ICE :

An open network of consumer data

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Abstract

ICE is a blockchain network of consumer data. It provides a zero-cost incentive scheme that service providers can leverage when gathering data. As ICE is an open system, the contributed data benefits all its members. By expanding value of data through openness, it creates a new economy that can go beyond trade-data-for-money system.

Introduction

Every purchase activity result in consumer data. These include purchased item, price, and geographic location of the store, as well as qualitative data based on purchase experience such as photos and feedbacks. Although challenged by limited volume and accuracy, the data has traditionally provided critical insights to consumer marketing – classification of purchase behaviors, identification of homogeneous customer segments, measuring of customer lifetime value and return on marketing investment.

More recent developments suggest the potential value of the data is still far from being fully exploited. With declining friction and expanding reach of digital payments, consumer data is becoming increasingly available spontaneously. It can be used collectively to provide personalized recommendations to increase engagement and drive monetization. It is an expression of individual customer's preference for marketers; source of insights into purchase behavior for researchers; promotional contents for retailers; search coverage extension for search engines; and source resolving information asymmetry for potential customers. It is transforming acceleration of e-commerce and ad-platforms by engaging customers with personalized product findings.

ICE is a blockchain of consumer data network that is designed to support service providers expand consumer data with its incentive schemes. The key guiding principles in designing ICE are transparency and openness of the data to its members.

As such, it is not a data trade protocol that excludes data from certain members. It aims to surpass data-for-monetary-value trade mechanism by aligning economic incentives to rewarding data contributions while allocating higher bandwidth of network resources to those who has committed highest value to the network.

How ICE contributes

ICE is a decentralized network of consumer data. It is not a community by itself, nor contents of creative contributions. It is sets of data that specifically reflect real world consumer trend. It is strategic resource that can facilitate core competencies for service providers. In this regard, data stored in ICE network holds inherent value.

One of the important aspects of ICE is that it enables service providers to collect consumer data at *zero cost*. Instead of relying on its own pool of funding, service providers can use ICE incentivization scheme to reward users when gathering consumer data. The process involves evaluation and

assessment on the quality of the data gathered, further creating value for service providers.

Because ICE is an open network, contributed data benefits all service providers. Through its openness, ICE expands value of the contributed data, creating an economy that can go beyond simple trade-data-for-money economy. In the process, the fragmentation issues and privacy issues are resolved.

Expanding value with cryptocurrency - zero cost incentivization

Using ICE, service providers can incentivize its users for consumer data at zero costs. Traditionally, the service providers were required to create their own pool of funding, entailed by continuous efforts to evaluate the contributions.

Leveraging on ICE, service providers can directly use the network's incentivization system, freeing services providers from burdens of creating its own pool of reward and continuous efforts to evaluate contributions from its users. Feedbacks will be evaluated by ICE members, and the incentives provided accordingly by ICE economy.

For example, online stores can encourage its users to provide feedbacks on their purchase experience by offering promotions and discounts. Without a proper measure on the quality of the feedbacks, such incentivization may cause the service to be populated by contents that contain little or no value to future customers and the service providers.

Overcoming fragmentation

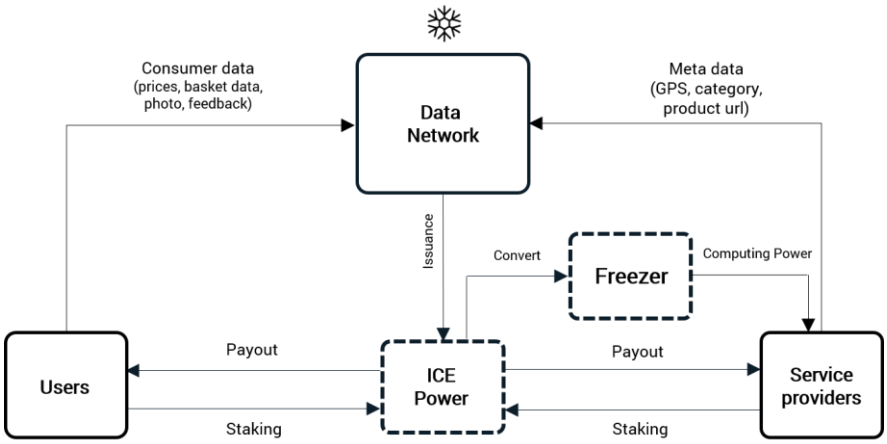
At present, consumer data is fragmented, with each fragment of data centralized by every player along the steps of consumption process. Retails and shops have products that are purchased, but do not know what customers are buying from other stores. Payment processing and card companies share fragments of payment information, but not the purchased item and its information. E-commerce and online stores have purchased product information and customer's feedback, but lacks information on where customers go offline; SNS/Search engines know how customers feel about products, but lacks purchase information.

