

ATTENTION BASED CURRENCY

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ABSTRACT

Attention Based Currency (ABC)¹ is a non-random, pattern-based system of allocating rewards for blockchain transaction processing. The algorithm can be implemented in combination with Proof of Work, Proof of Stake, or a hybrid system such as Gridcoin.² ABC adds to the cryptocurrency ecosystem by delivering:

1) more efficient energy consumption; 2) lower transaction fees; 3) improved network decentralization and node density; 4) global access for billions to a new class of cryptocurrency assets.

A successful ABC integration will consist of the following:

Proof-of-Play (PoP) - In contrast to mining or consensus based protocols, PoP delivers rewards based on interactions with a streaming music application. Listeners use PCs, gaming consoles, and mobile devices to process block transactions, in exchange for free access to streaming music and occasional algorithmically determined payouts.

Lotus Petal Architecture - A trend-based algorithm for allocating rewards, based on data generated and allocated by the system being measured. Petal architecture vectorizes points of available data, mapping data points that match system-defined parameters to a predefined curve. The intersection of points on homologous curves generates payouts for a subset of participating nodes.

“Everybody Gets a Trophy” - Under most existing cryptocurrency schemas, ordinary consumer electronics would quickly be outcompeted by specialized mining rigs. Even the heat generated by these computation could be damaging. Thus, we must introduce a rule to level the playing field. *An equalizing principle allows us to expand the number of participating nodes by several orders of magnitude, creating a far more resilient, far less centralized network.* Using song length as the interval against which system work is paced, we can easily integrate this principle with PoP.

¹ ABC has no relation or association with Bitcoin Cash, formerly known as Bitcoin ABC.

² Gridcoin’s Proof of Research algorithm (<http://wiki.gridcoin.us/Proof-of-Research>) represents one example of a “hybrid,” energy-efficient cryptocurrency combining both PoW and PoS.

Lotus Petal Architecture

Lotus Petal Architecture is a trend-based algorithm for allocating rewards based on data generated and analyzed by the system being measured. It presents an alternative to traditional blockchain mining but is not bound to a specific protocol. Here it is explored together with **Attention Based Currency's Proof-of-Play**, in which listeners process transactions in exchange for access to streaming music.

Petal architecture vectorizes available data, mapping data points that fall within system-defined parameters to a predefined curve. The intersection of points on homologous curves generates rewards (payouts) for a subset of participating nodes.

How does this work?

- Listeners choose music from a pool of songs, streamed by 4 or more hosts.
- Hosts may stream all songs in the pool, or only a subset.
- All plays count toward the same song trend, regardless of which host streams the song.
- Play is tracked cumulatively; a trend may level off but will never dip down.

S₁ (Song 1) might have a trend like so:



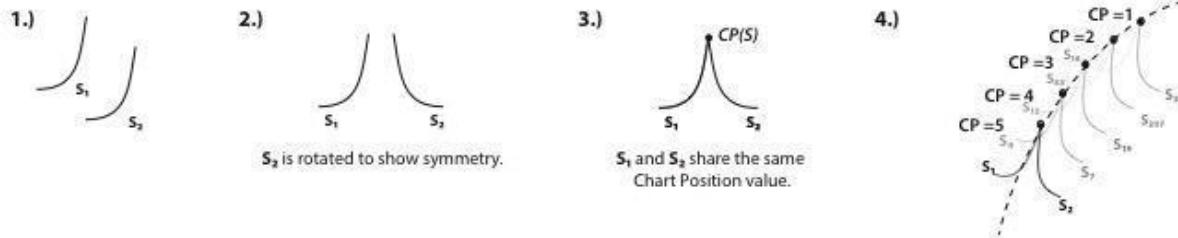
S₂ (Song 2) might have different play data but fits the same trend:



Whereas **S₃ (Song 3)** does not fit the same trend:

