

# Universal Digital Dollar

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## Abstract

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This whitepaper analyzes the technical and market aspects of the Universal Digital Dollar (UDD), a crypto-currency designed to function as a modern alternative to facilitate financial transactions and drive a healthy economy.

Practical functions from real-world economies are built into the UDD framework, and in many cases improved. One of the most attractive features is that buyers and sellers are **paid to make transactions instead of being charged fees**.

UDD is based on a combination of blockchain and “tangle” technology to maximize both efficiency and reliability. In order to promote full-scale and rapid adoption of the currency, all key players in a functional economy are incentivized with discounted shares of the initial coin base. UDD strongly encourages a circulating economy with a rich set of features to enable commerce and investment.

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Bitcoin gave people low fees...

Iota gave machines no fees...

**UDD has no fees, and it pays you!**

## Table of Contents

Part I – General.....	3
1. Disclaimers .....	3
2. Introduction .....	3
3. Formal Name and Symbol .....	5
4. Comparison to Existing Crypto-currencies.....	5
5. System Development, Maintenance, and Growth.....	7
Part II – Economic and Financial System.....	8
6. Genesis Block .....	8
7. Inflation .....	8
8. Rewards.....	9
Part III – Core Functionality.....	11
9. System Roles .....	11
10. Methods of Payment.....	13
11. Tangle Validation .....	13
12. Blockchain Validation.....	15
13. Validation Level.....	16
14. User Identities.....	17
15. Actors.....	19
Part IV – Additional Features .....	21
16. Trust Model.....	21
17. Marketplace .....	21
18. Loans.....	22
19. Offline Modes.....	23
Part V – Project Plan.....	24
20. Initial Coin Offerings.....	24
21. Roadmap.....	27
22. Team.....	27
23. Budget.....	28
Conclusion .....	28
References .....	29

## Part I – General

### 1. Disclaimers

Please consult your authorized financial advisors for guidance on investments in token sales, initial coin offerings (ICOs), and crypto-currencies.

For legal purposes, the Universal Digital Dollar (UDD) is not to be considered as securities. The regulatory landscape for crypto-currencies and ICOs is still in the formative stages. Once terms are well established by recognized regulatory agencies, UDD will make best efforts to comply.

Details and functionality described in this whitepaper are subject to change without notice before final implementation.

### 2. Introduction

UDD offers a modern alternative to mainstream economies. It combines the immutable nature of technologies such as block-chains and “tangles” with a clear strategy to engage the wide variety of actors in mainstream economies.

The technological foundation of UDD uses a combination of tangles and block-chains. Tangles are used for short-term validation of transactions due to their higher levels of performance, and block-chains are used for long-term validation due to their higher levels of reliability.<sup>1</sup>

Tangles in UDD are similar in many respects with tangles in Iota. However, there are some key differences such as variable numbers of validations required for “tips”. Likewise, block-chains in UDD share similarities with block-chains in Bitcoin. Again, there are key differences such as a hybrid proof-of-work and proof-of-stake approach. These technical details are explored later in this whitepaper.

There is no mining involved. An initial set of 210,000,000 coins are created and distributed through a series of token sales. Participants in the economy are categorized by their functional roles, such as small businesses, non-profits, or individuals.<sup>2</sup> Each category is allotted a specific pool of coins to draw from.

The UDD economy is inflationary. Inflation is set at 2% of the total coins (circulating and reserved) per year<sup>3</sup>. Inflation is automatic, calculated annually, and added to the system in daily increments. This inflationary amount is used innovatively to reward buyers and sellers for making transactions instead of punishing them with typical transaction fees in traditional economic models and many crypto-currency transaction models.

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<sup>1</sup> A tangle-based system by itself is optimal for newer transactions, but less so for older transactions. A blockchain-based system by itself is inefficient for newer transactions, but optimal for older transactions. Thus, a hybrid system leverages the strengths of one to offset the weaknesses of the other.

<sup>2</sup> Categorizations are loosely based on real world markets. The goal is to execute any and every possible fiat transaction between any combination of agents using UDD instead.

<sup>3</sup> The rate of inflation can vary if needed to maintain the health of the economy. 2% is targeted based on real world market history and recommendations from respected economists.

Buyers and sellers<sup>4</sup> are charged no fees for transactions. Instead they are both rewarded with a share of the daily inflation based on their transactions. Transaction validators (tangle and block-chain) are also rewarded with a share of the daily inflation based on their validation load. Buyers can optionally include selected charities and/or government organizations<sup>5</sup> to share in the daily inflation based on their transactions.

This reward based transaction system offers many advantages over traditional debit or credit transactions:

1. Buyers do not have to pay bank or credit card fees (annual or per transaction). Instead buyers effectively get “cash-back”<sup>6</sup> bonuses the more they buy.
2. Sellers do not have to pay bank or credit card fees (annual or per transaction). Instead sellers effectively get “tips” for offering more goods and services that appeal to buyers.
3. Transaction validators do not have to pay enormous electric bills and hope they get lucky with a nonce before competing validators. Instead, all validators effectively “mine” successfully each and every time according to their abilities.
4. Buyers do not have to pay out of their own pockets to support charities or governments. Instead they can “donate” (or not) as they like.

Similar to how Ethereum built a framework with native features useful for managing distributed applications (dapps), UDD offers a framework with native features useful for managing an economy. These features include:

1. The option for buyers or sellers to remain anonymous by merging multiple anonymous transactions into one.
2. The option for buyers and sellers to be verified users with proof of identity, which is useful for large or sensitive transactions.
3. The separation of users and accounts, allowing one user to have many accounts, and many users to share one account.
4. The ability to use one account with both anonymous and verified identities.
5. Proof-of-stake doubling as credit to keep currency flowing instead of stagnating.
6. Controlled inflation at 2% of the total economy per year.
7. Rewards (“fees”) for transaction validators, both for tangle and block-chain validation.
8. Rewards (“cash-back”) for buyers and sellers with every transaction instead of fees.
9. Global marketplace for goods and services with transactions in UDD.
10. Multiple methods of payment, similar to existing debit and credit transactions.
11. Option for buyer to specify which charitable organization (if any) to reward with every transaction.

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<sup>4</sup> A “buyer” is anyone who gives money to another. A “seller” is anyone who receives money from another.

<sup>5</sup> Each transaction can opt to share rewards as follows: no government, no charity; government only, no charity; no government, charity only; government and charity. None of these choices impact the rewards the buyer themselves receives. The options empower buyers to express their personal/political preferences towards third party agencies.

<sup>6</sup> Traditional credit card models take some percentage (~3%) from the seller and re-direct some percentage (~1%) to the buyer to incentivize the buyer to prefer their card. The UDD model takes a share of inflation (variable based on transactions) and re-directs half of that amount to the buyer, and the other half to the seller.

12. Option for buyer to specify which government agency (if any) to reward with every transaction.
13. Rating system to rate buyers and sellers, where better ratings improve transaction validation.
14. The option to refund transactions (from public or verified users) which are still in the tangle.

### 3. Formal Name and Symbol

The formal name of this crypto-currency is “Universal Digital Dollar”. The formal acronym is “UDD”. It is valid to refer to the crypto-currency contextually as “dollar”, “coin”, “uni-coin”, “unicoin”, “UDD”, or “UDD coin”.

For convenience, the formal symbol is the same as the dollar symbol (\$) for other existing dollar currencies (USD, CAD, AUD).

The smallest recognized unit is the “nano-cent” which is precise to 9 decimals. \$ 0.000 000 001 = 1 nano-cent.<sup>7</sup>

### 4. Comparison to Existing Crypto-currencies

Since 2009, Bitcoin pioneered the field of de-centralized crypto-currency using blockchain technology. Ethereum built upon the blockchain to create a framework for de-centralized applications. Iota used the “tangle” as an efficient alternative to blockchain to enable machine-to-machine micro-transactions without fees. As of 2017, many “alt-coins” exist<sup>8</sup> which offer niche functionality or market focus. The underlying technological foundation for most alt-coins traces back to Bitcoin, Ethereum, or Iota.