Given the private nature and strategic value of the data, it is difficult to share or integrate the information on firm-level, effectively leaving firms to collect on their own. Consequently, obtaining reasonable amount of consumer data is made even more difficult.

ICE adopts decentralization of data ownership, making data on network publicly accessible. This opens up sets of data to multiple fields of applications, creating more value than when confined as one.

The economy

ICE is not a community or a service of its own; it's a reservoir of resources that members can use to facilitate its services and community. Hence, its economy is focused on increasing the amount of valuable resources available as well as expanding the value of resources already held within the network. Along with the demand for insights to market trend on real-time, the non-rivalrous nature of the data makes this possible.



Members: Service providers and users

The entities using ICE can be grouped into two: one is service providers, and the other is its users. Service providers leverage on ICE resources to enrich its own services and its zero-cost incentive schemes to gather quality data. Its users are rewarded cryptocurrency from ICE when they contribute their consumer data.

Aligning incentives for service providers

ICE is designed to benefit both service providers and consumer (or users), but particular importance lies with aligning incentives for service providers. Service providers act as mediums between ICE networks and individuals. They are the channels via which consumers contribute data to ICE. They are the medium that can transform data in the network into value to individuals. As catalyst to both fuel growth of the network and expand the value within the network, continual participation from service providers are essential to ICE.

There are three incentives for service providers to employ ICE. One is the cost-less incentive system. As briefly explained in the previous section,

service providers are at liberty to use incentive system of ICE to reward its users in building its consumer data at zero cost. What's more, the process inherently entails evaluation process on data gathered as well, further eliminating any efforts required to screen quality feedback.

The second the instant access to consumer data resources. Below are examples of how service providers can use ICE data resources instantly to supplement its own services.

Online stores / e-commerce

- Instant access to abundant consumer reviews
- Faster accumulation of feedbacks from users without incentive scheme of its own

Search engines, SNS

- Up-to-date products information, including consumer experience and prices
- Consumer-described product characteristics
- Offline store information and customer feedbacks

Research

- Build and maintain consumer panels
- Research data backed by consumer data
- Realtime time-series data

Smart wallet, finances

- Tailored offering of benefits, coupons
- Obsoleting membership costs
- Track purchase data to evaluate customer status

Location based services

- Popular spending locations
- Estimated average spending on venues
- Reviews & ratings
- Visitor's spending stat summary
- Real estate value based on spending activities

Payment services

- Additional ways to exploit its resources
- New revenue source
- Expanded understanding on its users by integrating with other data sources

And lastly, service providers themselves earn profit when contributions from its users are rewarded. During the contribution reward process, portion of rewards are allocated to service providers. This is allocated in recognition of service provider's role as a channel connecting users to ICE, as well as providing meta-data that enriches the consumer data. This meta-data information can include automatically tagged GPS, category of products, or product url when consumer data is contributed.

Assessing value of contributed data

Contribution of consumer data is the essential activity that adds value to ICE network. The more data contributed, the more value added to the network. It can be as simple as a string of payment information to enriched feedback that includes product information, category of the product, payment data, rating, customer's feedback, and location where it is purchased.

