problems have arisen from massive centralization and data hoarding by 3rd parties. And for B2C engagement, the centralization of marketing and communication channels, as well as ineffective customer loyalty and CRM strategies and tools.

These are in a sense technology problems, but they are also problems relating to the structure and nature of the B2C interactions. Centralization of data and interactions has created efficiencies, breakthroughs, and network effects, but up to a certain extent they start creating bottlenecks and interactions and relationships become one sided.

The goal of APEX Network is through proprietary blockchain technology, foster deeper 1-to-1 B2C relationships, by giving enterprises newer optimized ways to approach marketing, CRM, loyalty, and customer experience, and at the same time maximizing value obtained by the consumer in all B2C interactions.

The Data Problem

The best way to describe the current data ecosystem is that it's broken for both consumers and enterprises. For the consumer, data and the value generated via its use is typically completely out of control of the consumer, who by principle should hold data a sovereign asset and retain data ownership. For the B2C enterprise, there's a multitude of issues surrounding data transparency, quality, cost effectiveness, and security, hindering the maximum potential of data-driven applications.

Centralized Data Ownership Model and Data Hoarding

With the advent of distributed computing and big data, a centralized data aggregation model has created a number of efficiencies and breakthroughs for consumer data analytics, digital marketing, and in general Web 2.0. Business models that benefited the most from centralized data aggregation included but is not limited to consumer data companies, internet companies, and media platforms - these business models typically focused on "network effects", "monetization opportunities", and "economies of scale" created by amount and depth of consumer data points with a "the more the merrier" approach. The centralized data ownership model has proven to be very lucrative for such companies and their constituents, and are behind the core business model that drives their profitability. Prime examples include Facebook, Google, Baidu (China), Alibaba (China), Tencent (China) and Naver (Korea).

This problem with this model is that it goes against the grain of the ideal model of data ownership, in which contributors obtain a fair share of value that's earned from the contribution, incentivizing more in-depth participation instead of simply a one-sided model. A decentralized protocol that models fair data ownership model between platforms, consumers, and enterprises is more ideal and healthy going forward.

Data Security and Privacy

Data security and protection of privacy is one of the largest issues in the consumer data space, particularly because of the number of catastrophic incidents of consumer data breach or privacy violation of data stored with internet and consumer data companies. Some incidents are examples of the security flaws of centralized data storage, such as the 2017 Equifax data breach incident, which leaked close to 150 million sensitive identity data, and multiple Yahoo data compromises starting in 2013. Other major incidents can't be classified as traditional data breaches, but flaws in design due to centralized data business models. The Facebook user data privacy violation that occurred in 2014 as a result of research firm Cambridge Analytica harvesting the behavioral and psychographic data of 50 million users for political use was due to a product design loophole that exposed the data rather than data storage security breach.

Data security and privacy issues don't just affect consumers, they also affect enterprises that are looking to optimize their customer experience and lifecycle. In terms of the general consumer data landscape, if consumers do not trust enterprises to keep their data safe, they are less likely to share much information and engage in various interactions. With the influx of applications and different types of devices, including IoT, close to 70% of consumers worry about security and privacy risks. In lack of response from brands and enterprises and inability to implement measures (and lack thereof of an effective solution) have over 30% of surveyed consumers believing that brands simply do not put consumer data privacy as a priority.

Consent and Legal Compliance

Consumer consent and legal compliance is becoming a significant factor that is shaping how the consumer data landscape is moving forward. One prime example is GDPR (General Data Protection Regulation), which is set out to officially roll out May 25, 2018, tightens data protection rules for all companies in Europe and outside of Europe for any data collected relating to and of EU residents. GDPR sets strict rules and practices for data collection, consent, and processing for the enterprise and gives consumers more control and rights in data access and erasure. The enforcement of consumer data rights and consent is not just a EU phenomenon but can be seen in a wave of recent regulations in Asia as well, including China's new Cybersecurity Law that was already effective since June 2017 and Japan's Personal Information Protection Law (effective mid-2017).

One primary theme within this wave of regulations is consent and control the consumer has over her own data, and secondary point emphasized mostly revolves around stricter processes surrounding the storage and processing of consumer data. The consent aspect has been for the most part in the past one-sided, with consent protocol not implemented or implemented in a implicit manner. Decentralized technology can play a significant role of how consent and layered permissioning protocols can become more fair, transparent, and automated.

Data Transparency, Accuracy, and Quality

For enterprises who actually acquire consumer data using compliant means - the quality, accuracy, recency, and transparency of data source are the key factors to consider when trying to evaluate overall value. There are two aspects that affect overall data quality and value - first is internal processes in collecting and managing customer data, second is data acquired from 3rd party providers and sources. On the internal side, it's purely a best practice and technology problem - the process can be completely managed and the data is entirely transparent from the start.

On the external and 3rd party side, data is typically acquired by the enterprise in structured and usable form. The original data source, validity, recency, method of cleansing, and method of analytics is typically a "black-box" to the enterprise user. To give some perspective of 3rd party data acquisition in practice - APEX Network/ Chinapex has studied our enterprise customers' results with 3rd party data across over 200 companies. 3rd party providers included Unionpay and data partners of China Mobile and China Unicom (largest telecommunication companies in China), and were connected into our clients' data platforms via APIs using Chinapex's flagship marketing data product NEXUS. The results of our study were rather surprising - 23% of the data points had the consumer gender wrong, and 27% of the data had a wrong device type/brand identified. We estimated the average data recency to be 4 to 6 months. We have come to a conclusion that a centralized black-box model of data transaction via aggregated sources is difficult to give enterprise users the reassurance that it needs.

Cost Effectiveness, Cost Control

Being able to having a say in determining the fair cost for any particular datum should be of importance to both enterprises/brands as well as consumers. The centralized data aggregation business model of internet, media, and consumer data companies do not allow that to happen, which by design goes against a fair data ownership model of consumers themselves setting the cost (and gets compensated as a result), or an enterprise setting the cost, in the case of B2B transactions without a centralized platform or middleman.

As we see as a general theme here - centralized models in data ownership, storage, and exchange leave many difficult problems surrounding trust, privacy, security, rights, quality, and cost-effectiveness on the table unsolved, hindering the development of next generation of data-driven B2C interactions.

The B2C Interaction Problem

The data problem is only one side of the picture - on the other end there's the interaction and engagement layer that makes up the core of the B2C customer lifecycle. When we talk about engagement, it consists of components such as channel of engagement, the customer experience, and level of engagement. Currently we have various channels of engagement being ineffective, customer experience being subpar, and level of continuous engagement lacking. Brands try new B2C interaction methods and channels, and new loyalty programs, but they're only having marginal effects.

DATA	Audience Data	Behavioral Data	Purchase Data	CRM Data	CRM + Product Usage
	Awareness	Engagement	Conversion	Retention & Loyalty	Maximize Lifetime Value (CLV)
ENGAGEMENT	Direct + 3 rd Party	Direct + 3 rd Party	Direct Channel	Direct Channel	Direct Channel

Data-driven insight combined with in-depth engagement is the future of optimized B2C lifecycle, from awareness to conversion to maximum customer lifetime value (CLV).

Significant Value Expended by Middlemen Networks

In this particular context, we define "middlemen networks" as any channel or layer that facilitates communication, interaction, or exposure between enterprises and consumers. Some examples arising from the scope of "middlemen networks" may include media, ad networks, affiliate networks, advertising platforms, push notification channels, 3rd party applications, etc. Some of these channels have one "layer" which delivers the method of engagement directly to the consumer, while others have multiple layers nested within each other that take a cut of the value (typically in the form of marketing budget) - examples include ad networks, advertising platforms, and affiliate networks.

With the advent of programmatic marketing, using audience targeting via acquired 3rd party data has somewhat increased efficacy of the advertising, but questionable consumer data quality, media inventory quality, and suboptimal cost effectiveness has not solved the core problem. There is minimal value returned to the consumer for participating or partial participation in the engagements, hence no incentive for being involved in a more in-depth manner. Looking at a couple numbers may be enough to put things in perspective:

- **56% of digital advertising** are not seen (noted viewed) [Google/Double Click Study]
- **\$6.3 Billion of digital ads** will be wasted on fraudulent activity or bots [ADWEEK]
- **23% of premium video ads** is fraudulent bot activity [IAB]
- **58% of consumers** do not trust online banner advertising. [Nielsen]
- **52% of consumers** find push notifications annoying [Localytics]

Ineffective Loyalty and CRM Programs

Brands and enterprises from various B2C sectors including travel, retail, and financial services have attempted to create their own loyalty programs of various formats, the most typical case using a point system in different tiers of rewards can be redeemed. The results have been for the most part mediocre, and the process at times cumbersome and not helping the customer experience in general. Reasons include 1) mainly purchase-related behavior has been linked to rewards, not adding much value of the loyalty point system to deeper engagement levels 2) redemption processes are cumbersome and options are limited mostly within the vendor's offering - brand partnerships require manual commercial negotiation process and cross-brand redemptions are complex due to unstandardized integrations.

