

EchoLink - EKO – Blockchain Based Professional Networking and Recruiting Platform

Building A High-Trust Economy

Token Name: EchoLink, Symbol: EKO

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Abstract

We introduce a blockchain based system of verified education, skill, and career information for individuals. The EchoLink System stores professional and other related information in an unalterable format on blockchains. The EchoLink System supports and provides access to multiple public, alliance, and private blockchains. All information is provided by trusted information authorities. The system saves businesses and other entities time and financial resources in recruiting, admission, vetting efforts while providing easy access to a pool of vetted candidates. The EchoLink System can be further extended to provide verified information in addition situations and industries, such as banking, finance, and insurance.



Figure 1: **Echo** = Education + Career skills + Human capital + Opportunity; **Link** = Worldwide Network

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 - (iv) rights under a contract for differences or under any other contract the purpose or pretended purpose of which is to secure a profit or avoid a loss;
 - (v) units in a collective investment scheme;
 - (vi) units in a business trust;
 - (vii) derivatives of units in a business trust; or
 - (viii) any form of investment;
- (i) you are fully aware of and understand that you are not eligible to acquire any EchoLinkTokens if you are a citizen, resident (tax or otherwise), person domiciled in, or green card holder of the United States of America or a person who is located in the United States of America at the time of your intended purchase or purchase for of EchoLinkTokens in the Token Sale;
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- (k) the amounts that you use to acquire the EchoLinkTokens were not and are not directly or indirectly derived from any activities that contravene the laws and regulations of any jurisdiction, including anti-money laundering laws and regulations;
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- (m) you are not obtaining or using EchoLinkTokens for any illegal purpose;
- (n) none of:

- (i) you;
 - (ii) any person controlling or controlled by you; or
 - (iii) if you are a privately-held entity, any person having a beneficial interest in you;
- (o) you have a basic degree of understanding of the operation, functionality, usage, storage, transmission mechanisms and other material characteristics of cryptocurrencies, blockchain-based software systems, cryptocurrency wallets or other related token storage mechanisms, blockchain technology, and smart contract technology;
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- (d) changes in the anticipated growth strategies and expected internal growth of the Foundation and the EchoLink System network;
- (e) changes in the availability and fees payable to the Foundation in connection with its businesses and operations or in the EchoLink System network;
- (f) changes in the availability and salaries of employees who are required by the Foundation to operate their respective businesses and operations;
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1. **INFORMATION**

In an information society, education, skills, and work experience lead to better career opportunities for individuals. Businesses increasingly seek out candidates with the right level of education and real world job skills. The need for high quality employees creates tremendous opportunities for people with the right education background, skills, and job experiences.

1.1. **Global Education in the Age of Internet**

The education industry is being disrupted by the Internet. The global e-education market has been growing at a [compound annual growth rate] of around 7.2% over the next decade to reach approximately \$325 billion by 2025.

The size of the e-Learning market in the United States of America (the “**U.S.**”) was over USD 27 billion by 2016, owing to rising significance of these services across the region¹. There are numerous other encouraging facts about the continuing growth and adoption in this sector.

Easy accessibility along with improvised effectiveness due to animated learning is likely to positively impact the size of the e-learning market. In addition, an increasing number of internet users coupled with an escalating number of internet enabled mobile phones are anticipated to propel industry demand [for e-learning] over the several upcoming years.

On top of academic education, the online corporate training market [in the U.S.] is expected to grow by 13% per year, with 77% of U.S. companies offering online training to improve the development of their employees¹. The era of e-education is truly upon us. In addition to academic training, skill training related to specific job requirements is also in demand.

1.2. **Demand For Talent**

The economy of today is based on knowledge. As such, employers are increasingly looking for job candidates with a high level of skill. Be it language skills, IT skills, financial skills, or other service skills, skilled labour is highly sought after by employers.

Employers pay high amounts of referral bonuses or head hunting fees to acquire candidates with good skills. The recruiting industry generated USD 428 billion in revenue worldwide in 2016 (approximately equivalent to EUR 386 billion), with the U.S., Japan and the United Kingdom making up a majority of the revenue². Online job sites, such as TaskRabbit, that cater to employers seeking certain skill sets for specific jobs are experiencing explosive growth. Employers are increasingly looking for and paying for employees with specific skill sets.