Appropriate measures to assess value of the data contributed is vital in ensuring continuous growth of value in the network.

The challenge of the assessment lies in the subjectivity of the contributions. They are subjective in the sense that it is at complete discretion of consumers. Some consumers may choose to share all their purchases, while

others choose to limit to certain items only. This selectiveness, along with qualitative contents such as ratings, photos, and feedbacks, create subjectivity.

While still facing several challenges, the subjective proof of work pioneered by other platforms, such as STEEM, has proven its viability as an alternative. ICE benefits from the pioneering approach, along with the dynamics of bandwidth and staking. In ICE, the power to assess value of data is delegated to its member in accordance with the power they hold.

Value of capital contributions

Both sweat and capital contributions are important in facilitating growth of the economy. Sweat, or in this case consumer data, provides value to the network with its information; capital contributions provide appreciation to the cryptocurrency within the system. The appreciation of cryptocurrency directly benefits individuals who has received cryptocurrency for their contributions – or sweat.

For this, ICE rewards capital contributions. Members can choose one of the following rewards: additional cryptocurrency or higher priority in using network resources. Both rewards are proportional to the amount of capital contributions. Regardless of type of the reward chosen, all capital contributors enjoy additional benefit of voting power. With voting power, members can influence distribution of reward pool on data contributed.

Capital contributions can be made by committing cryptocurrency, ICE, to a long-term vesting schedule. Members can decide to discontinue commitment over a period of time, similar to that of Steem Power.

The problem with trading data for value

Unclarity of value

The value inherent in consumer data is without question. But the problem lies with assessment of the value. Neither the quality nor the quantity of data from individual consumers are homogenous, let alone the value of each consumers represented by the data. Complexity increases even more if recency of data is factored in: while more recent data is most likely be valued more than past, how much more value does “more” recent data carry?

The unclarity of reasonable method to assess value of data, or sets of data, hampers creation of price for the data, where value of goods is incomparable to willingness to pay. This creates a friction for trade of data, hampering all transactions between members.

Nonrivalrous, nonexcludable

Creating paywall for consumer data is difficult, because data is nonrivalrous and nonexcludable goods. Any instruments and devices to ensure data ownership maintenance and controllability will increase costs, burdening both buyers and sellers. This impedes efficiency of the market, lowering potential transaction volume and hence the market size.

Extending on the matter, it can be reasoned that trading of data-for-value exposes consumers to privacy risks. Not being able to maintain the controllability and ownership of the data can result in the data being held by unexpected entity with almost impossibility of tracking the leak source.

The assurance required against privacy risks will increase cost higher, driving potential buyers to seek other ways to obtain data, while lowering profit to individual consumers.

Token model

ICE adopts two tokens model – ICE and ICE Power. The conversion from ICE to ICE Power is a one-to-one fixed rate, analogous to that of STEEM and STEEM Power. Similarly, powering up is an immediate process while powering down takes longer term.

ICE

ICE serves as the liquidity vehicle for exchange and transfer, whether within or outside the economy.

ICE Power

Members can convert their ICE token to ICE Power. The conversion is made by committing ICE token to ICE economy on a long-term vesting schedule, for which members receive equivalent amount of ICE Power.

ICE Power is the basis for all activities within the system. Rewards, activities, and influences are all based on ICE Power. However it is non-exchangeable and non-transferrable unit. Members need to power down from ICE Power to ICE in order to transfer.

Given the vesting period of ICE Power, conversion from ICE to ICE Power is considered staking capital to the system. The staking is recognized as capital contribution by the ICE economy and rewarded - ICE Power holders are entitled to new tokens during the inflation process, proportional to the amount they have relative to total ICE Power in the system.