Brands in general have had a hard time creating a loyalty solution that consistently increases engagement, seamlessly fits into the customer journey, and enhances the customer experience on a continuous basis. A ideal solution would need to provide consumers more tangible immediate value as well as optionality, and fit in more comprehensively in the customer lifecycle and the customer experience rather being focused on purchase behaviors.

In terms of CRM programs that focus on promotions and offers via notification and messaging channels, 55% of them have not proven to deliver results. Studies have shown one key factor is that most CRM programs have been more of a one-sided approach where the consumer views it as a solicitation rather than value-adding.

Ineffective Solutions for Customer Lifecycle Management

Customer lifecycle management is often a tricky task even for large established enterprises with a strong IT and data strategy. An optimal customer lifecycle management approach for the enterprise would enable the brand to provide their customer a seamless and engaging customer journey across all the different touchpoints in the lifecycle, including online, at brick and mortar retail locations, and in mobile applications. To achieve this, 1) comprehensive behavioral data needs to be collected at various touchpoints 2) cross-channel, cross-touchpoint, and cross-source data need to be stitched together in unified profiles 3) suitable engagement methods that fit in seamlessly with the entire customer experience.

Chinapex (Parent company of APEX Network) happens to be in the business of data-driven customer lifecycle and journey management. Chinapex's data management product, NEXUS has solved many of our 300+ enterprise customers' problems surrounding integrating data across various touchpoints and data sources into unified profiles - but still two key problems remain 1) data collected via the various touchpoints often are often not deep enough to produce meaningful actionable insights 2) ways to engage the customer are often still limited to direct marketing or push notifications, and produce a noticeable difference but do not change the nature of the engagement.

Summary

As we see from our assessment above, optimizing both the data plus interaction layer is the key to improving B2C relationships and the customer lifecycle, but we have seem to come to bottlenecks on both ends with current technologies that do improve B2C engagements but not changing the nature of the B2C engagement model. We see where the problem lies is in the structure of the value network for both the data and interactions aspects. In the case of data - currently it's a one-way street in which data aggregators receive the majority of the value followed by enterprises and then for consumers the least. The structure of this data value chain creates problems surrounding privacy, compliance, security, cost-effectiveness, transparency, and quality. On the interaction side a similar problem appears where either most of the value is expended via middlemen networks or the consumer receives no value, or negative value in the form of solicitation. **A paradigm shift is needed in which value is balanced and driven by trust and balanced benefit-sharing.**

Blockchain as a Solution

So far platform-level blockchain technology (excluding tokenized applications) has mostly been adopted for the use case of cryptocurrency or the broader fintech (financial technology) space. Since Bitcoin, there has been a proliferation of more general public blockchains which dApps (decentralized applications) can be built on such as Ethereum, EOS, and NEO, as well as more use-case specific chains (Ripple, Filecoin, ICON, Ontology). In this paper we will show that marketing, CRM, and B2C lifecycle is a unique but significant use-case in which adoption of blockchain technology has a clear advantage.

Based on our previous analysis, below are key points of transformation that need to occur surrounding the B2C engagement and lifecycle in order to optimize B2C interactions to the next level:



These aspects of B2C engagement and interactions can all be optimized with blockchain technology. Any problem concerning fair value distribution or value conservation (elimination or reduction of middlemen networks' value expenditure) can all be addressed through smart contract technology combined with an immutable distributed ledger. For giving more control back to the consumer over her data as well as enhanced privacy and security, features such as encryption of data in-transit as well as using an encrypted self-sovereign identity, combined with consent-driven data transaction protocol using smart contracts can change the existing centralized consumer data aggregation and ownership model.

On improving the level of engagement, incentivizing for engagement, as well as providing more tangible value for engagements, tokenizing value within a particular dApp or brand network, and then being able to exchange the asset easily for other assets (ie. from other brands) on the larger network is disruptive new possibility that blockchain brings to the table. This traditional CRM and loyalty programs haven't been able to achieve.

With an enterprise-ready blockchain platform that is crafted for building data-driven and engagement-rich B2C applications, brands and enterprises will be able to build custom dApps around the entire customer lifecycle aimed at increasing trust, protecting privacy, enforcing consent, increasing the depth of interactions, building loyalty, and in general creating stronger 1-to-1 relationships.

Scale of the Problem

Using blockchain technology, our goal is to solve and optimize the B2C engagement problems as seen outlined earlier in this paper - which is not a simple single problem but rather a set of problems along the B2C customer lifecycle value chain applicable to almost all B2C subverticals. The scope of the problem includes marketing, branding, CRM, loyalty, customer experience, as well as using data and insights to improve product design and other core competencies. Note that it is not the goal to replace existing centralized systems, tools, and middlemen networks, but having decentralized technology to disrupt parts of the value chain when it makes sense to.

\$ 156 Billion

Size of consumer and marketing data sector in the US alone (DMA).

\$ 82 Billion

Projected size of the CRM market by 2025 (Grand View Research)

\$ 32.4 Billion

Estimated size of 2018 marketing technology sector. (IDC)

\$ 281 Billion

Estimated size of the global digital marketing market in the year of 2018 (Statistica).

\$ 17 Billion

Customer experience management (CEM) market size by 2022

Retail

In a survey of leading retailers, 87% of participants believe that blockchain technology will be key to the future of the retail industry, including in areas of networked loyalty programs and customer data management. (Cognizant)

Automotive

The auto sector is going through a transformation of shifting from product-centric to customer centric. This would require stepping up to the next level in terms of customer lifecycle management and data-driven personalization. (Ernst & Young)

Travel

High quality and real-time customer data is playing an increasingly important role in travel industry marketing. Blockchain technology is already used in pilot programs to improve marketing and sales in the travel industry. (Skift Research)

Financial Services

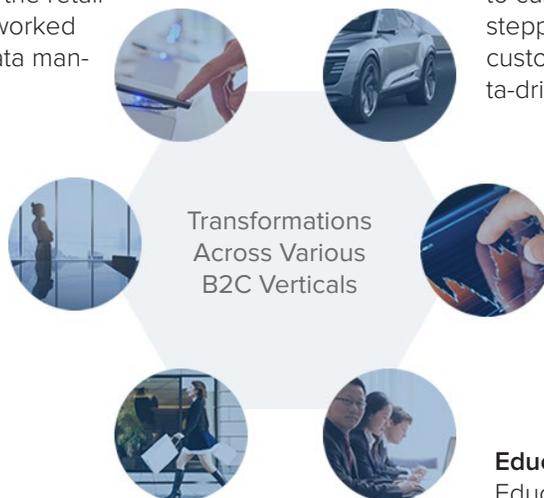
Blockchain will be important in the financial services and banking sectors to help transform customer experience, one key example of using blockchain to help create a unified view of the customer. (UNISYS)

Luxury & Lifestyle

Blockchain will be playing a transformative role in optimizing customer experience, trust, and marketing in the luxury industry. (FTAccelerator)

Education

Education is a sector in which CRM plays a critical role to the customer lifecycle. Blockchain technology has large potential to transform customer data management in this sector. (EdTech)



Key Considerations

Given our understanding of the problem, the market, B2C customer lifecycle, and the target user groups, the next question to ask is what would be some key considerations in designing an ideal blockchain solution for the particular use case and purpose. These key considerations need to be looked at at a holistic perspective - from both technical and commercial aspects, as our priority is speed-to-value and adoption and technology is just a means in itself without use-case adoption.

Speed-to-Value

An ideal solution has an ecosystem in which network effects can be stacked up over time - one in which has a healthy, growing, and collaborative ecosystem of enterprises/brands, consumer users, application partners, and enterprise technology partners. For this to happen, it's key for the process in which the enterprise experiments and adopts the technology must be timely. This factors into various aspects of the blockchain project, including built-in enterprise features, ease of development, SDK/API robustness, and level of support for POC (proof of concept) stages.

Connectivity

Many applications and smart contracts on the blockchain need to be connected to the real world and integrated with existing systems in order to maximize real value - real-time data streams from external centralized or decentralized applications and data sources is especially important for enterprise-related applications. Currently on most public chains such as Ethereum, connectivity to external data sources are realized through oracles, but they are built as external add-ons rather than native modules usable easily directly through SDKs. For enterprise to build and deploy real-time connected applications in an agile manner, built-in data connectors and data middleware capabilities can significantly expedite the process. This is also important in the other way around - easy implementation of triggers that send signals from the blockchain and dApps to outside application and platforms.

Scalability

Performance at scale is definitely an important consideration for enterprise applications, especially for networks with over thousands of members. While most public blockchains that are available do not have a high transactions per second (TPS) metric (with most below 100), performance limitations are increasingly critical to enterprise adoption moving forward. Consistent performance at scale requires architecture that separates and localizes workstreams, uses optimized consensus protocols, and uses higher performance technology for code execution. For a blockchain to be truly scalable, it also needs to be redundant in design to prepare for major outages.

dApp Ecosystem

Depending on the primary application use case of the blockchain, the way the dApp ecosystem is built out could vary. Ideally, the developer ecosystem creates apps organically over time, but if its main use-case is enterprise heavy, we will need to focus on accelerating value and usable solutions first. To accelerate value, the core developer of the project as well as strategic partners would need to develop or propel some basic applications that fulfill an initial use case, and then either open source it or even release an SDK for customization and quick development.