In today's competitive global market, employers are willing to spend a high percentage of their revenue to find the right employee with the appropriate skill set(s).

In the case of LinkedIn: Q3 2016 revenue was USD 960 million with 17% generated (USD 162 million) generated from premium account subscriptions, 18% (USD 175 million) from marketing solutions, and a staggering 65% (USD 623 million) from talent solutions³.

¹ LLP Accuracy Research. Global elearning market analysis trends industry forecast to 2025. https://www.researchandmarkets.com/research/nv2b9g/global_elearning, December 2016.

² Staffing Industry Analysts. Global staffing market achieves 428 billion in revenue. <http://www2.staffingindustry.com/eng/About/Media-Center/Press-Releases/Global-Staffing-Market-Achieves-428-Billion-in-Revenue>, 2017.

³ Salman Aslam. LinkedIn by the numbers: Stats, demographics fun facts. <https://www.omnicoreagency.com/linkedin-statistics/>, 2017.

According to LinkedIn, its talent solutions help corporate recruiters share, find, and engage the best talent. Corporate recruiter services provided by LinkedIn costs \$9,000 per year per seat (user login).

2. CURRENT ISSUES

While demand for education and training has become global, academic and training institutions have nevertheless remained fragmented and isolated. Academic record verification and skill verification are cumbersome processes. In the U.S. and many other countries, there is no nationwide unified academic record system.

When it comes to job skill certification, such as IT skill certification, the process is even more fragmented. Degree certifications and grade reports can be altered, difficult to verify, or non-verifiable in many situations. Employers spend a significant amount of resources searching for candidates with the right skill set, and even more resources to check their references and verify their academic records and skill certifications.

All these problems can be solved with an immutable and verifiable blockchain based system.

In particular, the following areas are most affected by inaccuracies in education, skill, and employment history:

(a) Degree Inflation

Inaccurate or false education and degree information being listed on resumes in order to gain employment or attain a high position in an industry. In a high profile case in 2012, Scott Thompson left the employment of Yahoo! as its chief executive officer after it was uncovered that he had embellished his academic credentials, ending his term at the company after just 4 months.

(b) Skill Inflation

Certain specialised industries value and seek candidates with the right skill set. As a result, many applicants who apply for jobs in such industries will claim to have the requisite skills in their resumes. For example, as certain information technology skills become increasingly in demand, claims of applications possessing certain information technology certification in areas such as big data or artificial intelligence have become more common. It is entirely up to the employer to verify such claims. In situations where certification is provided by private organisations / academic institutions, verification of such academic credentials can be difficult.

(c) Job Experience Inflation

Inaccuracies in job experience stated in resumes are not limited to certain sectors, but are pervasive across industries. The following are some of the more well-known cases that took place in recent years⁴:

- (i) celebrity chef Robert Irvine lied about designing Prince Charles and Princess Diana's wedding cake⁵;

⁴ Business Insider. This is what happened to 10 executives who lied about their resumes. <https://goo.gl/qgWq8f>.

⁵ Shirl; Keeler Janet; Reiley Laura 17 February 2008 Montgomery, Ben; Kennedy. Tv chef spiced up his past exploits. St.PetersburgTimes, 2008.

- (ii) an Massachusetts Institute of Technology (“MIT”) dean never received any college degrees despite claiming to have a bachelor’s and a master’s degrees;
- (iii) Jeffrey Papows, president of IBM’s software maker Lotus Development, fibbed about his academic and military background;
- (iv) top Wall Street analyst lied about studying at MIT when he actually attended Boston University. At one time, Salomon Smith Barney’s Jack Grubman was Wall Street’s highest-paid analyst with a salary of \$20 million per year;
- (v) former University of Notre Dame head coach lied about receiving a master’s degree and being a football legend in college when he never even played a game;
- (vi) top Norwegian bureaucrat lied about being a registered nurse and having 2 degrees. She was sentenced to 14 months in prison; and
- (vii) Bausch & Lomb chief executive officer lied about his Masters in Business Administration (“MBA”). Ronald Zarrella had to forfeit his bonus of \$1 million when it was revealed that he never received his MBA from New York University as claimed. He commenced study of the programme, but did not in fact complete it;
- (viii) former Harvard University student Adam Wheeler fabricated Scholastic Aptitude Test (SAT) scores, letters of recommendations, and transcripts to gain admission and received \$40,000 in grants. Wheeler’s true academic credentials were revealed when he attempted to apply for the Rhodes and Fulbright scholarships in his senior year.