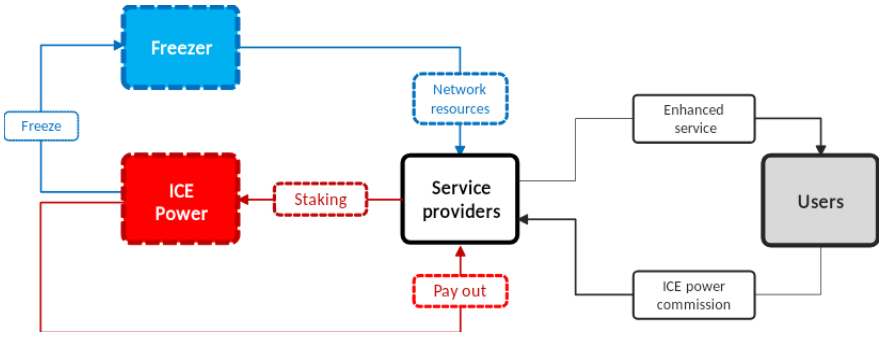
Freezing Power and bandwidth

Power holders can choose to receive their reward in terms of network

capacity instead of capital gain. Members can freeze their power should they choose network capacity over capital gain. Members who froze their Power are entitled to higher priority (and hence, QoS) of bandwidth proportional to the proportion they froze. In concept, service providers with 0 Frozen Power can use ICE bandwidth, only when there is no query from services providers holding frozen power.

Frozen Power is not entitled to tokens during the inflation process. This reduces total number of Power eligible for the new tokens, increasing the rate of return for non-frozen power holders. This increased rate of return is a reward for renting their right on fragments of bandwidth they are entitled to. In effect, this results in a network capacity lending relationship between power freezer and power holders, where the interest rate is a result of demand and supply for data resources in the network.

This interest rate effectively reflects the value of the data stored in ICE network. Based on the rate, members can weigh value between holding power and freezing power. Note that the supply of network capacity is fixed in the short run. If members feel that the interest rate is too low compared to the value from using data resource, they may find it more profitable to freeze their power for higher priority in network capacity and better QoS to their services.



Reputation – an internal index

ICE network adopts an internal index that reflects activities of individual consumers within the system. It is designed to support and facilitate evaluation of contribution process. The index directly effects reward amount to any given members. That is, other things being equal, contributor with higher reputation index will receive more favorable reward from the system.

This is because past contributions can influence value of current contributions. Instead of spots of transactional information and reviews, string of consumer activity history can provide much more value in that it helps identify consumer's pattern and trend. Also any fraudulent efforts undermines credibility of not only current but past and future contributions as well.

Payout distribution and stability

Individual consumers, service providers, network providers all play a role to produce value and support for the ICE economy. Consumers share their spending experiences with payment information in the form of consumer data. They read, vote, and comment on other member's contributions, all of which collectively increase the value of the network. Service providers are the medium through which all interactions are based. Network providers supply network capacity, an infrastructure for the network.

All contributions are rewarded in accordance with the value added to the network, and the value of the reward is reflected by capital contributions.

Interest rate decision in the short-run (fixed network capacity)

The value from the data (V) and the demand for the ICE Power(D) are assumed to be determined as below:

$$V = g(n, s), \quad \frac{\partial V}{\partial n} > 0, \frac{\partial V}{\partial s} > 0 \tag{1}$$

$$\begin{aligned} D &= f(n) + i\left(r\left(f(n)\right)\right) \\ &= \alpha + \beta V - \gamma p \\ &= \alpha + \beta g\left(n, \frac{K}{f(n)}\right) - \gamma p \end{aligned} \tag{2}$$

f: amount frozen

n: number of users (The number of users is used as a proxy for the data value)

s: speed of data providing service

$$s = \frac{K}{f}, \quad where\ K: network\ capacity \tag{3}$$

c reflects all other factors affecting the demand other than the price and the value, $\alpha>0$ and $\beta>0$.