APEX Network

Vision

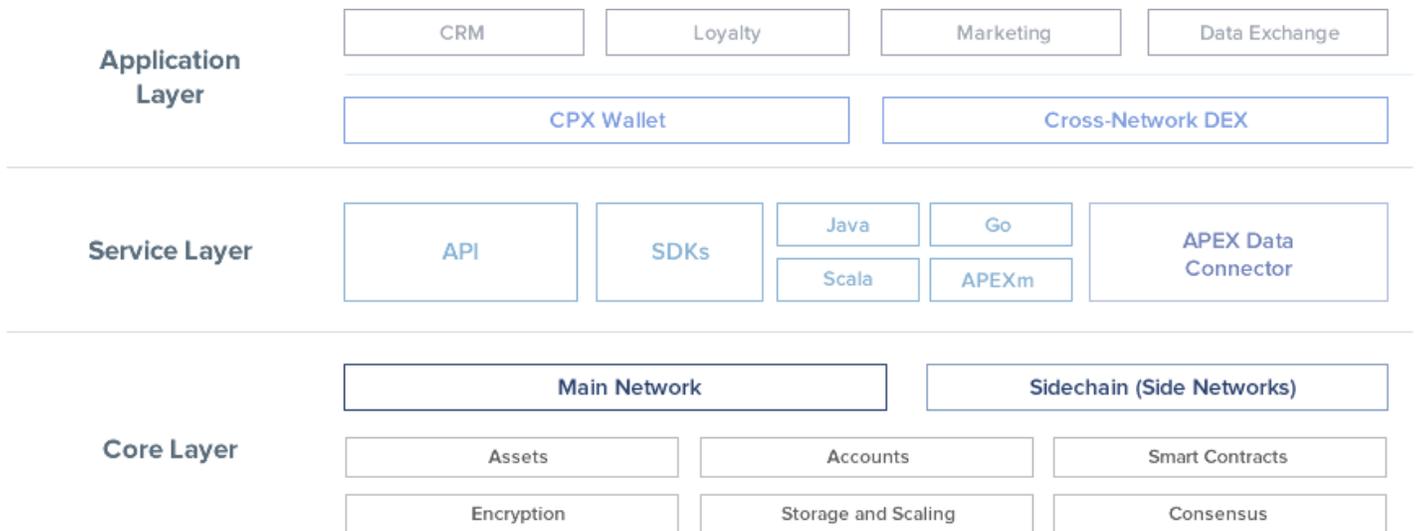
The vision of APEX Network is to build stronger 1-to-1 relationships between the enterprise and consumers through proprietary blockchain technology - transforming how interactions, information, and value is exchanged throughout the B2C engagement process. APEX Network will help facilitate increased trust, privacy, and transparency for B2C interactions. It will also optimize efficiency, cost-effectiveness and help eliminate middlemen networks when necessary.

Another key component to APEX Network is connectivity, in terms of both connected information as well as connected value. Information and data, when transacted using fair and transparent protocols, not only can enhance B2C interactions and experience but also can facilitate B2B data-level collaboration and exchange. Similarly, connecting and enabling the exchange of brand-assets, such as tokens and loyalty points, on a frictionless platform provides a turnkey gateway to alliances and commercial partnerships that previously required manual arrangements.

Brands and enterprises will be able to rapidly build and deploy decentralized applications for use cases across the customer lifecycle, including but not limited to marketing, CRM, customer experience optimization, loyalty, and customer insights.

Platform Framework

The comprehensive framework of the APEX Network blockchain is 3-fold - the core blockchain layer, the service layer, and the application layer. The core layer allows for the flexibility of transactions, assets, and dApps to reside on either the main network or side networks (sidechains) for both scalability and enterprise ecosystem considerations. For an enterprise to create new tokens or assets, it must occur on the sidechain, while the main network still maintains full record of all transactions, as well as would be required for cross-sidechain transactions. The APEX Network uses a delegated Proof of Stake (DPOS) consensus mechanism for the main network and Proof-of-Stake (PoS) for any sidechain on APEX Network.



The service layer serves as the building blocks for real applications and fosters data connectivity to real world and external systems. On top of the RESTful API, there will be initially 4 SDK's - Java, Scala, Go, and APEXm, an XML-based markup language and syntax system custom-built to quickly customize and deploy decentralized applications. Initial selection of Scala, Java, and Go is considering a combination of enterprise fit, data-driven application suitability, and overall performance.

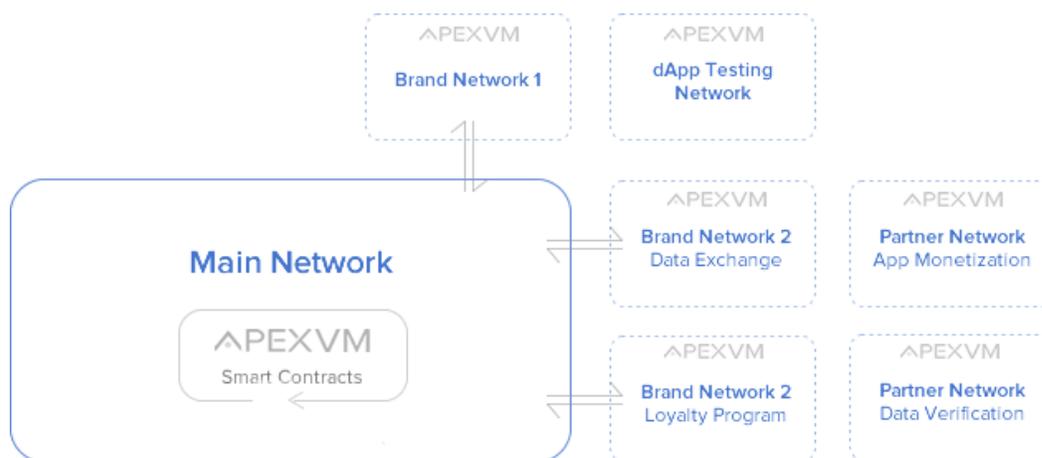
The APEX Data Connector is enterprise-grade data and API middleware built for use on top of APEX Network smart contract system and use with service layer API and SDKs. APEX Data Connector will enable easy development of both inbound and outbound data transmission as well as triggering certain external actions. This is done through a YAML/XML-based API middleware syntax developed by Chinapex since 2016 with a DAG (directional acyclic graph) logic structure. This module is crucial for building enterprise-grade applications requiring integrating with existing legacy systems data sources, and platforms.

The application layer gives boundless potential for applications surrounding the B2C customer lifecycle, such as CRM, marketing, customer experience enhancement, customer loyalty, gamification, data exchange, customer insight, and other engagement-related applications. Two initial applications built by APEX will be CPX Wallet, and a cross-network DEX for APEX Network-based asset exchanges, which will be also embedded within CPX Wallet.

Sidechains

APEX Network utilizes sidechains as one of the key unique features of the blockchain for 1) scalability of standalone applications and localized transactions that do not need to apply to the entire network (in other words enterprise user-specific transactions) 2) seamless transfer of assets across main network and various sidechains while keeping “workstreams” separate at the same time. Sidechains on APEX Network use a 2-way peg in which CPX and other assets can be transferred to and from the main network and sidechains.

To create a sidechain, a APEX Node Client will need to be run on at least one server, with the main account meeting the minimum Supernode requirements, including amount CPX held (it requires at least one Supernode to create an APEX Network sidechain). Unlike other blockchain sidechains in which different technology can be used from main chain to sidechain, APEX Network sidechains can be thought of as essentially mini-replicas of the main network with a subset of the functionality and permissions as the main network (ie. sidechains cannot create and index additional sidechains). We recommend each enterprise user to at least have one sidechain on APEX Network, depending on size of organization and breadth of use case, as well as APEX core development team having its own sidechains for various projects and initial applications.



Consensus Mechanism

APEX Network uses Delegated Proof-of-Stake (DPOS) as its consensus mechanism for the main network, which uses a reputation system and real-time voting to achieve consensus. Delegates (Supernodes) must hold a minimum amount of CPX before they can be eligible to be voted. Once Supernode status has been achieved, their main roles include 1) aggregation of transactions across the main network into blocks 2) validate the transactions by signing and broadcasting the blocks 3) help resolve consensus issues in a democratic manner. Typical Supernodes on APEX Network are expected to be run by APEX Core Development, enterprises/brands, certain strategic investors, and application partners. In the initial phases of Mainnet launch, APEX and Chinapex will provide technical and operations support on setting up Supernodes.