Bitcoin has seen some success as a functional alternative to fiat currency for commercial transactions. By allowing de-centralized and anonymous transactions it was largely embraced by marketplaces which valued anonymity very highly.<sup>9</sup> In contrast, acceptance rates have remained negligibly low for legitimate and ubiquitous vendors.

Increased visibility of the crypto-currency markets, especially since May 2017, and acknowledgement by brand-name organizations such as Goldman Sachs may help increase adoption of Bitcoin by a wider and more mainstream audience.<sup>10</sup> The most common use of Bitcoin these days appears to be simply for trading on the currency exchanges, whether for fiat or other crypto-currencies.

Ethereum built its own microcosm where a growing list of dapps trade in Ether on the Ethereum platform, including ECR20 compliant tokens used to kickstart new ventures. Iota has by design purpose-built their system towards machine-to-machine micro-payments with less focus on how this

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<sup>7</sup> Using 64-bit signed integers, UDD values can be represented up to 9,223,372,036,854,775,807 nano-cents, which translates to UDD \$9,223,372,036. At 2% inflation for 100 years, the money supply will reach UDD \$ 1,462,298,813.

<sup>8</sup> There are many coin listing sites to reference, including [finance.yahoo.com](http://finance.yahoo.com). There are also many ICO listing sites, including [icoalert.com](http://icoalert.com).

<sup>9</sup> Silk Road, the infamous dark web marketplace, is well-known for wide acceptance of Bitcoin.

<sup>10</sup> While it is possible to find some cutting-edge bars in Amsterdam that honor Bitcoin as payment for a beer, we are still far from the days when one can purchase a Big Mac directly from McDonald’s using Bitcoin. A significant inhibitor for seller acceptance will remain the fee per transaction required to sustain a Bitcoin economy.

can function for human or organizational transactions.<sup>11</sup> Alt-coins with defined niches function natively within their own niches, but need to convert to fiat or other coins when outside their niche.

UDD improves upon Bitcoin and all these subsequent currencies by providing a functional strategy to encourage adoption by key actors in mainstream economies as a whole. The measure of success for UDD is to provide a truly functional alternative to fiat currencies that is de-centralized and accepted by a global mainstream economy. It can and should be possible for users to participate in multiple niches with no currency exchange and no fees.

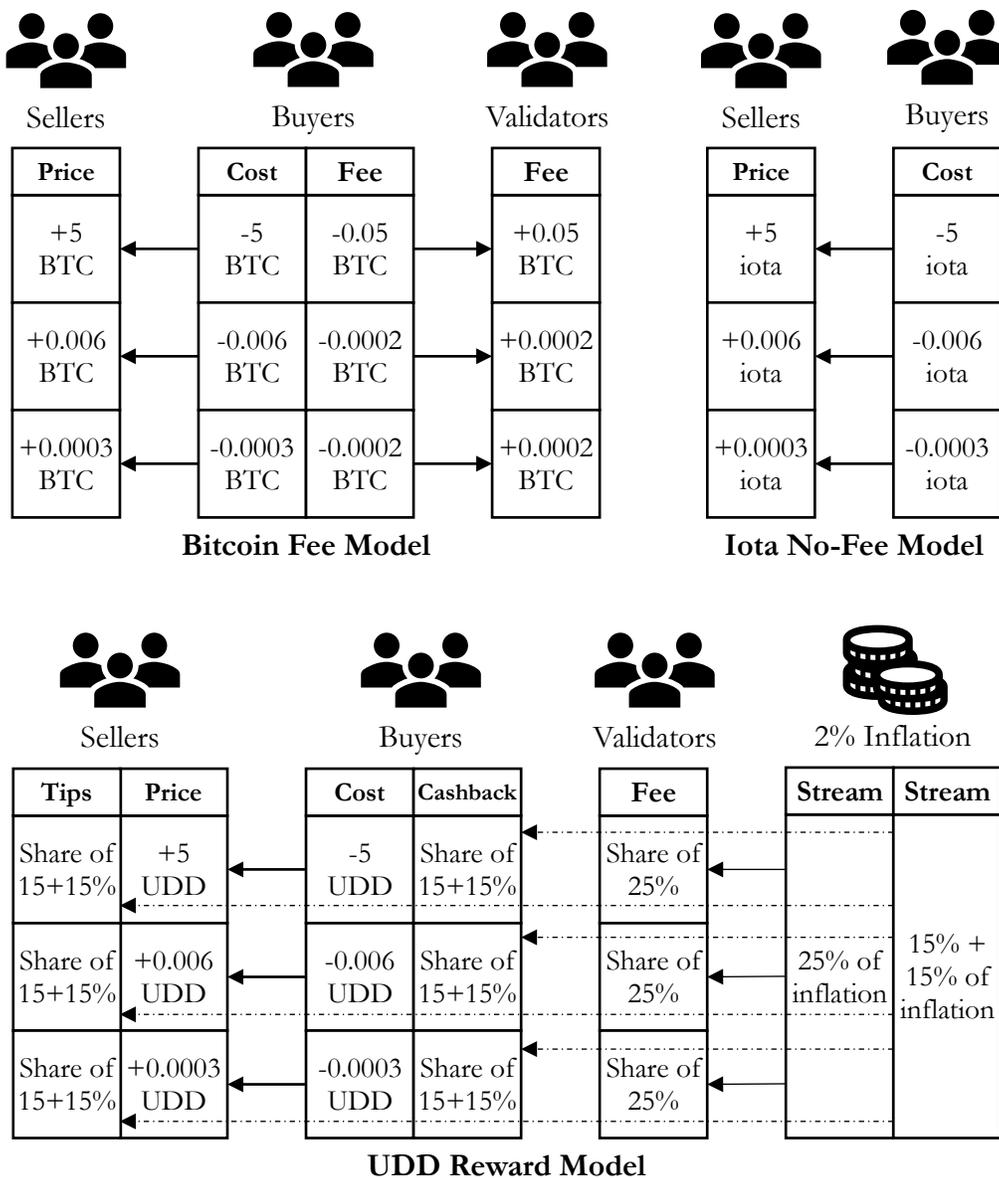


Figure 1 – Fee models for Bitcoin, Iota, and UDD

<sup>11</sup> The Iota whitepaper states it is possible to use the system beyond M2M paradigms, but does not provide details. Iota's priority remains devices, not humans. Humans may participate indirectly via their devices.

Key to the challenge of market adoption is the management of fees for transactions. Bitcoin relies on mining and fees within a deflationary system to incentivize blockchain validators.<sup>12</sup> The problem is that fees which were considered low when 1 BTC = 10 USD are considered unreasonable when 1 BTC = 10,000 USD. Even if fees scaled meaningfully, they still subscribe to the philosophy of re-allocating funds<sup>13</sup> from buyers and sellers for making transactions in order to reward validators. Iota recognized Bitcoin fees are so large that they effectively prevent micro-transactions where the fee is larger than the value of the transaction. Iota's approach to the problem is getting rid of fees altogether by making buyers and sellers do double-duty as validators.

UDD goes one step further when it comes to fees. It leverages controlled inflation to not only prevent buyers and sellers from being charged fees. Instead it pays them for participating in the economy. It is also very clear how validators and others within the economy share in these profits. Controlled inflation also encourages would-be speculators hoarding currency to become productive investors instead.<sup>14</sup>

## **5. System Development, Maintenance, and Growth**

The UDD framework will be built and maintained by the UDD development team. They will create the genesis block and issue formal releases of the protocol.

The UDD sales team will engage in active promotion of the system to vendors, employers, and other organizations to increase global adoption of the currency.

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<sup>12</sup> Getting lucky with mining is a large incentive for Bitcoin until 2140, at which point fees become the only incentive.

<sup>13</sup> "Punishing" may be a more appropriate term if one talks to sellers, or to buyers when sellers choose to pass fees onto their buyers.

<sup>14</sup> Hoarding by speculators leads to stagnation and starvation of circulating supply, which in large volumes is the death-knell for an economy. Investment is a more positive approach which allows the money to continue circulating and grows the investor's money as the economy grows.