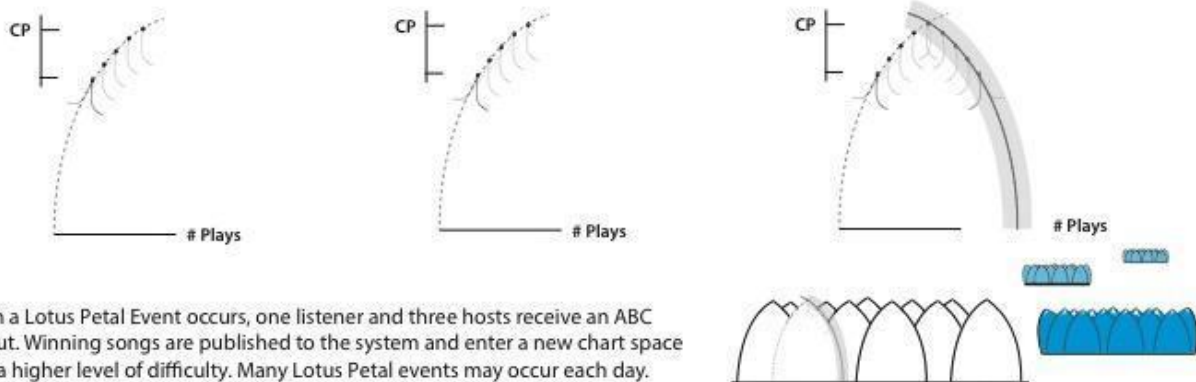


If the trend curves for **S₁** and **S₂** are congruent, a new data point is created to mark the intersection of their maximum values. We call this new vertex of intersection **Chart Position (CP)**¹.



Whenever a pair of songs “chart,” the next listener to each song receives a reward (payout) in the form of Attention Based Currency.

- Chart position relative to song play forms a new dataset known as the “petal edge.”
- This distribution is represented visually as a quadratic Bézier curve (the “Lotus Petal”).
- When petal edges intersect,² a Lotus Petal Event occurs.



When a Lotus Petal Event occurs, one listener and three hosts receive an ABC payout. Winning songs are published to the system and enter a new chart space with a higher level of difficulty. Many Lotus Petal events may occur each day.

¹ *CP(S)* is defined as a function of the total number of plays of a song to date, evaluated relative to the total numbers of plays of other songs assigned to the same chart. CP is an ordinal number. Ex. the song on the chart with the highest total plays would have a CP of 1, the song with the next-highest total would have a CP of 2. Charts created at regular intervals and describe a specific snapshot in time. The songs on a specific chart are not determined by genre or other external characteristics. There are no “ties” on the chart and a song may only belong to one chart at a time. Play data is recorded for every song, but in order for a song to **chart** it must A) Have a growth trend within the range of a system-defined curve; B) have approximately the same number of plays as another song meeting the criteria defined in Part A. Thus, charts are always created in pairs. This use of symmetry makes it more difficult to game the system, helping to “keep listeners human.” A song without enough data points (plays) would not yet qualify for a chart; similarly a song with an abrupt spike in plays indicative of bot activity or paid listens would not be included. As songs increase in popularity, they may leave their original chart space (a “Lotus Petal Event”) and begin life on a new chart; listener and host rewards are adjusted accordingly. The highest rewards to listeners and hosts accrue on charts for “unknown” songs with low numbers of total plays.

² *Intersection* is defined as the event when four songs (two from each petal edge) receive the same number of total plays. It goes without saying that the edge for any given chart will not map exactly to the ideal “Lotus Petal” shape; rather, the Lotus Petal defines a range of acceptable values consistent with normal listening trends.

ABC is an inflationary currency, but one with that contains scarcity constraints as a counterbalance (chiefly, limitations on bandwidth and limitations on time). The general public is becoming more curious about Bitcoin, but its purchase is out of reach to most. ABC holds the potential to make cryptocurrency universal.

The ABC rewards system supplies a missing part of the equation, providing a new way to incentivize the circulation and use of non-fiat currencies. Unlike revenue from transaction fees, mining, and speculation, ABC is sustainable for the long term.

The **“Way of the Lotus Petal”** makes possible a global decentralized money system where any human being with a cell phone and a set of headphones can be a stakeholder.