DPOS allows for major speedups in transaction times and minimize effort and resources required to run and secure the network. For sidechains created extending the main network, a Proof-of-Stake (POS) consensus mechanism will be used - for the purpose of growing the sidechain ecosystem in a scalable manner (maintaining a localized delegated voting system per sidechain does not make functional and economic sense in the particular use cases of APEX Network).

Supernodes

Supernodes on the APEX Network will receive rewards in CPX based on an incentives framework, which specifications will be released in detail by APEX Network in May 2018. The dimensions in which total incentive amount per Supernode is determined includes:

- I. The amount of CPX held in account
- II. Total transaction volume of CPX across main network
- III. Supernode status
- IV. Number of sidechains created and sidechain transaction volume

There will be a standard profit sharing of Supernodes to voters set in the range of 30-40%. Voters who receive profits will be split into three tiers (There is a 50:32:18 ratio in weight difference in profits received between T1/T2/T3):

- **T3** - no minimum requirement on CPX held
- **T2** - minimum 70,000 CPX required
- **T1** - minimum 200,000 CPX required

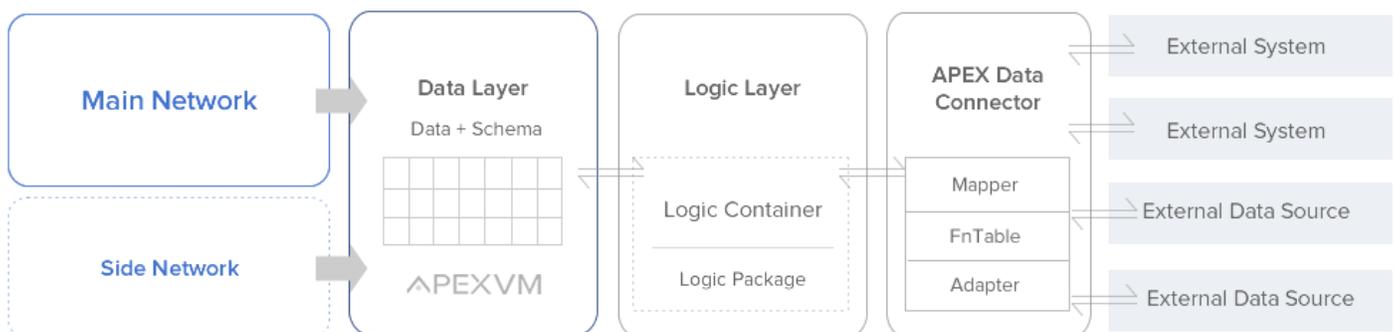
Smart Contracts

APEX Network utilizes a different smart contract system than typical public blockchains - our goal is to provide enterprise users with the largest flexibility, scalability, and confidentiality when necessary for their various B2C (and B2B) applications. APEX Network's approach is to create multi-layered architecture for smart contracts, which consists of the data layer, logic layer, and middleware layer.

Data Layer - The on-chain layer directly running APEX Virtual Machine (APEXVM) defining the data logic and schema on the main network or side networks. All data and transactions will be persistent on the APEX Network blockchain.

Logic Layer - The logic layer is a secure layer that hosts the functional and business logic of the smart contract. The logic layer does not need to be run on the nodes of APEX Network and can be run in the cloud or a remote server. The logic layer consists of what APEX refers to as 1) The logic container and 2) the logic package, which contains the custom code for execution. The logic layer will require digital signatures using private keys, enclaves, and other features to perform cryptographically secure operations. The logic container will also be able to expose APIs to connect with the middleware layer and other outside systems. The logic layer is what provides APEX Network's smart contract scalability.

Middleware Layer - The middleware layer is the service layer that communicates with outside systems and data sources, this is effectively the APEX Data Connector, which we will outline in more detail in the next section.



APEX Data Connector

APEX Data Connector is a heavily modified version of APEX Link tailored for use with APEX Network. APEX Link is a proprietary data integration middleware technology developed by Chinapex in 2016 for the purpose of rapid two-way functional and data integration of external systems and data sources into flagship data platform NEXUS. The technology was used with large success by its enterprise user base and decreased integration time and resources to nearly 15% of manual integrations.

APEX Data Connector consists of 3 main modules:

Adapter

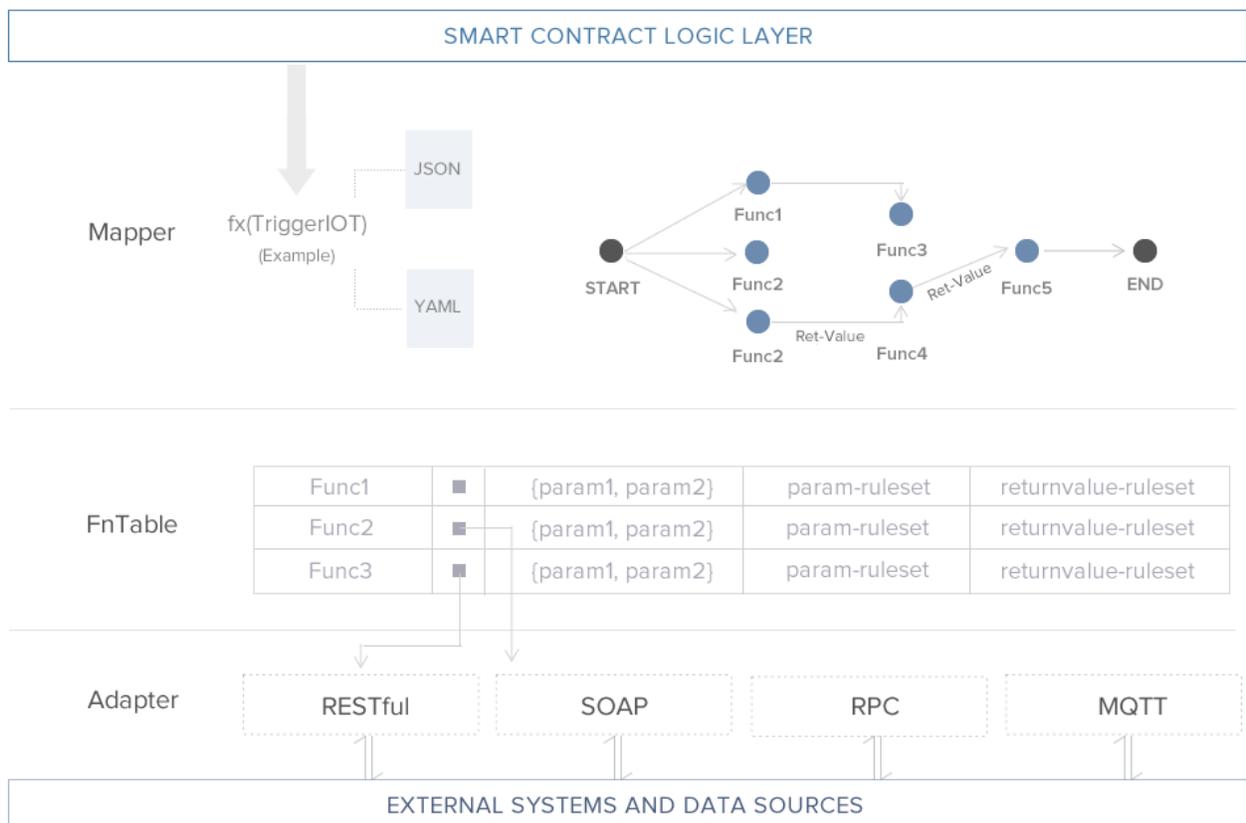
The adapter module serves as the “socket” for all all major API and connection types to external systems, including REST, SOAP, RPC, and MQTT. It serves a similar purpose to an API gateway.

FnTable (Function Table)

FnTable abstracts any API call to the adapter module into DNS-like pointers representing functions. Each function has a specific rules and parameters, as well as return values. Original implementation of FnTable data structure was using Aerospike on SSD persistence.

Mapper

The mapper is where virtually any type of integration regardless how complex can be implemented in an efficient and simplified fashion. To create a map requires a setting up a mapping document in JSON or YAML (XML-like) format. A map consists of multiple nodes in the structure of a DAG (directional acyclic graph), with each node as a abstracted function from FnTable. If we imagine the graph having a left to right direction, left-right represents primary importance of runtime execution order and and top-down represents secondary priority. Return values of one node/function can be passed on to the next node as a parameter. The last node will always by default the END node, which finishes the map and may have an optional return value dataset (if the objective is to retrieve data from an external system).