## Part II – Economic and Financial System

### 6. Genesis Block

The genesis block for UDD starts with all 210,000,000 coins assigned to the UDD corporate account. When the system goes live, UDD token holders from token sales can exchange their UDD tokens for UDD coins on the UDD system at the rate of 1 coin per 1 token.

### 7. Inflation

As mentioned previously, UDD is an inflationary economy. Inflation is set at 2% of the total money supply per year. Inflation is calculated annually on the first day of each year, and we can know precisely what the amounts will be for future years. Inflationary amounts are added to the system daily at 1/365 of the annual amount.<sup>15</sup>

Year	Money Supply	2% Annual Inflation	Daily Growth
2019	210,000,000	4,200,000	11,506.85
2020	214,200,000	4,284,000	11,704.92
2021	218,484,000	4,369,680	11,971.73
2022	222,853,680	4,457,074	12,211.16
2023	227,310,754	4,546,215	12,455.38
2024	231,856,969	4,637,139	12,669.78
2025	236,494,108	4,729,882	12,958.58
2026	241,223,990	4,824,480	13,217.75
2027	246,048,470	4,920,969	13,482.11
2028	250,969,439	5,019,389	13,714.18

*Table 1 – Projected inflation by year<sup>16</sup>*

For readers who may be concerned about using an inflationary economy instead of a deflationary economy (like Bitcoin, Ethereum, and Iota), please consult the wide amounts of literature from reputable sources discussing the behavior and merits of both types of economies.<sup>17</sup>

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<sup>15</sup> 1/366 for leap years.

<sup>16</sup> The table assumes the currency goes live on Jan 1, 2019. If the start date is later, the inflationary amount for the year will be pro-rated using the daily growth amount multiplied by the number of remaining days in the year.

<sup>17</sup> You'll find that most trained economists agree that 2% inflation is the "sweet spot" for a healthy economy that encourages productivity and growth. Any higher, and the currency quickly loses value and confidence. Any lower, and productivity is stifled.

## 8. Rewards

Daily inflationary amounts are distributed as rewards to buyers, sellers, validators, and other actors. There are multiple distribution channels so that activities are compared fairly against the same type of activity.<sup>18</sup> There is a hard cap of 1% for some channel shares per user to prevent abuse by users making extraneous transactions. Unclaimed amounts (if any) from each channel are donated to under-served charities.<sup>19</sup>

Reward Criteria	% Share of Inflation	Share of 2019 Daily Amount	Hard Cap
Number of transactions	15%	1,726.03	17.26
Transaction value	15%	1,726.03	17.26
Tangle validations	25%	2,876.71	--
Blockchain validations	25%	2,876.71	--
Charitable and gov. donations	10%	1,150.69	11.51
Loan default recovery	10%	1,150.69	--

*Table 2 – Shares of inflation by reward criteria*

For “number of transactions”:

- Let  $T_N$  = a single user’s total number of transactions in a single day (as buyer or seller)
- Let  $T_A$  = all user transactions in a single day
- Let  $S_N$  = a single user’s share of the daily inflation for “number of transactions”

$$S_N = T_N / (2 * T_A)$$

For example, if a user makes 5 transactions in a day, and all users make 1,000 transactions in a day, then  $5 / (2 * 1,000) = 0.25\%$ , applied to 1,726.03 coins comes out to 4.32 coins for the day.

For “transaction value”:

- Let  $T_V$  = a single user’s total transactions value in a single day (as buyer or seller)
- Let  $T_A$  = all user transaction values in a single day
- Let  $S_V$  = a single user’s share of the daily inflation for “transaction value”

$$S_V = T_V / (2 * T_A)$$

For example, if a user makes 5 transactions in a day totaling 5,000 coins, and all users make 1,000 transactions in a day totaling 1,000,000 coins, then  $5,000 / (2 * 1,000,000) = 0.25\%$ , applied to 1,726.03 coins comes out to 4.32 coins for the day.

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<sup>18</sup> It is possible to lump every type of activity into the same global pool. However, the “fair” math becomes incredibly complex compared to the simple elegance of split channels. Channel separation also makes it easier to tweak relative weights and to add new channels over time.

<sup>19</sup> Sorted by total donations received from smallest to largest, then by date of last donation received from oldest to newest.

For “tangle validations”:

- Let  $V_T$  = a single validator’s total number of validations in a single day (for tangles only)
- Let  $V_A$  = all tangle validations in a single day
- Let  $S_T$  = a single validator’s share of the daily inflation for “tangle validations”

$$S_T = V_T / V_A$$

For example, if a validator validates 100 tangles in a day, and all validators validate 10,000 tangles in a day, then  $100 / 10,000 = 1.00\%$ , applied to 2,876.71 coins comes out to 28.77 coins for the day.

For “blockchain validations”:

- Let  $V_B$  = a single validator’s total number of validations in a single day (for blockchains only)
- Let  $V_A$  = all blockchain validations in a single day
- Let  $S_B$  = a single validator’s share of the daily inflation for “blockchain validations”

$$S_B = V_B / V_A$$

For example, if a validator validates 100 blockchains in a day, and all validators validate 10,000 blockchains in a day, then  $100 / 10,000 = 1.00\%$ , applied to 2,876.71 coins comes out to 28.77 coins for the day.

For “donations”:

- Let  $D_T$  = the number of transactions pledged to an organization in a single day
- Let  $D_A$  = all transactions pledged to all organizations in a single day
- Let  $S_D$  = a single organization’s share of the daily inflation for “donations”

$$S_D = D_T / D_A$$

For example, if an organization gets 100 transaction pledges in a day, and all organizations get 10,000 pledges in a day, then  $100 / 10,000 = 1.00\%$ , applied to 1,150.69 coins comes out to 11.51 coins for the day.

For “loan default recovery”:

- Let  $D_L$  = the remaining principal on defaulted loans owed to a single lender
- Let  $D_A$  = the remaining principal on defaulted loans owed to all lenders
- Let  $S_D$  = a single lender’s share of the daily inflation for “loan default recovery”

$$S_D = D_L / D_A$$

For example, if a lender is owed 100 remaining principal from defaulted loans, and all lenders are owed 10,000 remaining principal from defaulted loans, then  $100 / 10,000 = 1.00\%$ , applied to 1,150.69 coins comes out to 11.51 coins for the day.

## Part III – Core Functionality

### 9. System Roles

The UDD eco-system requires several roles to interact in a functional manner. Each role serves a specific purpose. Any user can fill one or more roles if and when they meet the required criteria for the roles.

1. **Buyers** have one or more identities (anonymous, public, verified) and accounts with enough coins to make purchases. When a buyer agrees to make an eligible purchase, their account signs the transaction and waits for validation.
2. **Sellers** have one or more identities (anonymous, public, verified) and accounts to receive coins from purchases. Sellers list items for purchases and set transaction requirements (value, validation level, allowed identity types). Once a transaction is validated, the buyer's account receives the coins.
3. **Tangle validators** must have an associated public or verified identity. After logging on, they synchronize with a full copy of the current tangle. Once synced, they validate individual transactions, tracing it all the way to the blockchain.
4. **Tangle coordinators** are randomly promoted<sup>20</sup> tangle validators. They manage the list of transactions and direct transactions to tangle validators.
5. **Blockchain validators** must have a public or verified identity. They must stake at least 100 coins<sup>21</sup>, though they may want to stake more to earn additional income from loan interest rates. After logging on, they synchronize with a full copy of the blockchain. They must have free disk space equal to twice the current size of the blockchain.<sup>22</sup> When a new block must be created, they share nonce-hashing work.
6. **Blockchain coordinators** are randomly promoted blockchain validators. They compile the list of tangle transactions which must be contained in the newest block. They divide the load for nonce-hashing across all available blockchain validators.

For the purposes of this paper, “buyer” is synonymous with sender, employer, payer, lender, donor, client, or any other term which indicates someone is sending money to someone else. Similarly, “seller” is synonymous with receiver, employee, payee, borrower, charity, contractor, or any other term which indicates someone receives money from someone else.