$$p\ is\ assumed\ to\ be\ exogenously\ given\ for\ now.$$

Differentiating both sides of (2) gives;

$$f'(n) + \frac{\partial i}{\partial r} * \frac{\partial r}{\partial f} * f'(n) = \beta \left\{ \frac{\partial g}{\partial n} + \frac{\partial g}{\partial s} * \left(-\frac{K}{f^2} \right) * f'(n) \right\}$$

$$\left(1 + \frac{\partial i}{\partial r} * \frac{\partial r}{\partial f} \right) f'(n) = \beta \left\{ \frac{\partial g}{\partial n} + \frac{\partial g}{\partial s} * \left(-\frac{K}{f^2} \right) * f'(n) \right\}$$

$$\left(1 + \frac{\partial i}{\partial r} * \frac{\partial r}{\partial f} \right) = \beta \left\{ \frac{\frac{\partial g}{\partial n}}{f'(n)} + \frac{\partial g}{\partial s} * \left(-\frac{K}{f^2} \right) \right\}$$

$$\frac{1}{\beta} \left(1 + \frac{\partial i}{\partial r} * \frac{\partial r}{\partial f} \right) = \frac{\frac{\partial g}{\partial n}}{f'(n)} + \frac{\partial g}{\partial s} * \left(-\frac{K}{f^2} \right)$$

$$\frac{1}{\beta} \left(1 + \frac{\partial i}{\partial r} * \frac{\partial r}{\partial f} \right) - \frac{\frac{\partial g}{\partial n}}{f'(n)} = \frac{\partial g}{\partial s} * \left(-\frac{K}{f^2} \right)$$

To keep the speed of the network constant,

$$\frac{\partial s}{\partial f} = -\frac{K}{f^2} = 0 \tag{4}$$

$$\frac{1}{\beta} \left(1 + \frac{\partial i}{\partial r} * \frac{\partial r}{\partial f} \right) = \frac{\frac{\partial g}{\partial n}}{f'(n)}$$

$$\left(\frac{\partial i}{\partial r} * \frac{\partial r}{\partial f} \right) = \beta \frac{\frac{\partial g}{\partial n}}{f'(n)} - 1$$

$$\frac{\partial r}{\partial f} = \frac{\beta \frac{\frac{\partial g}{\partial n}}{f'(n)} - 1}{\frac{\partial i}{\partial r}} > 0 \tag{5}$$

Note that, as $\beta \frac{\partial g}{\partial n}$ represents the marginal increase in the demand from the data usage, and $f'(n)$ is the marginal increase in the freezing demand with respect to n, $\beta \frac{\partial g}{\partial n} > f^{'}(n)$ holds. Therefore, interest rate is designed to increase with demand to freeze.

While the interest rate can adapt to change demand for network resources, its starting value must be initialized with a number.

Payout to contributions

All of the value created in each period is distributed to data providers, network providers and capital providers. Data providers are the community users who created value by writing reviews or comments or voting. Community users who did not engage in any of

these activities are not paid. Capital provider refers to the outside players who hold the ice power. Let D, N, and C denote the payoff to the data providers, network providers and

Aggregate payoff (A):

$$\begin{gathered} A = D + N + C \\ N = \left\{NF, \left(A * \frac{NF}{NF + i * r}\right)\right\}, NF\ is\ the\ fixed\ network\ fee \\ C = min\{i * r, \left(A * \frac{i * r}{NF + i * r}\right)\} \\ D = max\{A - NF - i * r, 0\} \end{gathered} \tag{6}$$

New token issuance level

While it is reasonable to assume that the aggregate payoff over a given period, or A in the above equation, should reflect the value added to the network over the same period. However, for the sake of stability and predictability of the economy its value will be prefixed during its early and growing periods. In addition, NF, or fees to the network provider, will be prefixed during this period as well.

The prefixed inflation rate will gradually decrease with number of blocks produced until it reaches certain level, upon which time the value of A will measured by change in value of the appropriate proxy. Candidates to this proxy include number of accounts (or users), number of new postings and etc.

Conclusions

ICE is designed to outperform present day data market structure that relies on direct-payment between data buyers and sellers. By leveraging on inflation and staking model, it expands the data value so that individuals earn more reward than they would have through data market using direct-payment, while service providers can leverage the data at a lower cost and higher transparency.