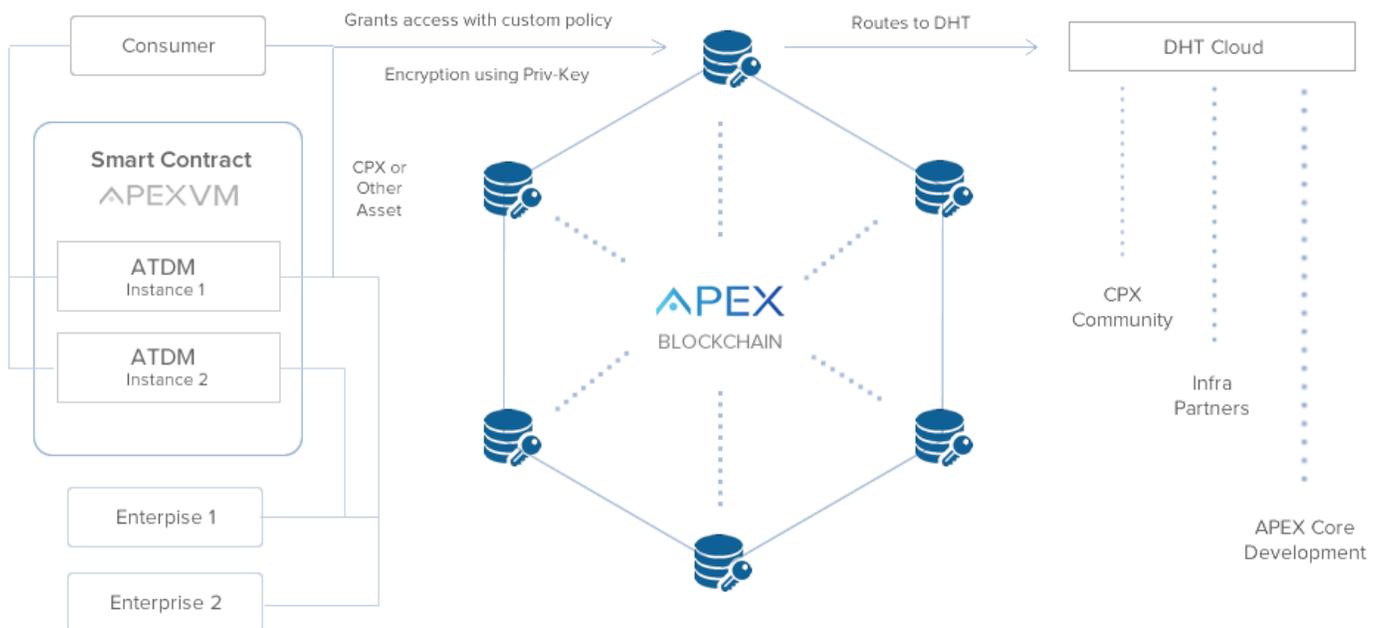


Personal Data and Transactions

One of the advantages of APEX Network is that it has built-in capability for data privacy, consent protocols, and transactions protocols for both B2C and B2B use cases. We use a hybrid on-chain and off-chain consumer data management model that facilitates data ownership, transparency, auditability, and access control.

We call this data management protocol the APEX Transactional Data Management System, or ATDM in short. ATDM is built as a native module in the APEX Virtual Machine and can be easily plugged into smart contracts and decentralized applications. The basic building blocks of ATDM is as follows:

- In terms of smart contracts and APEXVM, ATDM acts as an object that has methods, input parameters, and return values.
- To create any data transaction protocol using ATDM, the program just needs to create a new ATDM instance and initialize it with rules and properties. (cost controls, preconditions, maximum transactions, etc). There may be multiple ATDM containers per contract or dApp.
- ATDM has a fixed set of native building blocks to protect consumer data:
 - Identity management** - for personal users, there are two types of data that are transactable 1) unified identity data and 2) application data. Each user has multiple sub-identities associated with different applications.
 - Access control** - give access to enterprise users with a customizable set of policies.
 - Encryption** - encrypted data is routed from the blockchain (using SHA-256 hash) and stored off-chain in a DHT (distributed hash table) run by a collection of Data Cloud Nodes. Consumers users will be able to store a portion of their unified identity and personal data on the Data Cloud Nodes.



The Data Cloud nodes housing encrypted consumer data from the APEX Network dApp ecosystem will initially be hosted by APEX Core Development and infrastructure partners and eventually will open up the Data Cloud to be hosted partially by the CPX holding-community, in which would include a separate rewards and incentives program, which would come from data transaction fees.

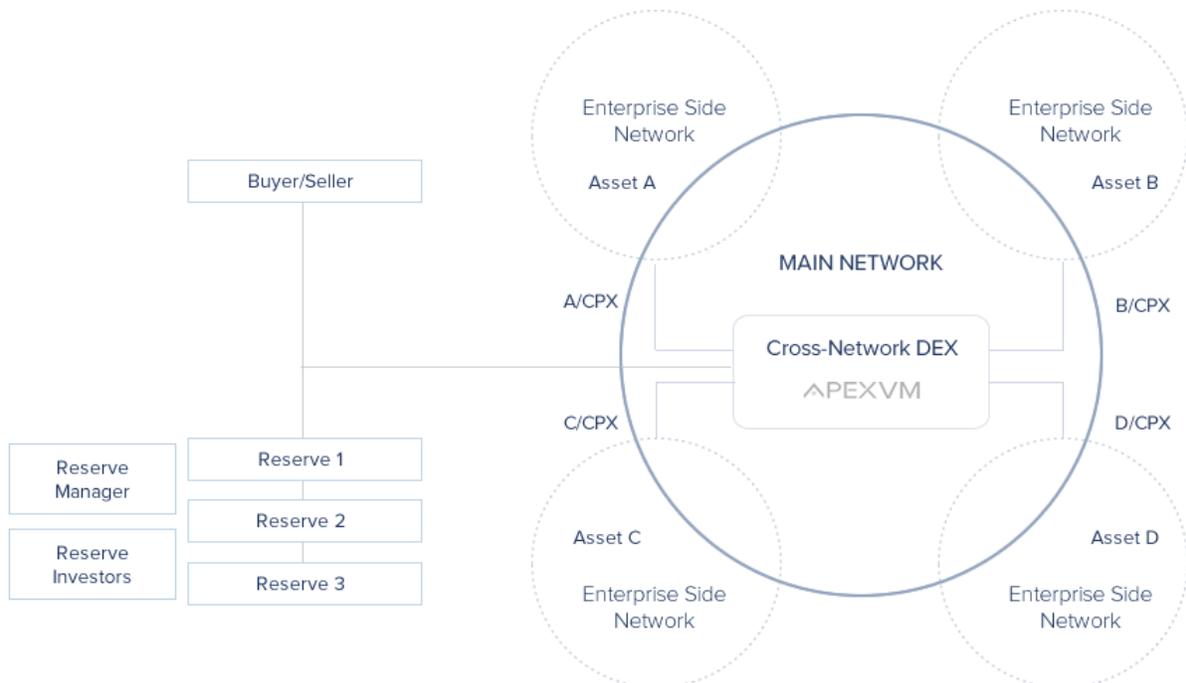
Cross-Network DEX

Connectivity of enterprise and brand assets is prone to become an important facet of the B2C ecosystem - through the exchange and liquidity of enterprise assets (that can be exchanged for tokenized products, rewards, items) across the blockchain, B2C interactions would have further augmented value and economies of scale, as well as making B2B commercial partnerships becoming more frictionless and effortless.

For APEX Network, it means that having a mechanism of liquidity and exchange across different asset classes with CPX being the main traded medium - in other words a decentralized exchange DEX protocol native to the platform. Note that here simplicity, transactional speed, and liquidity is valued over actual “trading” functionality. The ideal method of transaction is simply exchanging one asset for another through the CPX Wallet or any custom enterprise wallets through the same API-enabled DEX protocol.

APEX Network will be building a CPX-based enterprise asset DEX that will make it easy for consumers, enterprises, and partners to swap between assets. The DEX will be built off of APEX Virtual Machine as both a dApp and extensible protocol on the main network, and will utilize a multi-reserve approach for instant liquidity. Each reserve, via a APEXVM smart contract, can list asset/CPX trading pairs and control a price-setting mechanism, and each request to sell or trade a certain amount of a particular asset will be transacted with the reserve with the best offer. The reserve will have the option of separating reserve management and funds management from the reserve itself (ie. managed through a 3rd party market maker or partner). This approach is very similar to the DEX protocol of Kyber Network. We expect initial reserve holders to be APEX Core Development, who will hold multiple CPX/asset pairs, our enterprise ecosystem, which will hold their own CPX/asset pairs and that of their partners in the ecosystem, as well as investors and the CPX-holding community, who will have an opportunity to gain profit of transaction spreads.

It's clear that there is a myriad of different on-chain and hybrid (on-chain + offchain) approaches to developing a DEX, but after evaluating use-case suitability we find this one to be the most suitable approach.