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<sup>20</sup> Not totally random. There will be markers which increase or decrease the likelihood of selection, but that is beyond the scope of this whitepaper.

<sup>21</sup> The coins required may fluctuate based on factors such as validator availability and loan demand. Changes will be gradual to avoid sudden disruptions to services.

<sup>22</sup> Existing validators are given a grace period to become compliant again if and when they fail the disk size criteria.

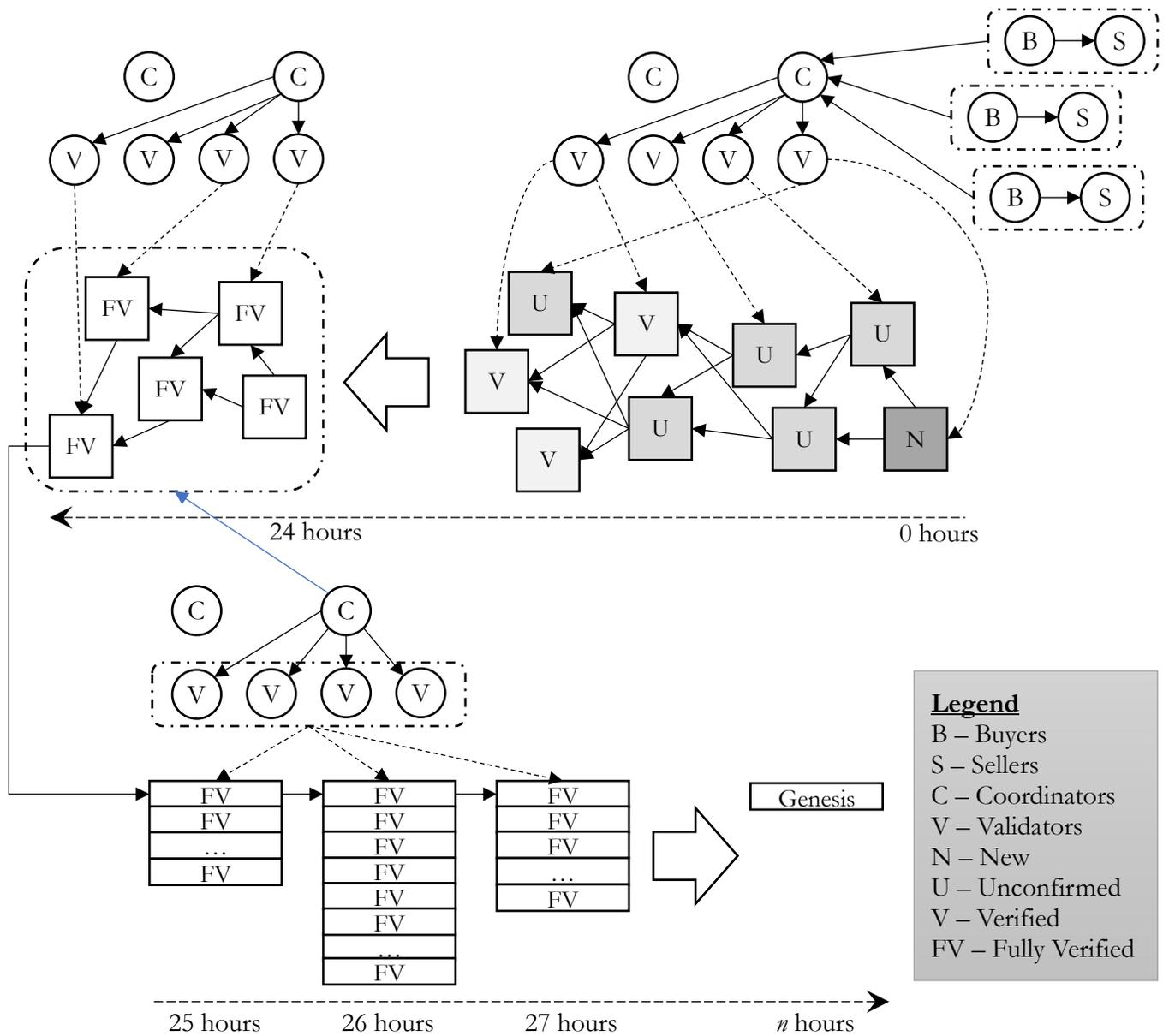


Figure 2 – System roles from latest transaction to genesis<sup>23</sup>, counter-clockwise from top right

<sup>23</sup> Assume transaction chains are consistently linked through the big arrows.

## 10. Methods of Payment

Users of the system will have a variety of ways to make purchases and payments. Ease of use is key to ensuring satisfaction for both buyers and sellers.

Initial methods at launch include:

1. Digital wallet – Using the UDD wallet (or compatible wallet software), the buyer enters the buyer account to use, the seller’s id, and the value of the transaction. The account signs the transaction and sends it off for validation.
2. Browser extension – The buyer clicks a transaction link on the seller’s website. The UDD browser extension (which is connected to the buyer’s UDD account) displays a confirmation dialog with the seller’s info and value of the transaction. After clicking OK, the account signs the transaction and sends it off for validation.
3. Email address – The buyer logs onto their UDD account using a secure browser session and clicks a link to send money by email. The browser displays a form to enter the seller’s email address and the value of the transaction. If the email address is associated with a seller id, the account signs the transaction and sends it off for validation.

Additional methods will be available after launch:

1. Mobile app with QR codes – The buyer opens the UDD app and scans the QR code for the seller id. The app displays the seller’s info. The buyer enters the value of the transaction. After clicking OK, the account signs the transaction and sends it off for validation.
2. Physical cards and POS terminals – The buyer uses a physical card to swipe, chip, or tap on compatible point-of-sale (POS) terminals. The POS terminal is connected to the seller’s account and displays the value of the transaction. The card is connected to the buyer’s account and when the card is used on the POS terminal, the seller’s account signs the transaction and sends it off for validation.

Integration with popular existing payment methods (PayPal, bank accounts, credit cards) will be explored in the future. The guiding principle is to make it possible for sellers and buyers to make transactions using any method they are comfortable with as long as it remains possible to validate the transaction.

## 11. Tangle Validation

Conceptual and mathematical foundations for the “tangle” directed acyclic graph (DAG) technology are thoroughly documented in the Iota whitepaper.<sup>24</sup>

Tangles in Iota are primarily designed for machine-to-machine (M2M) interactions. That is, buyers and sellers are expected to be online virtually all the time, and thereby able to double as validators at

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<sup>24</sup> This UDD whitepaper will not delve into the mathematical details. Readers are welcome to reference the Iota whitepaper for this purpose. Beware that the logic and supporting formulas gets very technical at a post-graduate level. The layman’s summary is that tangle validations can be very fast and reasonably reliable compared to blockchain validation.

no extra cost. To keep the system light and responsive, transaction chains eventually reach zero-sum states and are permanently removed from the tangle.

Tangles in UDD are primarily designed for human-to-human interaction. That is, buyers and sellers may only be online briefly, limiting exposure to the start of the transaction process only. Thus, the task of validation needs to be delegated to third parties committed to staying online for extended periods of time who can notify buyers and sellers when transactions are validated.<sup>25</sup>

Fully verified tangles older than 24 hours are moved to blockchains. Thus, transaction records persist, but the tangle remains light and responsive.

Transactions are initially validated in the tangle, going through several phases:

1. New – A new transaction with no validations.<sup>26</sup>
2. Unconfirmed – A transaction still waiting to be validated per the validation level for the transaction.
3. Validated – A transaction which has been validated per the validation level for the transaction.
4. Fully Validated – A transaction which has been validated to the maximum level (10 validations).

When a transaction occurs, it triggers the following procedure:

1. Transaction is queued in sequence for validation, and marked as new.
2. Transaction is used to validate the most recent unconfirmed, validated, or fully validated transaction.
3. Transaction is marked as unconfirmed.
4. Transaction is used to validate the next most recent unconfirmed or validated transaction which has not yet been traversed by previous validations.
5. Keep repeating step 4 until there are no more validations.
6. When the next new transaction occurs, this transaction will eventually be validated by the new transaction.
7. When enough new transactions have validated this transaction to meet the validation level requirements, it is marked as validated.
8. When 10 new transactions have validated this transaction, it is marked as fully validated.<sup>27</sup>

Tangle coordinators assign transactions to available tangle validators for validation in a round-robin fashion. Validators earn rewards based on their share of the load.