BACKGROUND

All forms of exchange gain their value from scarcity. Whether we speak of gold mined in remote areas of the world, or the supply of dollars in circulation controlled by the Federal Reserve, traditional mediums of exchange would have no value if their quantity were not limited. Hyperinflation is the curse of an overabundance of currency – if a government begins printing too many bills to finance its own debts in times of war or economic distress, consumers pay the price.

More recently, the invention of the decentralized Internet currency known as Bitcoin represents a way to build the property of scarcity into an apparently limitless electronic medium. Individuals “mine” Bitcoin and other related crypto-currencies by solving a series of complex cryptographic hash equations. The activity of Bitcoin mining is time-consuming and processor-intensive. The value of Bitcoin has risen dramatically since its inception in 2009, with a live market capitalization just over \$1 trillion, as of the time of this writing.

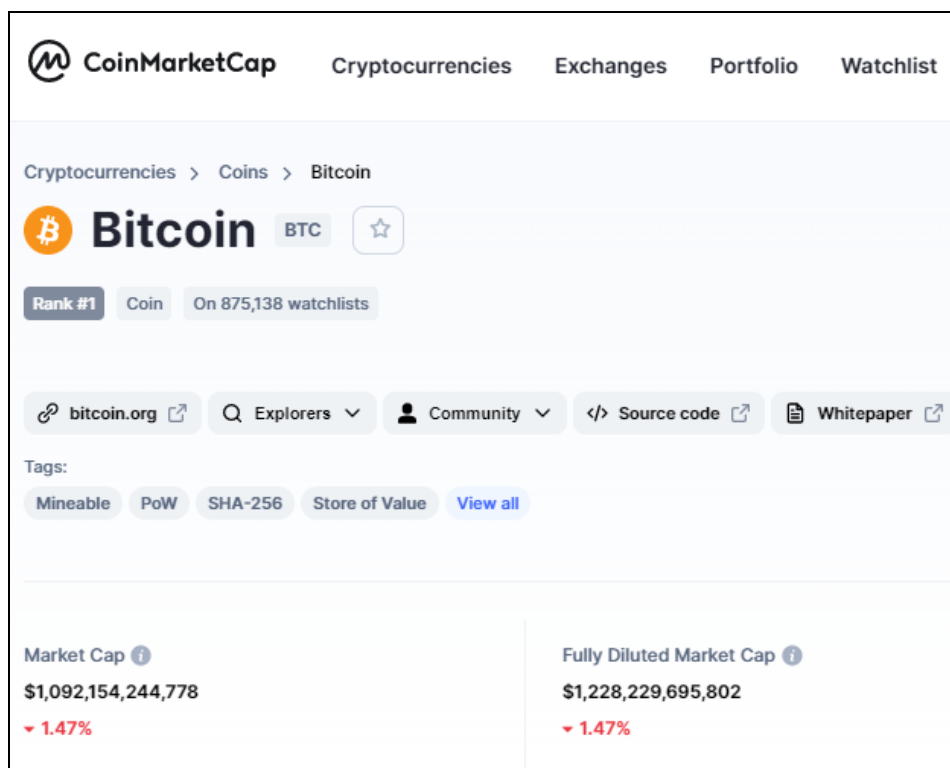


Image Source: [CoinMarketCap](https://www.coinmarketcap.com/coin/bitcoin)

Attention Based Currency (ABC) seeks to utilize a different scarce resource: **the attention span of human beings**. Specifically, ABC measures the interactions of users with an online streaming music service, and rewards listeners and hosts with

currency units based upon these interactions. From an end user’s perspective, **mining ABC depends on the simple act of listening to a song.** User choice and interaction with the system introduces a social variable that prevents the system from becoming too deterministic or predictable.

ABC is a microcurrency designed for online transactions of information-based products whose value will most often be less than a dollar (\$USD 1). In other words, the ABC microcurrency is a way to monetize and capture value for information-based products and services currently “too cheap to meter,” whose value is most often not realized for investors or creators, except through the inefficient, imprecise, and fraud-prone medium of online advertising.