Application Layer

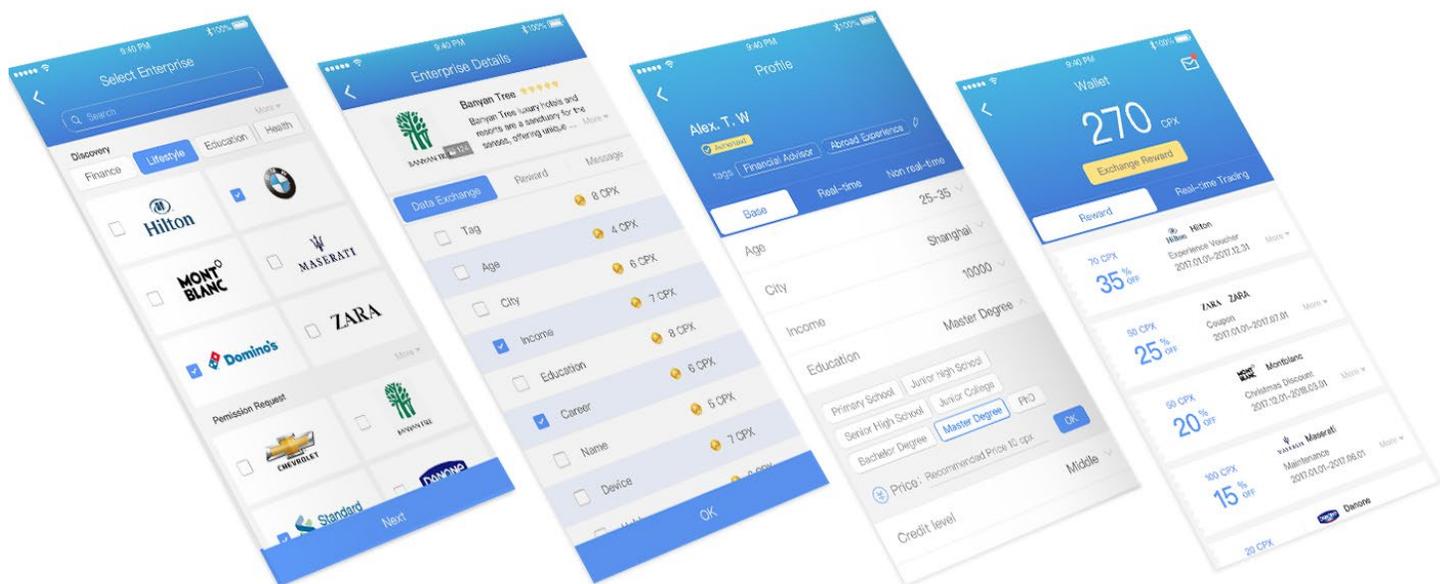
Overview

APEX Network provides boundless possibilities to build next generation consumer applications with optimized trust, relationships, engagement, and interactivity - it also provides a collaborative and trust-based gateway for commercial partnerships on frictionless blockchain protocol. Its focus on speed-to-value, scalability of applications, and real-world connectivity adds to its potential value for the B2C lifecycle.

Next we will take a look at some example use cases of APEX Network, which include but are not limited to:

- B2C Data Transactions
- B2B Data Exchange
- Rewards Exchange/Alliance
- Gamification
- Consumer Insights/Analytics
- Interactive Messaging
- Unified Customer Experience
- IoT Interactions

CPX Wallet



The CPX Wallet will be the official and initial wallet developed by APEX Core Development for the main purpose of storing and transacting both NEP-5 CPX (placeholder) and APEX Network Mainnet CPX, as well as various assets on the APEX Network blockchain. An NEP-5 CPX and Mainnet CPX swap functionality will be implemented directly in the CPX Wallet after Mainnet launch for the CPX-holder's convenience.

The CPX-based DEX protocol will also be implemented directly in the CPX Wallet for maximum ease in swapping across different enterprise assets on the APEX Network. Other features will include:

Unified data settings and permissions

Unified individual data and identity management, data permission setting for enterprise users and various dApps.

Brand and reward discovery

Users can discover enterprises and brands that are a part of the APEX Network ecosystem, as well as discover the rewards and products that can be redeemed using CPX-based assets.

Personal tags and attributes

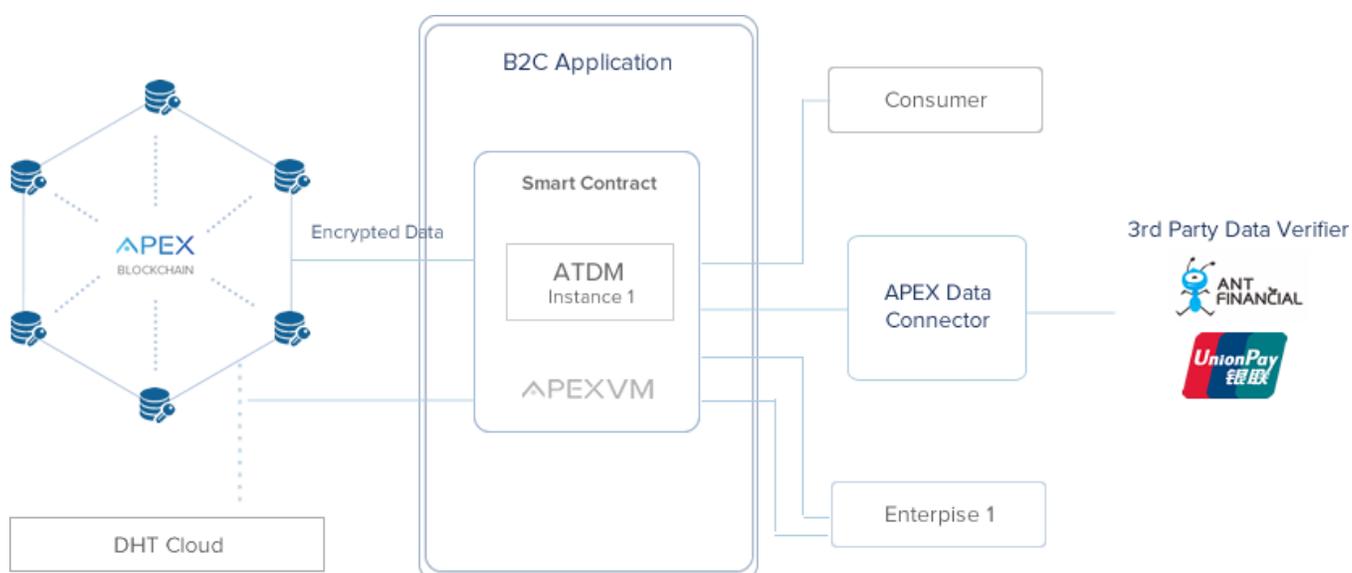
Personal tags and attributes can be set as both a way for enterprises users to discover individual consumers as well as data-level attributes that are transactable and monetizable for the consumer user. Initial implementation for tags and attributes will eventually be moved to a distributed hashtable in the Data Cloud Nodes as described in an earlier section.

The development plan for CPX Wallet has been adjusted and optimized to the strategy of a public blockchain platform - where freedom for enterprises to develop and customize their own customer experiences and applications are a priority. CPX Wallet will provide the basic and standard functionalities and a DEX, but we expect enterprise users to develop their own versions of an asset wallet for their customer and user base as well. APEX Core Development will open source CPX Wallet codebase upon Version 1 non-beta release for redevelopment use by the enterprise users, application partners, and the ecosystem.

Example Application Scenarios

B2C Data Transaction

APEX Network will make it easy for enterprises and partners to create privacy-focused, consent-driven, and fair compensation data sharing and transaction protocols between enterprises and consumers. The protocol can be embedded within a non decentralized application or could be a standalone dApp built on top of APEXVM. One or multiple ATDM (APEX Transactional Data Management) instances can be initialized in a smart contract and the application can configure the ATDM instance to its requirements and needs. To take extra measures to insure data quality, a data verification mechanism can be added via APEX Data Connector. Using APEX Network to build B2C data sharing protocols allows enterprises to build trust and a deeper connection with their users, as well as stay compliant with regulations such as GDPR. The enterprise can set a tokenized cost structure that it finds suitable - of course, the consumer can also determine the minimum price particular dimensions of his or her data is worth.



B2B Data Exchange

The value of APEX Network's data ecosystem is amplified when data transactions are also conducted between enterprises. The mechanism and protocol is similar to B2C data transactions but do not require an ADTM instance to be in place. A protocol is setup via an APEXVM smart contract where terms and conditions are configured for data exchange. The smart contract can dictate whether the data exchange 1) uses data-to-data model and if so, what would be considered a "balanced transaction" 2) enterprise assets and tokens for data and a fair data valuation formula 3) or both. If it's determined that a 3rd party data verifier is to be used, then a connection to an external data verification source can also be setup via APEX Data Connector. Depending on the enterprise's policy on compliance, a B2B transaction protocol with 2 or more participants may want to include a consumer consent step if it is transacting on consumer data, which can be done easily by initializing an instance of ATDM within the smart contract.

A B2B data exchange protocol may be built on APEX Network by not only by enterprises themselves but also by third party application partners and consumer data related companies.