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<sup>25</sup> As the number of participants and transactions grows, the effective validation time gets shorter to the point of being almost instantaneous.

<sup>26</sup> Equivalent to “tips” in Iota tangles.

<sup>27</sup> At this point, the old transaction waits to be shifted to the blockchain to clear up space for new transactions.

## 12. Blockchain Validation

Conceptual and mathematical foundations for blockchain technology are well documented in the Bitcoin whitepaper.<sup>28</sup>

Blockchains in Bitcoin provide front-line validation and new coins using proof-of-work. Lacking the flexibility of tangles for front-line validations, blockchains require intentional and artificial delays to secure transactions.<sup>29</sup> Since coins are given only to the first to find the correct nonce-hash for a block, there is an ever-growing arms race where vast amounts of electricity are wasted.<sup>30</sup> Finally, fees make micro-transactions untenable.

Blockchains in UDD provide back-line validation and distribution of new coins using a hybrid proof-of-work and proof-of-stake dynamic. Relieved from dealing with front-line weaknesses, blockchains focus on improving back-line strengths for creating strongly secure, permanent records. A cooperative model rather than a competitive model pools resources efficiently to avoid wasting electricity and time. Without fees, micro and macro transactions are equally viable. Finally, proof-of-stake is transformed into a loan system to ensure currency flows instead of stagnating.

Every hour, blockchain validators compile tangle transactions which are more than 24 hours old into a block on the blockchain. Since the number of eligible transactions are likely to vary each hour, the block sizes will vary.<sup>31</sup>

The complexity requirement for the blockchain hash depends on the number of records to compile. Fewer records require more complexity.

Number of Records	Hash Complexity (leading zeros)
10	10
100	9
1,000	8
5,000	7
10,000	6
50,000	5
100,000	4
500,000	3
1,000,000	2

*Table 3 – Blockchain hash complexity by number of records*

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<sup>28</sup> This UDD whitepaper will not delve into the mathematical details. Readers are welcome to reference the Bitcoin whitepaper and academic papers on blockchains prior to it for this purpose. The Bitcoin paper itself focuses more on the programmatic logic. A layman’s summary is that regulating the hash complexity for a block of transactions makes it increasingly more difficult for attackers to corrupt the chain as more blocks are added.

<sup>29</sup> Bitcoin sets the artificial delay at 10 minutes. Alternatives such as Litecoin (2.5 minutes) have different delays. Blockchain technology has a constant tradeoff for speed vs. reliability.

<sup>30</sup> The real and present logistical complexity of where to place ASIC farms and which mining pool to join captures the sheer madness of this paradigm of “industrial waste” in the information age.

<sup>31</sup> In practice, performance considerations and file size limits may require multiple blocks per hour. For logical simplicity, each hour has one block.

Hashes are composed of the block sequence id, previous block hash, records, block timestamp, and nonce.

To avoid duplication of efforts and minimize resource usage<sup>32</sup>, all eligible blockchain validators can request a nonce range from a blockchain coordinator. Each request can be for 10 to 1,000 nonce values to try.

Validators must return the nonce-hash pairs back to the coordinator to request another range. The coordinator spot-checks a random sample<sup>33</sup> of the results to verify the validator did the work before providing the next range. If incorrect work is detected, the coordinator asks other validators to confirm the work. Confirmed incorrect work results in bans for the guilty user.

Results must be returned within a 5-minute timeout to receive validation credits. To reduce the likelihood of timeouts, coordinators monitor validator performance to increase or reduce load requests accordingly.<sup>34</sup>

The validator that finds the correct nonce notifies the coordinator, which verifies the result. The coordinator notifies all validators to stop work on this block and to verify the result.

Every validator gets credit for the nonce-hash pairs processed up to the stop point. There is no bonus for finding the right nonce. Therefore, all validators earn rewards based on their fair share of the workload.

### 13. Validation Level

Each transaction requires 2 to 10 validations depending on the validation level for the transaction. Validation levels are assigned to the seller’s trust level, the buyer’s trust level<sup>35</sup>, the total transaction value, and the item type.

Level	Seller Trust	Buyer Trust	Transaction Value	Item Type
2	90%	90%	1	Default
3	80%	80%	10	Groceries, Gas, Clothing
4	70%	70%	100	Low End Electronics, Restaurants
5	60%	60%	500	Medical Services
6	50%	50%	1,000	Furniture, Flights
7	40%	40%	5,000	High End Electronics
8	30%	30%	10,000	Industrial Services
9	20%	20%	50,000	Jewellery
10	0%	0%	100,000	Vehicles, Real Estate

*Table 4 – Validation levels by level*

<sup>32</sup> Electricity, clock cycles, massive corporate-grade ASIC farms, IT staff, etc.

<sup>33</sup> Not so random. Validator trust levels, hash complexity and other factors may influence sample selection.

<sup>34</sup> The goal is to create an inclusive system. Slower systems are allowed to participate, but they cannot be allowed to slow down the group effort as a whole.

<sup>35</sup> Initial versions of the protocol will function without the trust model in place.

The highest-level requirement from all factors is required for the transaction. For example:

- Seller Trust = 90%, Buyer Trust = 90%, Value = 0.50, Item type is not restricted → Level 2
- Seller Trust = **60%**, Buyer Trust = 90%, Value = 0.50, Item type is not restricted → Level 5
- Seller Trust = 90%, Buyer Trust = **40%**, Value = 0.50, Item type is not restricted → Level 7
- Seller Trust = 90%, Buyer Trust = 90%, Value = **500**, Item type is not restricted → Level 5
- Seller Trust = 90%, Buyer Trust = 90%, Value = 499, Item type = **Furniture** → Level 6

Item types shown are just tentative representations. Not all item types may be captured by the system. Even if an item type is defined, it is up to the seller to determine whether to use an item type for each transaction.

## 14. User Identities

Users identities can be flagged as anonymous, public, or verified.

Transactions by anonymous users are merged together into group transactions to mask identities. This can slow down transactions somewhat if there are not enough anonymous transactions to merge with.

Public users have a consistent and unique textual/numeric id (similar to Blizzard BattleTags)<sup>36</sup> in addition to the user hash id. These identifiers can be tracked by other users to form a history of transactions visible on the public tangle and blockchains.

Verified users submit legal identification documents to authorized UDD teams. Once verified, users can choose who to expose any of the following verified information to:

1. Legal name
2. Legal residence
3. Citizenship
4. Income bracket<sup>37</sup>
5. Gender
6. Date of birth
7. Social media accounts
8. Websites
9. Email
10. Business license
11. Telephone
12. Fax
13. Tax id
14. Import/export license
15. Professional designations

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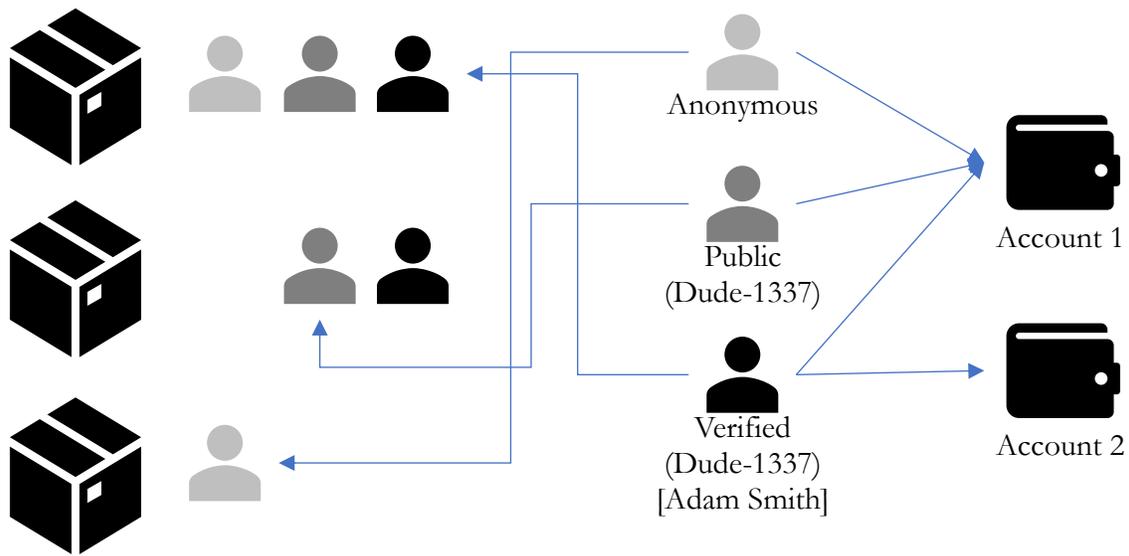
<sup>36</sup> <https://eu.battle.net/support/en/article/26963>. Example: SomeGuy#1337. This approach allows users to pick the textual part (mostly) as they like, while the randomized numeric part keeps the tag as a whole unique.