Examples of “weightless products” well suited to exchange for ABC include: digital images, videos, “apps” or software applications, electronic books, online gaming tokens, site subscriptions, and music downloads.

Why music?

Why not measure viewers’ responses to video? Or games? Or fantasy football?

- **Music is popular.** Currency is about building a brand, as much as it is about security and stability. Bundling microcurrency to an online service that is easy to use and understand will increase its circulation, and thus its long-term value.³
- **Music is global.** It is now possible to load in a selection of music that reflects the cultural and ethnic diversity of our current era.
- **Music is an efficient use of bandwidth.** Music is far less bandwidth-intensive than streaming video or real-time online gaming, and can be enjoyed easily through mobile devices, in a variety of settings and locations.
- **Music is not porn.** Audio files may contain mature content, but they do not contain the types of graphic and explicit images often produced in unsafe and/or illegal conditions. Building currency upon audio rather than visual content largely mitigates perceived needs for government or corporate censorship.
- **Music is complex, varied, and invites a lifelong relationship.** Listeners will return again and again, and find the experience rewarding at every step.

Lower Transaction Fees

Volatility in transaction fees has been a thorn in the side of nearly every major blockchain cryptocurrency. Bitcoin fees have risen more than 1200% since March 2015.⁴ Whether the currency in question is Ethereum, Blockchain, or Blockchain Cash (**Fig. 3**), there is no programmatic guarantee ensuring that transaction fees will

³ J. Scott Little. “Support of a Non-Vanishing Initial Value of ABC.” February 5, 2015.

⁴ <https://news.bitcoin.com/bitcoin-transaction-fees-1200-past-two-years/>

remain low, or even stable. As these fees are correlated closely with a currency's market capitalization, market forces result in a nearly impossible dilemma—**the success of a currency as an investment vehicle undermines its usefulness as an actual medium of exchange**. In particular, uncontrolled fluctuations in transaction fees render cryptocurrencies nearly useless for small transactions and micropayments. Even if one processes such transactions in bulk, these per unit costs may easily drive a merchant underwater.

We envision an implementation of ABC where the vast majority of mining may occur on consumer thin client devices (including but not limited to cell phones, tablets, video game consoles, mp3 players, and personal computers) rather than on specialized mining rigs.

Distributed computing is much more than a curiosity. Stanford University, for instance, harnessed the power of the Sony Playstation to study protein folding in its Folding@home microbiology project.⁵ The current ABC Proof of Concept (PoC)⁶ is a simple fork of Litecoin with a modified wallet structure. It is also possible to mine Litecoin on personal computers⁷ or even on a Raspberry Pi⁸.

⁵ **Stanford University's *Folding@home*** distributed computing project utilized a specialized client for **Sony Playstations**, along with other CPU and GPU processors. The Playstation processor delivered a 20X speed increase for some calculations. Its ability to stream data quickly to its GPU, proved especially useful for real-time atomic-level visualization of protein dynamics. Over its lifetime of five years and 7 months, more than 15 million users contributed over 100 million hours of computing to Folding@home, greatly assisting the project with disease research. The Pande lab considered the PlayStation 3 client a "game changer" for the project. <https://en.wikipedia.org/wiki/Folding@home>

⁶ Repository at <https://github.com/yesexactly/yxcoin>; live demo at <http://abc.yesexactly.com> (requires password)

⁷ <https://samsclass.info/141/proj/pLite.htm>

⁸ <http://raspnode.com/diyLitecoin.html>

KEY ATTRIBUTES OF ABC

The model below refers to the combination of secure online microcurrency with a streaming music application, or “online jukebox” that generates currency based upon plays of songs. This currency is referred to as Attention Based Currency (ABC).

Proof of Play

The “Proof of Play” algorithm is designed to:

- Create a system where, when more than one streaming music host is participating, a single host does not gain by flooding the entire system with bots.
- Allow/encourage play of a song by multiple hosts.
- Give hosts no incentive to block or prioritize certain listeners above others
- Enable rewards for Listeners, Artists, and Hosts, recorded and paid out through a blockchain structure.
- Allow processing of block transactions in near-zero fee environment.
- Deliver rewards algorithmically, rather than randomly.
- Encourage listeners to find good new music.