Rewards Exchange/Alliance

Previously brand and enterprise reward points programs have been largely ineffective and silo-ed, meaning that for the consumer they were not connected or transactable with that of other enterprises. And when that did happen, often what it comes down to is manual business negotiations and sit-down meetings with long decision cycles and more importantly, cumbersome and complex integrations. APEX Network has an out-of-box solution that solves this problem. On the APEX Network, one solution is as follows:

- 1) Create an enterprise sidechain on APEX Network or have at least one running
- 2) Create a new enterprise asset/token on the sidechain - that asset can directly replace the legacy loyalty or reward points system the enterprise is using. Code in the “points” distribution events in a smart contract under different conditions and touchpoints.
- 3) To swap for another enterprise asset, simply utilize a DEX protocol on the APEX Network to first swap to CPX and then CPX to the other asset. If APEX Core Development’s DEX protocol is used, then instant liquidity can be provided (via multi-reserve system, please refer to the DEX section of this paper for more details).

The approach described above is only the simplest solution that does not consider special alliances or commercial arrangements. For two enterprises that have a special arrangement or a strategic partnership, they are able to setup a structured exchange protocol via APEXVM smart contract according to special rules or exchange rates, and can swap directly from asset to asset without converting to CPX first.

Interactive Messaging

Current studies show that around 52% of consumers find push notifications annoying. Typically when a promotional push notification or text message appears, the enterprise has a particular purpose to stimulate consumer behavior into some type of purchase-related behavior. An ideal case is instead of a mode of solicitation (the result may be switching off or muting notifications altogether), a value is attached to each interaction associated with the message. This can start by opening the message, and then if the message is a rich media format (contains text, images, video, etc), by interacting certain parts of the message or media, a tokenized reward gets credited, and tokens can redeem rewards or be swapped for other assets. This type of engagement method increases engagement depth, longevity, and reduces annoyance and solification-like experiences.

The method in which we can deploy these applications is simplified via APEX Network’s architecture. The steps would be as follows:

- 1) A sidechain is required if an enterprise asset is to be used as incentive, or alternatively, a sidechain is not required if CPX is to be used. Create a smart contract that serves as a controller for disbursing rewards to public addresses on the network based on certain triggered actions - it may be necessary to connect the contract with an external data source matching public key and some other types of identifiers (username, device-ID, etc) using APEX Data Connector.
- 2) Create a simple API for the post message-opening action on either the landing page or within a mobile application to track actions. Integrate the API with APEX Data Connector and pass on corresponding identifiers as parameters for matching.
- 3) The loop is complete and the consumer may participate in interactive messaging.

Gamification

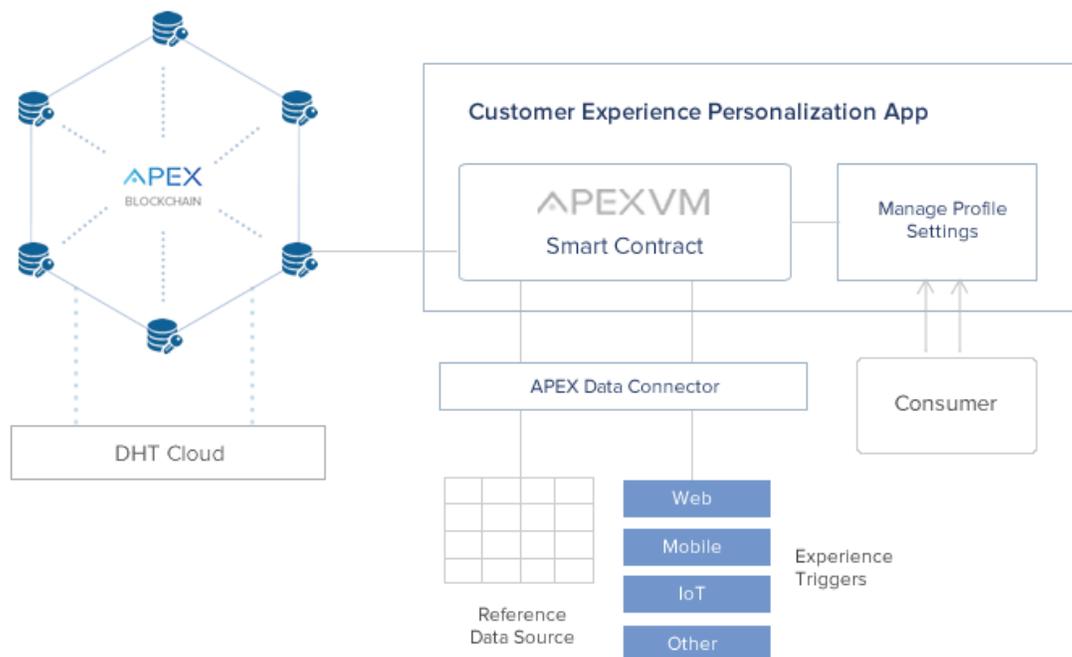
Gamification in both the B2C sector as well as in the workplace has been experiencing growth in the past few years, and has created higher engagement levels but often with limited longevity because it typically offers little incentive for consumers. Using APEX Network to tokenize reward assets and use them in gamification applications allows for an extra level of engagement, especially with the potential to exchange the assets for other utility assets or cash (CPX).

Unified Customer Profile/Customer Experience

A unified customer experience and a seamless customer journey across multiple touchpoints is crucial for optimizing customer lifecycle management and CRM - but in fact it's one of the most common and difficult problems that B2C enterprises face. A traditional approach would have been to treat each customer touchpoint and channel separately (online, retail, mobile, partner network) and collect data to optimize customer experience for each of these touchpoints. Recently a better approach is to use unified customer data platforms (CDPs), where data is collected from these touchpoints and stitched together into unified customer profiles based on rules (ID-matching). This is a significant improvement, but guesswork is still done in the process and is prone to non-matches, data cleansing issues, and inaccurate insights about the customer.

The goal to achieve a truly unified and seamless customer profile is still not achieved - and a large reason is because the profile and data is collected, centralized, and analyzed by the enterprise and not owned and managed by the consumer herself.

APEX Network enables enterprises and brands to build applications that enable a decentralized “unified customer profile” controlled and managed by the consumer. Below we outline a basic approach that is one of the various ways that customer experience personalization with a unified customer view on APEX Network can be implemented.



The approach we will briefly describe below:

- 1) Setup a smart contract on APEX Network, exposing an API that the unified customer experience app will use for the consumer to communicate with the smart contract.
- 2) Consumer manages profile and data settings in the app, which can set a confined structure for the data-level settings (ie. only specific tags and numericals within a particular range)
- 3) Encrypted consumer data gets sent to the blockchain and routed to the DHT cloud where it's stored.
- 4) Smart contract, via APEX Data Connector, will connect to a reference data source containing a “look-up table” of rules for experience customization/personalization under various data-driven instances
- 5) Result is returned to the smart contract and signal is sent to the personalization or experience triggers across different channels online and offline, again via APEX Data Connector. Channel/touchpoint detection and selection is a non-complex mechanism (for example, to see if the user is currently online or in a retail store) that the enterprise developer can implement.

Artificial Intelligence

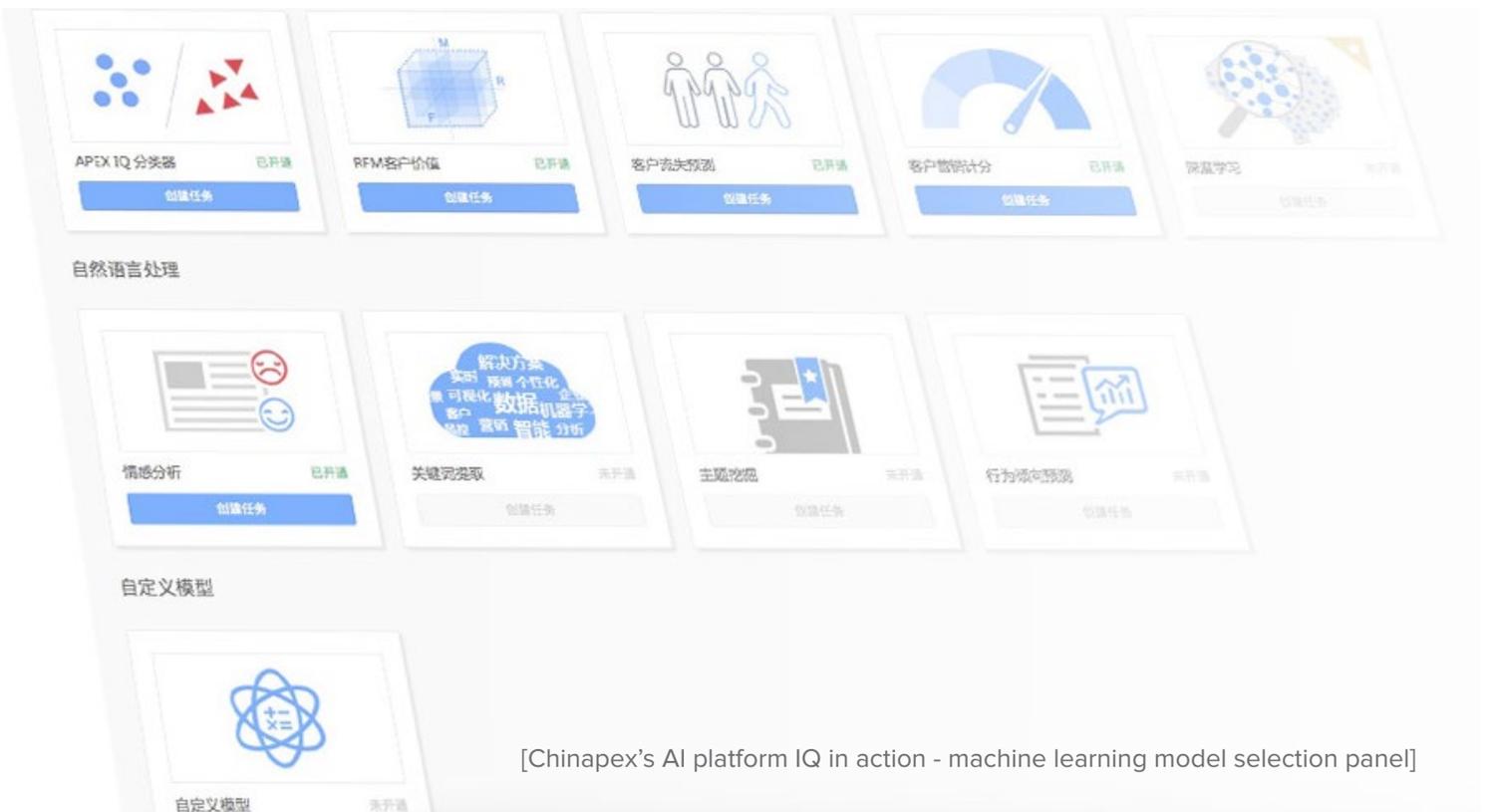
When considering artificial intelligence combined with blockchain, we typically consider one of three possibilities: 1) distributed machine learning via blockchain protocol 2) blockchain assisting auxiliary processes related to AI, including recording machine-made decisions on the blockchain and decentralized supervised learning or 3) obtaining value from the blockchain and using it on off-chain AI.