<sup>37</sup> Some verification elements may not be required to get “verified” status, but they may be needed for specific transactions per seller requirements.

By default, all these fields are hidden from view. Only the textual/numeric id and verified status are always exposed. There is a fee<sup>38</sup> to apply for the verification process. Verification is renewed every 12 months. Lapsed verifications still indicate they were once verified.

A user can create any combination of anonymous, public, or verified identities. All these identities can share the same account.

Sellers specify whether a transaction allows anonymous, public, and/or verified transactions. They can specify this for individual transactions, individual items, or as a default setting for everything they sell. Settings for individual transactions override settings for individual items which in turn override default settings.



*Figure 3 – Sample combinations for seller/item settings, buyer identities, and buyer accounts*

For example, a seller may choose to sell calculators to all three types of buyer identities, but restrict the latest cellphones to verified users only.

<sup>38</sup> Tentatively 1 UDD. The goal is to be high enough to deter bogus applications spamming the queue, but low enough that legitimate individuals can apply. This may be a sliding fee based on the pending queue size.

## 15. Actors

The UDD economy recognizes several types of actors<sup>39</sup> who participate in the economy. Distinct types of actors are subject to different rules and restrictions (and features and benefits) based on their roles within the economy. These categorizations are loosely based on real world economies.

1. **Small vendors** are small and medium sized businesses with consumer products or services to sell. Examples include a local grocery store, an artisan, a dental practice, or a small technology start-up. Small vendors may have up to 500 employees globally.
2. **Big vendors** are larger sized businesses, franchises, and corporations with consumer products or services to sell. Examples include McDonald's, Dell, Wal-Mart, and Shell. Big vendors have 500 or more employees globally. Franchises are counted as part of the brand name, and not as individual sites or owners.
3. **Non-profits** include not-for-profit organizations, charities, and non-government organizations (NGOs). Examples include Red Cross, PBS, Wikimedia Foundation, and the World Health Organization. Only agencies legally registered as a non-profit and operating for the last 5 years to qualify for this designation.
4. **Small employers** are small and medium sized businesses offering B2B or other non-consumer products or services. Examples include R&D firms, consulting agencies, and design houses. Small employers may have up to 500 employees globally.
5. **Big employers** are larger sized businesses offering B2B or other non-consumer products or services. Examples include Deloitte, NYSE Euronext, and Accenture. Big employers have 500 or more employees globally.
6. **Educational institutions** include private and public educational institutions serving any grade or curriculum. Examples include public elementary schools, ivy league universities, and trade schools. Only agencies legally registered as an educational institution with active classes for the last 5 years qualify for this designation.
7. **Healthcare agencies** include private and public healthcare agencies serving any geographical area or demographic. Examples include Stollery Hospital, STARS, Johns Hopkins, and Bellevue. Only agencies legally registered as a healthcare agency for the last 5 years are eligible for this designation.
8. **Government agencies** include government institutions, military divisions, and government contractors serving any geographical area. Examples include motor vehicle registries, Raytheon, the US Marines, and the IRS. Only agencies legally registered as government agencies or significantly contracted by a government agency are eligible for this designation. Governments must be formally recognized by the United Nations.
9. **Arts grants** include public and private grants, scholarships, and agencies available to further the fields of fine arts and liberal arts. Examples include the National Endowment for the Arts, Rhodes Scholarship, Rockefeller grants, and Julliard scholarships. Grants and scholarships must be legally registered for the last 5 years to qualify for this designation.
10. **Science grants** include public and private grants, scholarships, and agencies available to further the fields of theoretical sciences and applied sciences. Examples include the Nobel

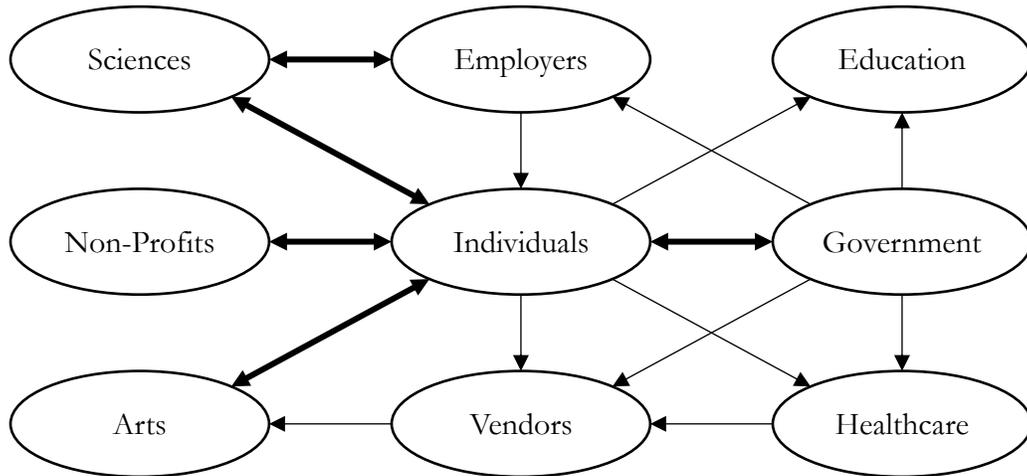
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<sup>39</sup> Actors as in users who perform transaction related actions within the system.

Prize for Physics, MIT scholarships, National Science Foundation, and the National Institutes of Health. Grants and scholarships must be legally registered for the last 5 years to qualify for this designation.

11. **The UDD corporation** is dedicated to building, maintaining, and evolving the UDD economy.
12. **Individuals** are individual global citizens.

Some actors may qualify for multiple designations. In this case, the most specific categorization shall apply. For example, a government-run medical facility could qualify as a big vendor, a non-profit, a government agency, or a healthcare agency. In this case, healthcare agency is the most specific categorization. Only one category is assigned, even if other possible categories exist.



*Figure 4 – Sample set of transactions (from sender to receiver) between diverse types of actors*

Some actors may fit into multiple specific categories at the same time. In these cases, either the primary category shall apply, or multiple categories may apply. For example, there are Nobel Prizes for both Arts and Sciences which are equally recognized. Therefore, the Arts portion is categorized under arts grants, and the Sciences portion is categorized under the sciences grants.

In all cases, the UDD corporation reserves the right to determine and assign categories. New categories may be created at future dates as the economy evolves.

## Part IV – Additional Features

### 16. Trust Model

Transactions between public or verified buyers and sellers can build trust. Higher levels of trust can speed up some transactions. Anonymous buyers and sellers cannot build trust.