As our seed variable, we are trying to introduce a pattern that is delicate and difficult to predict—humans’ unfiltered aesthetic musical taste. To deliver rewards, the system relies on morphological analysis rather than quantitative goalposts.

Lotus Petal Architecture

For an in-depth discussion of Lotus Petal Architecture, please see Page 2.

- Total plays are recorded for each unique song identifier in the system.
- Songs with similar growth trends over time are matched to each other.
- The points of their intersection can be used to generate a new chart, showing the relative popularity of songs to each other during a given interval of time.
- This chart can be compared to a second chart, following the same approximate pattern but using a different set of songs.
- The moment when these charts intersect (the “Lotus Petal Event”) represents four unique songs, all sharing the same popularity and all at the same chart position relative to other songs being played during the same time period.
- For one of the four songs being played, the next listener earns a reward.
- For the other three songs, the next host to play the song earns a reward.
- Each time a listener or host earns a reward, the artist earns an equal amount.
- The system is winner take all: rewards cannot be distributed among prior hosts/listeners in the chain because that would create false incentives to manipulate the system.
- It is in musicians’ interests to share their music widely across hosts. Creative Commons becomes an important resource.

Why overlay Proof-of-Play on top of Proof-of-Work?

It creates a set of patterns that are 1) mathematically observable, 2) difficult to game or fake, and 3) can be observed and evaluated algorithmically by the system itself.

This leads to a better rewards system.

Also, more people get to play.

Are Bots necessarily a bad thing?

Bot participation does not necessarily disrupt the system of ABC mining, and may in fact make the system more efficient, provided that mining incentives are structured properly, such that human listeners remain able to earn and spend ABC.

Aspiring pop stars will no doubt purchase fake listens on the ABC system, much as they now purchase fake “likes” and “follows” on Facebook and Instagram. If non-human agents want to “pretend” to listen to a song and process transactions on the network without expending bandwidth, this efficient use of resources does no harm. Similarly, there is no penalty if a user chooses to turn off the sound but continue processing transactions on their Client Streaming Application.

Issues ensue if bots receive a disproportionate share of payouts, collude with hosts to gain an unfair advantage (51% attack); and/or crowd out human listeners. We expect that many ABC hosts will employ captchas and other identity verification tools to prevent song plays from falling on deaf ears.

The Proof of Play algorithm does not attempt to weed out nonhuman users on an individual level; rather it defines the reward structure such that actions outside of expected listening behavior (totally random plays or flooding the system with plays of one particular song) while permitted, will not result in a payout.

Client Application

In order to generate currency, the user (listener) must download and install a Client Application (CA) to play music and connect to a participating ABC server. This thin client may be available for multiple platforms (desktop, tablet, and mobile) and must be connected to the Internet in order to earn ABC.

This is where the “**Everybody Gets a Trophy**” rule comes into play. The rule uses song structure to handicap fast processors and give slower processors a chance to

share some of the processing load, as only a set block of transactions will be processed during each varying song interval.

Each time a user plays a **song**, the CA solves hash equations in the background in order to validate block transactions. All songs are defined to have a minimum and maximum length. For example the system may define “songs” as audio files between 2:00 and 10:00 minutes. Listeners must play the entire song in order for listener and host to be eligible for a payout. Transaction processing begins upon play of a new song. The CA is assigned only a single block for processing. Block size and difficulty are set so that the processors in consumer electronics will be able to finish the block in less time than the minimum defined song length. The CA lets the device “rest” after the initial block is completed; they do not have to process another block until the next song begins.

Songs with fewer plays will be more heavily weighted to return rewards, rewarding listeners who seek out new and unfamiliar artists, and hosts who play a wide variety of artists. This system uses the blockchain to create a database with a sequential record of all transactions and song plays. This enables the payout system to function; providing an extra level of incentive to participate in the network (above and beyond free streaming music). Special care must be taken to protect the privacy of all user accounts and prevent the release of personally identifying information associated with user accounts and/or specific listening patterns.