(d) Cross Border Verification

The global number of students who study abroad continues to rise with an annual increase of 10%. There were almost 5 million international students in 2014. The Organization for Economic Co-operation and Development (OECD) has projected that, with demographic changes, the international student population is likely to reach 8 million by 2025⁶.

It is often difficult to ascertain information regarding degree or skill level certification across borders. It is also difficult to judge the quality of education for degree holders from abroad, with the exception of well-known universities.

(e) HR Verification Omission

According to a 2016 CareerBuilder survey, 75 percent of employers had indicated that they had hired the wrong person for a position, and of those who had had a bad hire affect their business in the last year, resulted in costs of nearly \$17,000 incurred on average⁷.

Steven D. Levitt, the co-author of the book *Freakonomics* and an economics professor at the University of Chicago, cites research suggesting that more than 50%

⁶ Suzanne Shaffer. 10 study abroad statistics for you and your student. <http://www.parentscountdowntocollegecoach.com/2016/12/09/study-abroad-statistics/>, December 2016.

⁷ CareerBuilder. More than 1 in 4 employers do not conduct background checks of all new employees, according to careerbuilder survey. <http://www.careerbuilder.com/share/aboutus/pressreleasesdetail.aspx?ed=12/31/2016&id=pr975&sd=11/17/2016>, November 17, 2016.

of job applicants lie on their resumes. Cover letters are notorious for embellishment and exaggeration⁸.

Though many employers are performing background checks, 75 percent of such employers have indicated that they had nevertheless hired the wrong person for the job. These employers say a bad hire has resulted in:

- (a) less productivity: 36 percent;
- (b) compromised quality of work: 33 percent;
- (c) lower employee morale: 31 percent;
- (d) lost time to recruit and train another worker: 30 percent;
- (e) cost to recruit and train another worker: 30 percent; and
- (f) employee's managers or co-workers had to spend excessive time assisting bad hire: 29 percent⁸.

Most importantly, the majority of employment related verification is done after the initial resume screening process or in-person interviews. Most pre-employment verification processes cost between \$5 to 65 per process⁹. Considerable time and effort are invested in the initial resume screening and interview processes, and would be wasted should the verification process discover any negative indicators. A resume screening system that offers verified education, skill, and job history would be invaluable to recruiters and save businesses time and financial resources. It would allow recruiters to precisely find candidates with the desired education, skill, and job history / background before spending valuable time and effort to engage the candidates.

3. OUR SOLUTION - ECHOLINK

EchoLink is a blockchain network that connects students, education, and training institutions and industry participants. EchoLink is a blockchain based system of verified education, skill, and career information for individuals. The system, EchoLink, stores professional career related information in a hashed and unalterable format on public blockchains. All information is provided by trusted information authorities.

For students, EchoLink stores student grades, degrees, and certificates in a protected and verifiable blockchain system. It provides student records to potential employers and higher learning institutions in a trusted manner.

For academic and training institutions, EchoLink provides them with the resources required to handle (provide and receive) degree and certificate verification.

For businesses, EchoLink provides a trusted source of candidate information that is not alterable. Academic records and skill certificates are associated with job candidates in a trusted way as they are supplied by the academic and training institutions directly, and are immutable.

⁸ Susan M. Heathfield. Do you know who you're hiring? <https://www.thebalance.com/do-you-know-who-you-re-hiring-1919148>, October 13, 2016.

⁹ Ryan Howard. Cost of a background check: How much should you pay? <http://blog.verifirst.com/blog/bid/305407/cost-of-a-background-check-how-much-should-you-pay>, June 2, 2017.

3.1. Advantages of Blockchain

Traditionally, any kind of credential verification has depended on the issuing institution or other trusted authority to confirm the authenticity of a credential. This is a time consuming and costly process. If the issuing organisation has ceased to exist, records are lost and unverifiable. The blockchain provides a more robust solution in the form of a distributed network of recorded ledger. A blockchain cannot be easily altered or taken down, removes single points of failure, and ensures that records can be verified without any organisational dependency.

The blockchain logs transactions between parties, and can be used to verify:

- (a) existence of a record;
- (b) that a record has not been altered since its issuance;
- (c) the identity of the issuing institution;
- (d) ownership of the record; and
- (e) that the record has not expired or been revoked.