The trust model works as follows:

1. Trust increases slightly for buyers and sellers with every fully validated transaction
2. Trust increases more for larger value transactions that are fully validated
3. Trust increases slightly as a buyer engages with different sellers, or a seller engages with different buyers
4. Trust decreases slightly each day a buyer or seller has no fully validated transaction
5. Trust decreases slightly for repeat buyers or sellers within the same day<sup>40</sup>
6. Trust decreases greatly if transactions are reverted

User ratings of other users are also factored into the trust model.<sup>41</sup>

### 17. Marketplace

Sellers can optionally list items for sale through their UDD accounts. The seller specifies the following:

Property	Required	Default	Details
Item Title	Yes	--	Up to 256 characters
Item Description	No	--	Up to 1024 characters
Available Quantity	Yes	1	Can be unlimited
Sale Start Date	Yes	Listing creation time	Can be in the future
Sale End Date	No	--	Can be indefinite
Allow Anonymous	Yes	Yes	At least one of these must be yes
Allow Public	Yes	Yes	
Allow Verified	Yes	Yes	
Item Type	No	Default	Can choose from list
Item Specifics	No	--	Varies by item type

*Table 5 – Item listing properties*

Once a list is created, it can be accessed by buyer's in several ways from:

1. The publicly visible user listing for the seller
2. The seller's website as an embedded listing
3. Search aggregators for UDD listings
4. The formal UDD marketplace website

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<sup>40</sup> The purpose is to protect legitimate users from involving themselves unwittingly with illegitimate users. The system will still allow the potentially illegitimate users to continue making transactions with each other.

<sup>41</sup> User ratings may have more value as a social element rather than a formulaic element in the trust model. Lessons learned from proven systems such as Amazon and eBay will influence the design of the UDD user rating system.

## 5. UDD marketplace apps

REST API calls will be available to create, find, and list seller listings.

Regardless of the listing or access method, all transactions use the standard UDD interface to confirm buyer purchases. The standard interface displays seller identification, trust levels, purchase requirements, item descriptions, and transaction value before allowing the purchase.<sup>42</sup>

## 18. Loans

Proof-of-stake coins for blockchain validators double as loans. Loan approval and management is fully automated by blockchain coordinators. If loans default, the remaining principal is repaid automatically from a share of the daily inflation.

Any public or verified user can request a loan. Anonymous users cannot request loans. Each user has a credit rating set by the system<sup>43</sup>, and it starts out with a neutral score. Good borrowing behavior raises credit ratings while bad borrowing behavior lowers credit ratings. Maximum loan amounts, repayment terms, and interest rates are all on sliding scales based on credit ratings and trust levels.

Credit Rating	Max Loan Amount	Days to Repay	Daily Interest
1,000	750	100	0.50%
900	600	75	0.75%
800	400	50	1.00%
700	250	30	1.50%
600	150	21	1.75%
(neutral) 500	100	14	2.00%
400	50	10	3.00%
300	25	8	5.00%
200	10	6	8.00%
100	5	3	10.00%
(lowest) 0	0	0	--

*Table 6 – Loan terms by credit rating at 90% trust level*

There is a 24-hour waiting period for loan approval. Every hour, blockchain coordinators review all pending loan requests older than 24 hours. Higher credit ratings and smaller amounts are given priority. If the available lending pool sits below certain thresholds, then loans for lower credit ratings and larger amounts are put on hold. Unfulfilled loan requests automatically expire after 72 hours.

In the future, users may be given the option to regulate their own lending terms.<sup>44</sup>

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<sup>42</sup> The purpose is to give sellers the freedom to present the listing as they like while also protecting the buyer from sellers who may be trying to trick buyers.

<sup>43</sup> Initially, nobody can view their exact credit rating, not even their own rating. This is an internal system metric for managing automated loans. Variables such as interest rates will also be impacted by overall system health. For example, higher demand may raise rates to encourage more lenders to participate.

<sup>44</sup> This will likely involve agreements with third party agencies.

## 19. Offline Modes

Offline transactions will be allowed in a later phase. The technology is similar to the Lightning protocol in that peer-to-peer key management temporarily replaces the need for the blockchain or online tangles.

Before an offline tangle is authorized, all users participating offline must first co-sign a shared online transaction. This serves as an anchor. When the offline tangle reintegrates with the online chain, all users must again co-sign a shared online transaction. This acts as another anchor. Both anchors are compared to ensure the total value in the offline tangle remained the same.

Offline transactions do not get any shares of daily inflation beyond the anchor transactions on the online portion.<sup>45</sup>

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<sup>45</sup> Offline transactions still have no fees.

## Part V – Project Plan

### 20. Initial Coin Offerings

UDD tokens are ERC20<sup>46</sup> compliant and will be sold through the UDD corporate Ethereum wallet listed on the UDD website, uddcoin.com.

The UDD ICO is offered in dedicated pools for distinct types of actors. Each pool offers rounds with set coin limits, and each round increases in price and available coins.

Discount Level	Price in ETH	Duration in Days	Cumulative Coin Limit	Extended Price/Round	Effective USD Market Cap <sup>47</sup>
75%	0.005	2	1,000	5	5,000
70%	0.006	2	2,500	9	15,000
65%	0.007	3	5,000	18	35,000
60%	0.008	3	10,000	40	80,000
55%	0.009	5	25,000	135	225,000
50%	0.010	5	50,000	250	500,000
45%	0.011	7	100,000	550	1,100,000
40%	0.012	7	250,000	1,800	3,000,000
35%	0.013	7	500,000	3,250	6,500,000
30%	0.014	7	1,000,000	7,000	14,000,000
25%	0.015	10	2,500,000	22,500	37,500,000
20%	0.016	10	5,000,000	40,000	80,000,000
15%	0.017	10	10,000,000	85,000	170,000,000
10%	0.018	14	25,000,000	270,000	450,000,000
5%	0.019	14	50,000,000	475,000	950,000,000
0%	0.020	14	100,000,000	1,000,000	2,000,000,000

*Table 7 – ICO rounds by purchase price*

If coins in a round are exhausted before the round duration, the next round will start. When a round expires, the remaining coins are added to the next round limit.

Each pool is capped at 10,000,000 to 100,000,000 coins.<sup>48</sup> If a pool reaches the coin limit within 120 days of the ICO for the pool, an additional round will be offered using a similar escalating pattern, and the ICO will be extended by another 15 days.

Any remaining coins which are not purchased during the ICO for a pool return to the UDD corporate account for future sale. Prices and timings for future sales are at the discretion of UDD corporate. Current plans are to re-open rounds every quarter for 14 days with the established round price or the

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<sup>46</sup> [https://theethereum.wiki/w/index.php/ERC20\\_Token\\_Standard](https://theethereum.wiki/w/index.php/ERC20_Token_Standard)

<sup>47</sup> Assumes 1 Ether = 1,000 USD.

<sup>48</sup> The business plan anticipates selling 1M to 10M coins from the individuals pool during the ICO. Remaining coins will likely seed future offerings over several years.

prevailing market exchange rate, whichever is greater at the time of sale. This continues until all available coins for a pool are purchased.

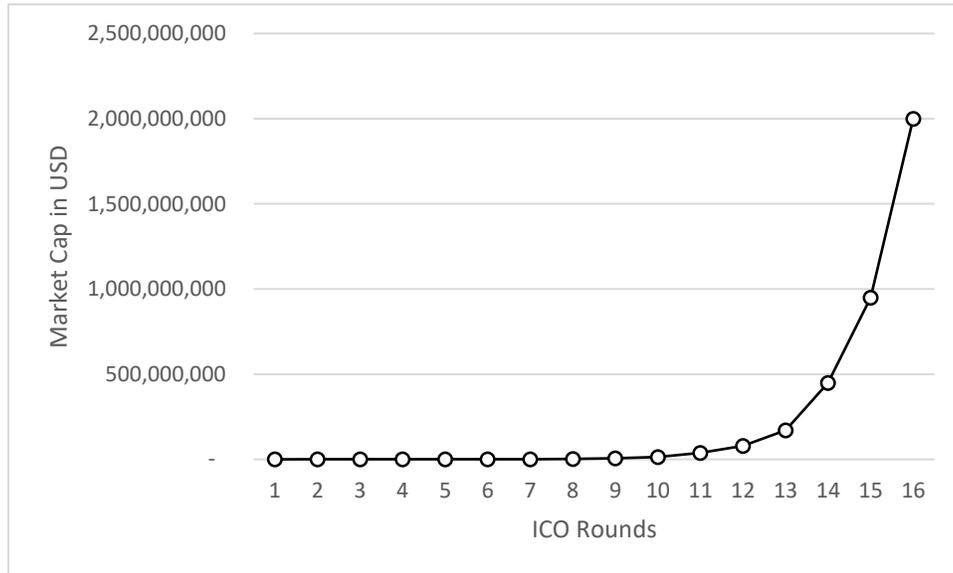


Figure 5 – ICO market cap progression by round<sup>49</sup> for the individuals pool

As the chart above visualizes, the market cap increases exponentially even at the low published prices for the ICO.<sup>50</sup>

Pools are assigned by actors with the following discount rates.<sup>51</sup> Manual verification is required for eligibility in some pools. Therefore, ICO pool start dates are staggered to allow for gradual integration into the economy. For updated ICO information, please visit the official website at [uddcoin.com](http://uddcoin.com).