For the purposes of the use case of marketing, CRM, and customer insights, currently the third is by far the most valuable and quick to realize value. For this particular use case relating to customer interactions, most of the AI-related applications used are related to predictive customer insights and natural language processing (NLP), and for these applications the most crucial are the quality, depth, recency, and relevance of the data being used for the machine learning models.

Data quality, cost effectiveness, and transparency are some of the areas in which APEX Network adds value. Through any of the B2C or B2B data exchange protocols outlined above combined with use of external data verification tools in particular cases, we have permissioned, transparent, and consented data that are higher quality than the majority of the structured and unstructured data collected and purchased from various sources.

Chinapex, the company behind APEX Network, has been developing predictive AI technology since 2016 to solve problems in marketing, personalization, and CRM. One of Chinapex's flagship AI products, IQ, enables enterprise users to use proprietary predictive machine learning, deep learning, and NLP algorithms to produce deep actionable consumer and customer insights across industries such as finance, travel, retail, automotive, and internet. Particular pilot program enrollees of APEX Network are also existing enterprise users and customers of our AI product IQ.

Upon testnet launch IQ will be the first AI technology integrated with APEX Network and used to test and refine the AI-readiness of datasets acquired via APEX Network.



[Chinapex's AI platform IQ in action - machine learning model selection panel]

About APEX Network



80+

Employees

300+

Global Enterprise Customers

35+

Employees in R&D

360 Million

Consumer Profiles Tracked Annually

40+

Global System Integration Partners

Chinapex is a customer data technology and AI company headquartered in Shanghai with offices in Beijing, Hong Kong and Silicon Valley. We combine cutting-edge AI and blockchain technology to tackle problems in areas of marketing, personalization, and customer analytics. We have served over 300+ mid to large global and China enterprises in sectors of finance, travel, automotive, retail, ecommerce, internet and real estate.



Microsoft Accelerator

One of 15 out of 1000 companies selected for Microsoft Accelerator Shanghai, the most selective accelerator in China.



Standard Chartered

2016's Standard Chartered's "Most Promising Technology Startup" Award in the big data analytics and machine learning space.

#21

Ranked number 21 on 2018 Top Artificial Intelligence Companies in China (China Internet Weekly)

#19

Ranked number 19 on 2017 Top Big Data Technology Companies in China (China Internet Weekly)



iResearch "Best Marketing Technology Platform of the Year"

Core Management Team



Jimmy Hu
Founder & CEO

- Founder & CEO of Chinapex
- Founder & CEO of APEX Network
- Oversees a combination of strategy, product, and vision
- Built internal marketing analytics and data mining for Microsoft, multi-year Microsoft technology contractor
- China & Asia big data and AI market advisor for Gerson Lehrman Group and multiple US financial institutions
- Forbes China 30 Under 30
- China Internet Weekly “Person of the Year” for Artificial Intelligence
- UC Berkeley BS Electrical Engineering & Computer Sciences



Tiger Yang
President & COO

- Manages day-to-day operations of Chinapex
- Managed multiple internal data analytics projects for Microsoft, Global Sources, Maserati, Hilton, and various other enterprise customers
- Keynote speaker at marketing technology and big data conferences such as GDMS, iDigital, & CBIS
- China Internet Weekly “Innovative Leader of the Year Award”, and “Person of the Year 2016”.
- UC Berkeley BS Political Economy, Minor EECS



Richard Wang
CTO

- Director of Engineering @ Alibaba, managed a team of 30+ person R&D team
- CTO @ 360 Finance
- Team Lead @ Youku, Machine Learning
- Team Lead @ Microsoft
- Microsoft IT Pro Award and Future Star Award
- Software Engineering @ Autodesk
- Masters Computer Science from Tongji University



Robert Xu
VP Product

- Product Director @ Alibaba, big data analytics division and Alibaba Cloud
- Alibaba “Product Expert of the Year”
- Analytics and personalization recommendation system team leader @Sohu, one of China’s largest internet platforms
- Director of big data products @ Emar
- Masters in Statistics from Renmin-University w/ focus on Machine Learning



Larry Fang
VP Business

- 10 years of sales management experience, and has served clients in finance, automotive, retail and other industries.
- Worked as VP Business of Beyondsoft, and has successfully managed up to hundreds of millions of annual sales revenue in big data, AI, and CRM solutions.
- Commercial Head at Microsoft for China Eastern Region for Enterprise IT Solutions
- Technology Manager at AvePoint
- Master in Software Engineering, Fudan University.

Technology & Operations Team

We have built a world-class team of passionate and talented individuals across engineering, product, and operations that come from a variety of top technology and internet companies.



Advisory Team



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Darius Rugvicius
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Connect Capital



JC Xu
Founder
Badwater Capital



Kenny Hsia
Founder
Badwater Capital



Wei Zhao
Director of
Engineering,
Appdynamics



Paul Yang
General Manager
Oracle Marketing
Cloud China



Aaron Choi
Vice President
BTCC

Enterprise Customer Ecosystem

Chinapex has a 300+ and growing enterprise customer and brand ecosystem and growing across various large B2C verticals, including financial services, travel, automotive, retail, ecommerce, and internet.

Technology, Infrastructure, and Ecosystem Partners



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Development Roadmap

Finish Development of NEXUS 2016 & Before

Start research and planning process for APEX Network and testing various existing blockchain technologies. Q3 2017

Release first version of CPX Wallet Late Q2/Early Q3 2018

Release APEX Blockchain Testnet Q4 2018

Release APEX Data Connector

APEX Mainnet Launches Q2 2019

Release DEX
Release APEXm markup language Q3/Q4 2019

Q1 2017 Finish Development and Release of AI platform IQ

Early February 2018 Start development of proprietary APEX Network Blockchain

Q3 2018 Release Beta Version of APEX Data Connector

Q1 2019 Release APEXVM and Smart Contract System with Scala and Java SDK

Q3 2019 Release Go SDK
Release DHT Cloud

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3. https://en.wikipedia.org/wiki/Yahoo!_data_breaches
4. https://en.wikipedia.org/wiki/Facebook_and_Cambridge_Analytica_data_breach
5. <https://www.gigya.com/blog/state-of-consumer-privacy-trust-2017-fear-hope/>
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7. <https://www.chinalawblog.com/2017/05/china-cybersecurity-and-data-protection-laws-change-is-coming.html>
8. <http://info.localytics.com/blog/the-inside-view-how-consumers-really-feel-about-push-notifications>
9. <https://hbr.org/2017/03/blockchain-will-transform-customer-loyalty-programs>
10. <https://hbr.org/2002/02/avoid-the-four-perils-of-crm>
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16. <https://home.kyber.network/assets/KyberNetworkWhitepaper.pdf>
17. <https://edtechmagazine.com/higher/article/2017/09/experts-see-new-ways-track-learning-experiences-blockchain>

The background features a dark blue field with a faint red grid. On the right side, there are complex, glowing blue digital structures resembling data paths or network connections. The text 'Thank You' is centered in white.

Thank You