This is all done on a distributed and public system. All amendments and alterations of the record are also recorded in the distributed ledger, which provides a chain of evidence on the record as well.

Once a record, in the form of a smart contract on the blockchain, has been cryptographically created and recorded on the blockchain, it cannot be altered or spoofed. Any person attempting to impersonate an issuing institution will not be able to execute the smart contract. Decentralized key registries map keys and institutions across different industries.

3.2. Economic Incentives

The EchoLink System operates on public blockchains, which greatly reduces the cost of operating a similar system in a traditional web environment.

In the case of the Ethereum platform, with a properly written smart contract, the cost of execution is fixed at 21,000 gas. Given that the speed of transaction confirmation is not the most critical factor in the context hereto, the smart contract may be confirmed at a slower pace. When confirmation of transaction is done at around 60 seconds, the cost is at around USD 0.003 per record creation. For a sizable university, such as University of California, Berkeley, with a graduating class of approximately 10,000 students, the cost of creating digital proofs of graduation for the entire class year is approximately USD 30 per year.

In the case of the NEO public blockchain, with an allocation of 10 free gas per smart contract, the EchoLink System essentially runs free of charge in most situations. This greatly reduces the cost of maintaining the system. The economic benefits are shared with all the participants of the system.

For businesses in particular, our system reduces the cost of verification, which directly translates into a reduction in cost of hiring.

For academic and training institutions, our system removes the burden of maintaining a verification system, which in most cases requires personnel and IT equipment. This amounts to savings to operational costs. In addition, our system passes a portion of the fees paid by

businesses to issuing organisations. This creates a positive economic incentive for issuing organisations.

For students, our system makes their credentials credible. Potential employers put greater trusted in verified education, skill, and work experience. Our system injects a higher degree of seriousness in employer queries, and provides students greater exposure in the job market.

4. TECHNICAL IMPLEMENTATION

Overview: The EchoLink System consists of four major components, and offers heterogeneous and multiple blockchain support:

- (a) Digital Identity and Mapping System – translates digital identity to real world names and well known institutions;
- (b) On-chain Credential Creation System – supports batch creation and storage of credentials;
- (c) Off-chain Data I/O System – external data input and output from web, database, feeds, etc.; and
- (d) Multi-chain Data Browser for End User – intuitive interface to credential created and stored on a number of heterogeneous blockchains, such as Ethereum, AntShares, Metaverse, etc.

Identities of students and organisations in the EchoLink System are recorded on the blockchain in the form of public encryption keys. Certificate / degree info are created and stored onto the blockchain by issuing organisations directly. Certificate / degree information includes the digital identity of the corresponding student.

All information is stored on blockchain in an encrypted format. Through the EchoLink browser, users may find candidates matching certain attributes based on recorded certificate / degree information. Query results will be resolved by the naming service into a user-friendly readable format. Results are presented to the end user by the EchoLink browser.