Actors	Coins in Pool	Discount	Eligibility Criteria
Individuals	100,000,000	--	--
Small Vendors	10,000,000	50%	Items can be bought in UDD
Big Vendors	10,000,000	35%	Items can be bought in UDD
Non-Profits	10,000,000	75%	Legally registered for 5 years
Small Employers	10,000,000	50%	Employee payment option for UDD
Big Employers	10,000,000	35%	Employee payment option for UDD
Governments	10,000,000	35%	Legally registered for 5 years
Educational	10,000,000	50%	Legally registered for 5 years
Healthcare	10,000,000	50%	Legally registered for 5 years
Arts	10,000,000	75%	Legally registered for 5 years
Sciences	10,000,000	75%	Legally registered for 5 years
UDD Corporate	10,000,000	--	--

<sup>49</sup> Assumes all coins in each round are sold.

<sup>50</sup> Actual market prices may accelerate rapidly, based on Q4 2017 trends for Bitcoin and Ethereum.

<sup>51</sup> Pool discounts are applied on top of round discounts.

*Table 8 – ICO pools by actors*

The individuals pool is the largest by design, as anyone can purchase coins from this pool without the need for verification. It is expected that individuals will form the bulk of the economy with the largest purchasing power.

The remaining pools serve as incentives to bring a wider variety of actors into the UDD economy. Discounts are offered to effectively grant more purchasing power than they paid for. For example, a non-profit can purchase round 10 coins from the non-profit pool valued at .014 ETH/each for .0035 ETH/each instead due to the 75% discount for the pool. By encouraging more types of actors to enter the economy, individuals and the economy as a whole benefit from wider acceptance of the currency.

For these remaining pools, each eligible organization may only purchase up to a limited number of coins per month. This helps build a more diverse user base. Any coins an organization purchases beyond the limit are drawn from the individuals’ pool. An admin fee of 1% is charged to validate eligibility on a monthly basis.

<b>Actors</b>	<b>Coins in Pool</b>	<b>Coin Limit/mo</b>	<b>Admin Fee</b>	<b>Est. Unique Organizations</b>
Small Vendors	10,000,000	100	1	8,333 to 100,000
Big Vendors	10,000,000	1000	10	833 to 10,000
Non-Profits	10,000,000	500	5	1,667 to 20,000
Small Employers	10,000,000	100	1	8,333 to 100,000
Big Employers	10,000,000	1000	10	833 to 10,000
Governments	10,000,000	500	5	1,667 to 20,000
Educational	10,000,000	500	5	1,667 to 20,000
Healthcare	10,000,000	500	5	1,667 to 20,000
Arts	10,000,000	500	5	1,667 to 20,000
Sciences	10,000,000	500	5	1,667 to 20,000

*Table 9 – ICO limits by actors*

The first 1,000,000 coins in each pool (except the individuals pool) are free to encourage initial buy-in from the various types of actors. Interested organizations can contact the UDD sales team in advance of their pool’s ICO start date to queue for the free funds.<sup>52</sup>

Coins in the UDD corporate pool will not be offered in an ICO. They are reserved for used by UDD corporate to cover operational and capital expenses over time. However, these coins do count towards the effective money supply.

At least 210,000,000 coins will be available in the UDD economy. More coins may be added based on market demand during ICOs for each pool.

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<sup>52</sup> Contact information will be provided on the official UDD website, uddcoin.com.

## 21. Roadmap

Q1'18	Q2'18	Q3'18	Q4'18	Q1'19	Q2'19	Q3'19	Q4'19	Q1'20	Q2'20	Q3'20	Q4'20
ICO: Individ.											
		ICO: Other actors									
Hiring: Round 1				Hiring: Round 2							
Design	Core Dev	Beta	Live								
		Design	Trust	Market	Loans	Offline	Refund	Cards			
Global	N. America	Europe, Aus.	Asia	S. America	Africa						

*Table 10 – Roadmap for ICO, hiring, development, and sales (3-year view)*

The ICO for individuals runs first, followed by staggered ICOs for other actors.<sup>53</sup>

Hiring round 1 will fill up the primary development and sales teams, and establish a new office location. Up to 20 employees will be hired, leaning more heavily on development staff. Hiring round 2 will fill up the secondary development and sales teams. The office will scale up to 50 employees, with most new employees on the sales team. Additional services will be contracted as needed.

The primary development team will design, implement, test, launch, and maintain the core system. This includes buyer/seller transactions, identities, accounts, tangles, blockchains, and initial payment methods. The secondary development team will do the same for additional features. This includes trust models, marketplace and related APIs, loan system, offline mode, transaction refunds, and additional payment methods.

The sales team starts with a general global strategy, which is later refined with targeted regional strategies.

## 22. Team

Rumi Mohammad is President of the UDD team. He has over 15 years of technical experience in e-commerce, industrial control systems, information technology, product management, and technical sales.

The executive team provides expertise on human resources, administration, and international law.

The development team focuses on creating the core and supporting technologies for UDD.

The sales and marketing team focuses on raising awareness of UDD on a global scale, and assisting organizations and investors to join the marketplace. While the design of the system allows for passive adoption, the sales team expedites the process with pro-active encouragement.

For updated information, please visit the official website at [uddcoin.com](http://uddcoin.com).

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<sup>53</sup> The staggered dates allow sales team members to provide sufficient outreach and sales support. Dates may be adjusted based on team capacity.

## 23. Budget

Primary funding for the project will be drawn from ICO rounds of the individuals pool. Secondary funding (if needed) will be drawn from the UDD corporate reserved pool of coins. Budgets are expressed in USD.

Year	Estimated Budget	Key Cost Items
2018	\$3,000,000	<ul style="list-style-type: none"><li>• Salaries for up to 20 employees</li><li>• Office space purchase and setup</li><li>• Contracted services</li><li>• Sales and marketing expenses</li><li>• Other operating expenses</li></ul>
2019	\$6,000,000	<ul style="list-style-type: none"><li>• Salaries for up to 50 employees</li><li>• Sales and marketing expenses</li><li>• Other operating expenses</li></ul>
2020	\$6,000,000	<ul style="list-style-type: none"><li>• Salaries for up to 50 employees</li><li>• Sales and marketing expenses</li><li>• Other operating expenses</li></ul>

*Table 11 – Budget forecast (3-year view)*

## Conclusion

In summary, UDD combines and adjusts established technologies and methodologies from existing systems in ways that overcome their individual weaknesses and bolsters their collective strengths. Fast tangles in the front-line meet solid blockchains on the back-line. Proof-of-work is shared and proof-of-stake keeps flowing in the form of loans.

Buyers and sellers have flexibility to be anonymous or verified. They can pick and choose how loose or restrictive transactions are, and even how to distribute the rewards.

Everyone – individuals, organizations, governments – is encouraged to grow the economy. In case a fast, secure system which rewards users for doing business isn't enough to draw people and businesses into this economy, the UDD team is prepared to actively reach out to the global community, understand their needs, and help them benefit from the growing marketplace.

Perhaps most importantly for you, you will make money. Whether you buy or sell or validate, a share of the controlled inflation is yours to use, so you can participate in the marketplace as a productive member of the economy. UDD is about sustained investment growth driven by all participants, which sets it far apart from the vast majority of highly speculative or narrow niche coins.

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