Using the Client Streaming Application

The CA will function in most ways so as to be indistinguishable from a standard online jukebox or music streaming application.

It may include such features as:

- Song Play by Artist
- Song Play by Album
- Song Play by Genre
- Pre-Programmed Playlists
- “Shuffle” or “Random” Mode
- Internet Radio Stations
- Social Media Integration

It is anticipated that many listeners will simply use the CA as their preferred musical listening platform and may not wish to track or closely monitor the currency mining functionality. In keeping with market-based incentives, the systems are structured so that individuals with the most conventional listening tastes (e.g. the majority of listeners) will reap comparatively fewer rewards from ABC “mining” while hosts retain a greater proportion of currency. Conversely, users who seek out independent

and less well-known artists, whether for musical or currency-seeking motives, will be rewarded for their more adventurous tastes. *Beyoncé fans and Charles Mingus fans will both earn currency; however Mingus fans will reap a somewhat greater proportion of payouts.*

Users may install the CA on more than one device; however only one device may generate currency at a time for a given user account identifier. All currency-generating transactions are assigned a timestamp. A feature may be implemented allowing users to listen to their favorite tracks offline; however, offline listens will not count toward generating currency.

The system is set up so that all users have a Dashboard to check their online balance and recent listening history. Statistics on returns from popular and trending songs and on the quantity and current value of currency generated system-wide will also be accessible through this dashboard.

In addition, users can check their ABC balance by logging in via the web or their cell phones to their secure wallet, which is synced in real-time with the client CA.

The host may at times wish to award ABC currency as a bonus or one-time incentive to users (for instance, when running a contest or funding initial account signups with a starting balance). Specific algorithms for mining and awarding ABC may shift and evolve over time, but must remain consistent throughout all streaming music host and listener nodes.

Demographic user listening data may be shared with outside sources, but only anonymously, in the aggregate.

Definition of a Song

For the purposes of this document, a “song” is considered to be any audio selection less than 10 minutes in length. Songs may also include spoken word, comedy, hip-hop, etc. Longer selections (e.g. audiobooks or podcasts) may also be included as part of the ABC online streaming audio selection. Selections over 10 minutes in length would be broken into smaller units in order to match the CA’s processing requirements.

Wallet

At the time of account signup, a secure individual ABC Wallet is created, with a unique login and user identifier. This Wallet can be used to make purchases and track account activity across different devices and on any Internet website accepting ABC as currency. This Wallet may be funded through one of several sources:

- Initial signup bonus
- Currency generated by listening to songs
- Conversion of currency into ABC via credit card or bank account
- Transfer of ABC funds by individuals or businesses (typically for the sale of information goods and services – ex. an artist receives ABC compensation for download and use of digital stock photography)

This ABC Wallet may be accessed online through any web browser or supported mobile device. In addition, the Wallet may be integrated with leading social networks and online experience sites. (For example, a user might employ the ABC Wallet to purchase game credits, or to download a news article. In both cases, no additional credit card or login information would be needed.)

Credit card or bank account information is not necessary to create an ABC account or use the Wallet; however the user may supply this information if they wish to exchange ABC for cash, or purchase additional ABC units for future transactions.

Music

Each music node (host) for Attention Based Currency contains a streaming media server with a database that may range anywhere from a few dozen to several million songs. In exchange for hosting the music, the server operator receives a share of the currency generated from its listeners (users). The current PoC utilizes the open source Ampache Streaming Application⁹, equivalent in functionality to Spotify and other commercial streaming music services. It is assumed that server operators will use material either licensed through Creative Commons or with full permission from the original artists.

A unique identifier is created for every song in the ABC database, and must be associated with an artist name and wallet account in order to be included. Artist wallet accounts may represent one individual or a group of individuals.

Signup

The user signs up for an ABC account using a secure web form to provide an email address and optional other form of identifications. No further identity verification is required; however hosts may implement other methods at their own discretion. A unique listener wallet ID is created for every individual ABC wallet.