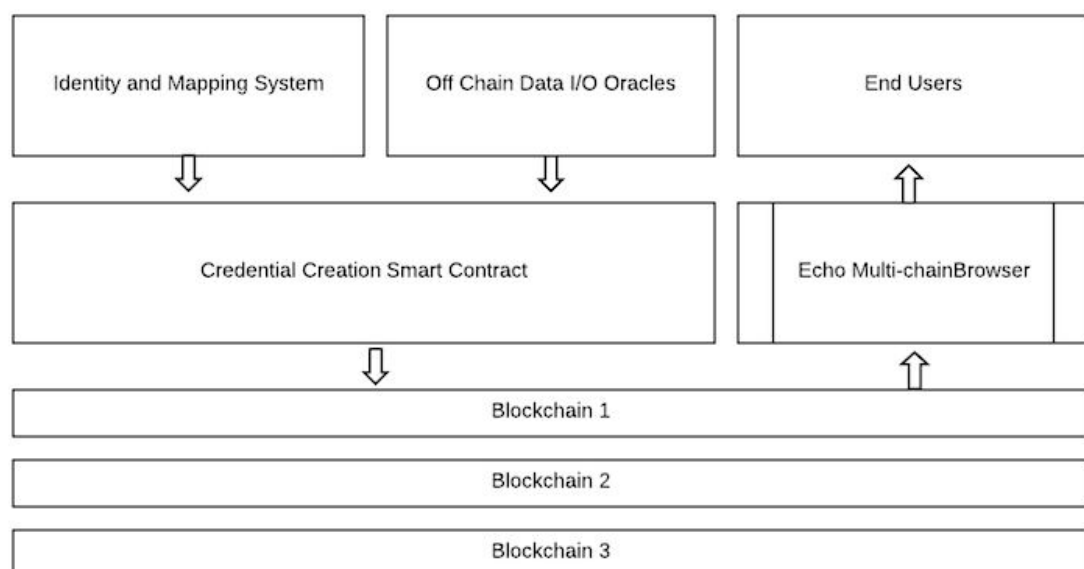


Figure 2: Echo System Overview

It is envisaged that all certificate / degree information will be entered into the system by the relevant issuing organisations, which lends to the credibility and integrity of the certificate / degree information.

Note: [Reference implementation] on Ethereum. The Echo system supports NEO, Dash, IOTA, and other blockchains.

4.1. Digital Identity and Credential Creation

The EchoLink System utilises public key (for example, Ethereum addresses) to identify entities in the EchoLink System. Each student is intended to hold a public key in the system. Each issuing organisation will also have a public key (in other words, account) in the EchoLink System.

Credentials creation involves the issuing organisation executing a smart contract that binds the issuer (for example, the academic institution) to the recipient (for example, the student) along with the corresponding credentials information. The smart contract acts as a proof of existence of the credentials on blockchain. Since the smart contract is executed by the issuer, we can be certain of the authority of such a credential.

4.1.1. Digital Identity

Digital identities of the participants of the system are stored in the blockchain in the form of public keys. Students and known issuers will have a set of public keys that are recognised by the community. The public keys are used in the creation of credentials in the EchoLink System.

The EchoLink System provides a convenient way of mapping public keys to students, known issuers, and their accreditation. Business organisations pay a fee in the form of EchoLink token to access the mapping information of real world identities and public keys in the EchoLink System.

4.1.2. Credential Creation

Issuing entities create credentials by executing smart contracts that set the status of the state of the smart contract. In the case of Ethereum, smart contracts with state information are time-stamped and stored in the blockchain. This mechanism creates an immutable proof of existence.

Issuing entities may include the recipient's public key address, degree information, or even hashed value of photographs and paper degree files into the blockchain. Even though the blockchain can be downloaded into a node and scanned, the information contained in the EchoLink System smart contract are only utilisable after resolution from the identity mapping service of the EchoLink System. The state information (in other words, credential details) is presented in user-friendly readable format through the EchoLink browser.

P2P encrypted document storage is utilised to store image and binary information associated with a certain credential. Once called upon, images and other binary files can be accessed by the EchoLink browser, thus providing the end user with a rich media experience accustomed to business users.

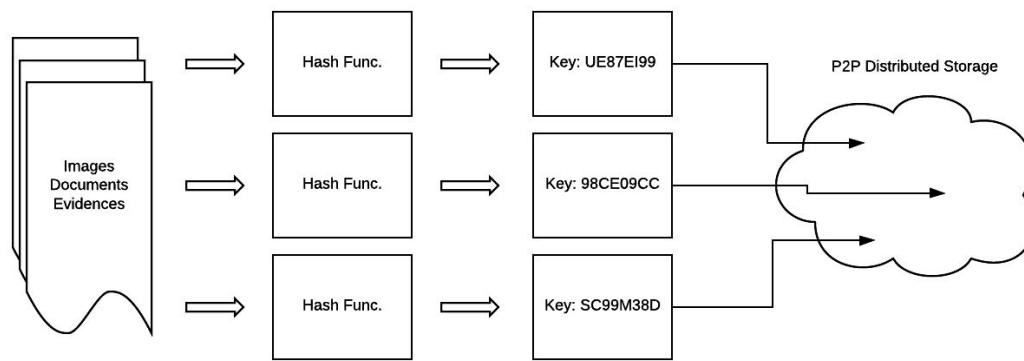


Figure 3: P2P Encrypted Document Storage

One method of implementing such off chain data feed is through InterPlanetary File System (“IPFS”) Images or files in portable document format (PDF) associated with the recipient are stored on IPFS. Hashed addresses of such documents are used in the smart contract that generates the credentials, thus linking additional documents to the credential.

4.1.3. Digital Identity Mapping System

As stated above, digital identities of the participants of the EchoLink System are stored in the blockchain in the form of public keys. Since the EchoLink System is a system that is intended to provide trustworthy credentials, anonymity is not a requirement for the users of the EchoLink System. On the contrary, participants of the EchoLink System should make their identities known in order to respond to system queries.

The EchoLink System provides a mapping service to map public keys to identities of students and organisations. This mapping service is related to the EchoLink browser to the end users, and is transparent to the end user. Only during the presentation of query results submitted by the end user, would the mapping service resolve the identities of the public keys and present human-readable information to the end user.

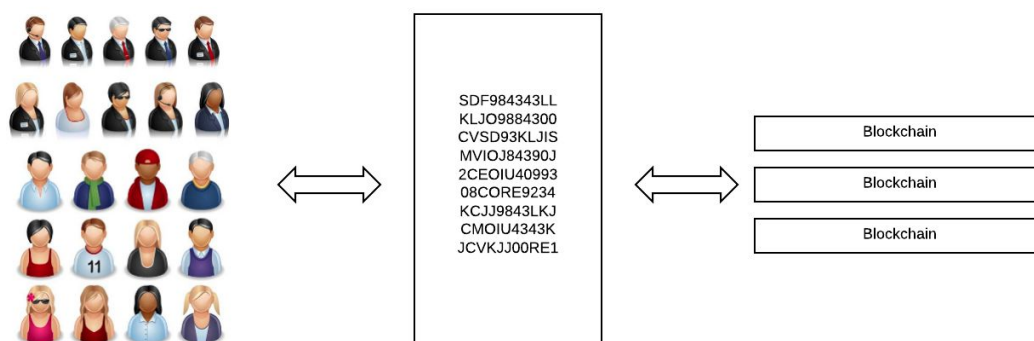


Figure 4: Digital Identity Mapping

4.2. Off Chain Data Sources

In the EchoLink System, only digital identities of the issuing entity and the recipient are required to constitute a verified credential on the blockchain. In reality, more information may be provided in order for the credential to be useful the user, providing more insight.

Besides digital identities, other important information regarding a person's credentials include academic records, course work transcripts, detailed degree information, and skill certification information. This information will be accessible to queries through "oracles" (in other words, off chain data sources).

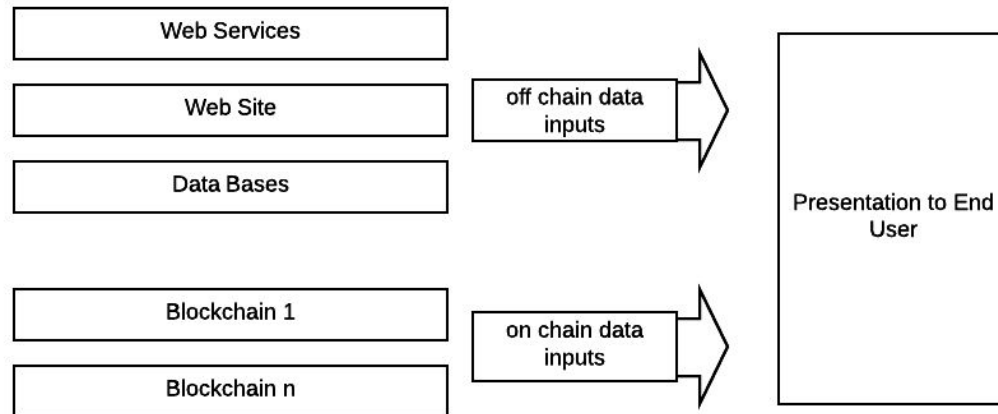


Figure 5: Off Chain Data Inputs Present More Information to End Users

Furthermore, through dedicated oracle services, more information sources, such as web services, may be linked to the smart contract.

4.3. Dynamic Blockchain Browser

The primary end users of the EchoLink System are primarily intended to be business organisations and recruiters. A user friendly blockchain browser would be essential to business users.