⁹ <http://ampache.org/>

Privacy

Listening history may be shared in the aggregate, but it will never be tied to an individual's name or other identifying information. Double encryption is utilized to ensure that when ABC wallet hosts store personally identifying information (ex. link an individual's wallet to a bank or credit card account) that information cannot be traced back to the individual's wallet ID. The goal is a system that ensures at least as much anonymity as the current Bitcoin blockchain, and ideally much more.

Future Issues to Be Addressed

First-generation streaming music hosts are encouraged to use music available through the Creative Commons system or licensed directly from the artists themselves. A number of different certification, identity verification, and naming solutions may be employed. ABC's model relies on the concept that the blockchain makes all transactions between hosts and artist wallets visible and traceable. See the ClaimTrie implementation in lbry.io¹⁰, another blockchain-based media project (currently in beta) for one potential approach to the problem of resolving competing claims to artist names.

Be aware that streaming music hosts must still find a way to reach listeners. **In a situation where users pay nothing to listen to their favorite artists, and in fact gain by listening, it is to be expected that listeners will choose hosts that are endorsed rather than blacklisted by the musicians they admire.**

The ABC system has the potential to be disruptive, creating a new source of wealth for artists and "cutting out the middleman." In this vision of the future, record labels can easily reinvent themselves to become streaming music hosts. Given full transparency and access to information, market forces are capable of providing better rewards to artists participating in Attention Based Currency than would otherwise be available through the current deeply flawed music industry regime.

¹⁰ <https://lbry.io/faq/claimtrie-implementation>

RELATED TOPICS FOR CONSIDERATION

API and Licensing

ABC may at some point include an API enabling listeners to other commercial streaming services such as Spotify and Pandora to participate in generating ABC. Currency units mind would be subject to the same rules and standards as those defined for the original ABC blockchain protocol.

Charitable Donations

Another potential application is the ability to designate a portion of ABC spending and/or proceeds to a given business, individual, or charity. (ex. A musical artist can designate their Artist Share of currency generated go to the charity of their choice.)

Comparison to IOTA

Non-blockchain cryptocurrencies such as IOTA's Tangle¹¹ claim to offer a zero transaction fee model. While IOTA's model holds promise, a few concerns emerge:

- The only incentive to contribute to the IOTA network is participation in the network itself.
- There is little incentive for competitors to adopt this technology, since benefits of fee-free microcurrency transactions can only be realized at scale.
- Fluctuations in usage may cause difficulties, given that eligibility of nodes to participate depends on a high and constant demand for network resources.
- *People are not meant to hold IOTA.* It is a currency for the Internet of Things.

How is this different from a Bitcoin fountain?

Rewards are not arbitrary, but are algorithmically tied to the entire transaction processing model. There can be no working implementation of ABC without trends based rewards and payouts. Similarly:

ABC is not gambling because no betting is required to participate.

ABC differs from airline miles or credit card "points" systems, in that:

- No purchase is required to earn currency.

¹¹ https://iota.org/IOTA_Whitepaper.pdf

- ABC awards currency to artists and the streaming application host as well as to consumers using the service.
- ABC transactions are not limited to “approved partners.”

Implementations

Additional implementations and applications of Attention Based Currency include:

- Visualization modules that graphically represent aggregate trends in attention and interaction, through a variety of informational or abstract patterns
- Modules for social media that share what songs a particular listener is listening to and how much currency has been minted
- Images and barcode-based codes enabling a user to scan a particular artist’s code on a mobile device and immediately begin listening to their songs
- Generation of industry music reports (“charts”) based on listening trends.

Universal Basic Income

ABC has significant potential to decrease the tax burden of implementing Universal Basic Income on a national or local basis, while increasing the ability of those without employment to generate assets and wealth. *Even more intriguing, it can be deployed as a standalone **market-based Universal Basic Income** solution without requiring public-sector investment.* For further discussion and economic modeling, please see journal article by Elizabeth Gadwa and Scott Little, Ph.D., published by the Basic Income Earth Network (BIEN) and first presented at BIEN’s July 2016 conference in Seoul, South Korea.¹²

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<http://artmeetscode.com/wp-content/uploads/2016/07/Attention-Based-Currency-and-Universal-Basic-Income-v-4.pdf>