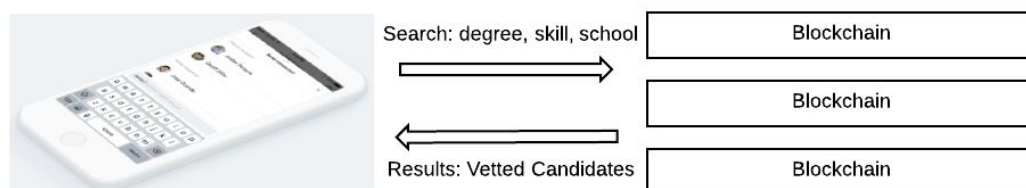


Figure 6: Echo Browser: Search and Get Vetted Candidates

Ideally, the EchoLink browser would combine functionality of both a blockchain explorer and an EchoLink wallet. Business users search candidates through the blockchain functionality and pay fees through the wallet functionality, all in the same browser application.

4.4. Multi-Blockchain Support

It is envisaged that EchoLink System users will span the globe. The EchoLink System is intended to serve students from various countries studying abroad. Businesses recruiting internally may also use our system to find the best talent worldwide. The EchoLink System will eventually need to provide support for data stored on different blockchains operating on different technology platform and countries.

The EchoLink System operates through smart contracts for credential creation on various blockchains. Blockchain platforms that offer support for smart contracts with Turin-complete virtual machines can be used as the underlying blockchain layer for the EchoLink System. (for example, Ethereum, NEO, and Dash). Although not necessary, blockchains that offer oracle access to off chain data would be more compatible with EchoLink premium features, such as graphical credential certificates.

The mechanism to establish multi-blockchain support is through the EchoLink browser. It is the end user interface for smart contracts to multiple back-end blockchains. The nature of the supported blockchain can be a public ledger, alliance ledger, or even private ledgers. The EchoLink browser provides a readable and user friendly interface to multiple blockchains.

5. ECONOMIC MODEL

As indicated earlier in the paper, large amounts of financial resources and personnel are spent on acquiring talent by businesses around the world. On average, each user of LinkedIn's corporate recruiter service pays \$9,000 per year. LinkedIn generated a staggering \$623 million from such solutions in Q3 of 2016 alone. The need to find the right job candidate is the fundamental economic driver of the EchoLink System.

The fees paid by business users contribute to the health of the EchoLink System. A portion of the fees are distributed to education and training organisations as incentives to provide verified information. A portion of the fees also contribute to the actual upkeep of the EchoLink System.

5.1. Token on EchoLink System – EchoLinkToken

The EchoLink System provides an exchange medium to pay fees between users and other participants of the system in the form of the EchoLinkToken (symbol: EKO). With support for heterogeneous back-end blockchain data sources in the EchoLink System, a common exchange medium is needed. The EchoLink smart contract and multi-blockchain browser have built-in support for the EchoLinkToken across different blockchain systems. Therefore, data providers from public blockchains, alliance blockchains, and even private blockchain would be easily rewarded with EchoLinkTokens.

An even more important use of the EchoLinkToken is to establish an international education reputation and skill level market place. With the EchoLinkToken as the common method of value exchange in the EchoLink System, quality of education in different countries, institutions, and disciplines can be measured by a common and consistent token.

6. CONCLUSION

The EchoLink System is a user focused blockchain application system, and is designed from a user perspective. The EchoLink System supports multiple blockchain platforms across countries. It addresses an acute business need, namely identifying great talent with verified credentials at a reduced cost. The EchoLink System is driven by real-world economic needs and is built on top of a sound economic model.

Furthermore, The EchoLink System breaks down barriers between education systems, credential verification systems, and value systems to bring out a truly trusted and worldwide talent market.

6.1. Future Work

We plan to further strengthen the EchoLink System by focusing on the following areas:

- (a) next generation of end user access and interaction: both mobile and desktop;
- (b) more industries support in addition to talent and education; and
- (c) education credential valuation market based on EchoLink System users voting.

In addition to improvements to the EchoLink System, the same design principle can be utilised to create blockchain based notary, transaction, and proof of existence system for other industries.

6.2. Acknowledgements

We would like to acknowledge several industry veterans for advising our project.

6.3. Whitepaper Versions

Echo v. 1.0 – April 2017, initial release

Echo v. 1.1 – July 2017, first updated draft

Echo v. 1.2 – October 2017, second updated draft Echo v. 1.3 – November 2017, third updated draft

6.4. Code Base

Codebase: <https://github.com/EchoLinkTech/EchoLink>