AED Universal

Whitepaper

Version 1.2

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Contents

Executive Summary

AED Universal ("AEDU") is a conservative fiat-backed stablecoin that is pegged 1:1 to the United Arab Emirates dirham (AED) currency.

Fully collateralized by dirhams deposited at UAE financial institutions, AEDU is a regulated, audited, and transparent digital currency that can transfer and store stable value on blockchain-based networks.

AEDU will be issued by Universal Digital INTL FZE ("Universal Digital"), a corporate entity in Dubai that operates under the Virtual Asset Regulatory Authority (VARA). AEDU is expected to be launched in the first half of 2023.

The project is led by His Highness Sheikh Juma Maktoum Juma Al Maktoum, an accomplished businessman and member of the royal family of the Emirates of Dubai. Virtual assets infrastructure provider Aquanow is the technology and implementation partner.

AEDU has the potential to become a leading digital currency as a result of its inherent attributes, including:

1. Transfer of value:
AEDU has significant potential for payments in the UAE and globally. As a cryptographic token, it can be used for payments via blockchains. Without reliance on legacy banking infrastructure and private payment networks, AEDU can be transferred anytime and anywhere, instantaneously, reliably, and at low cost.

2. Store of value:
AEDU reserves are dirham deposits held at regulated UAE financial institutions. The dirham itself has maintained a steady exchange rate to the U.S. Dollar (USD) since 1997 when the peg was officially established. The UAE's resources and stature as a global safe haven continue to uphold dirham stability.

AEDU has the following objectives as a digital currency:

1. Serve as the AED-pegged stablecoin for the UAE virtual assets markets

2. Foster efficient payments, remittance, and savings in the UAE

3. Enable DeFi applications such as exchange, lending, and metaverse

4. Be adopted globally for cross-border trade, remittance, and savings

AEDU will match or exceed leading industry standards for convertibility, stability, traceability, transparency, and security. The initial networks for the stablecoin will be Ethereum and TRON, with additional blockchains expected in the future.

The stability of the dirham is a direct result of the credibility of the United Arab Emirates. AED Universal looks to leverage this stability in becoming a leading digital currency for the United Arab Emirates and the world.

Background

The virtual assets industry began with Bitcoin in 2008. With decentralization, strong cryptographic security, and an immutable ledger, Bitcoin had the ambition to succeed as an open digital payments system. But price volatility and slow confirmation times have prevented its wide adoption for payments. Nevertheless, Bitcoin has given rise to many other blockchain projects and a new asset class of virtual assets.

Stablecoins

Stablecoins are virtual asset tokens whose value is linked to real-world assets such as commodities and fiat currencies, most often the U.S. Dollar.

Following the introduction of Bitcoin and other virtual assets, exchanges emerged to facilitate their trading, which led to the development of stablecoins.

From the early days of these exchanges, stablecoins were created to represent U.S. Dollars to trade, hold, and transfer value. Fiat-backed stablecoins offer the best of both worlds — they can be used to transfer value anytime across open blockchains, and are pegged to a real-world asset for stable value.

Banks did not readily accept the exchanges as clients due to insufficient AML/KYC compliance, so it was difficult for the exchanges to transfer customer funds. The major stablecoins were developed by exchanges to facilitate funds transfer, including Tether (USDT) by Bitfinex, USD Coin (USDC) by Coinbase, Binance USD Coin (BUSD) by Binance (powered by Paxos), and Gemini Dollar (GUSD) by Gemini.

Traditional banking did not have the adequate speed and availability to meet the funds transfer needs of the virtual assets market trading around the clock. Stablecoins have emerged to provide an efficient way for settlement and to eliminate arbitrage. Prior to stablecoins, Bitcoin was trading at vastly different prices across countries due to on/off-ramp difficulties.

These fiat-backed stablecoin issuers obtained bank accounts more easily than exchanges, and tokenized their fiat currency assets to represent U.S. Dollars on blockchains. Users could more easily deposit fiat currency at the issuer to obtain stablecoins, and then transfer the stablecoins onto exchanges to trade virtual assets.

Decentralized stablecoins — algorithmic and overcollateralized varieties — also developed in the market to bypass the use of real-world reserves to support their value. Instead, these stablecoins rely on smart contracts, trading incentives, and virtual assets collateral to maintain their U.S. Dollar pegs.

However, the decentralization principle is often compromised. For example, when MakerDao, issuer of the largest decentralized stablecoin DAI, began accepting USD Coin and the underlying U.S. Treasury securities as reserves, these reserves needed to be held by a trusted party in the real world.

Decentralized stablecoins also come with their own set of risks. Both algorithmic and overcollateralized stablecoins have higher smart contract, price oracle, and AML/KYC compliance risks. In May 2022, the credibility of algorithmic stablecoins was tarnished by the sudden collapse of Terra (UST) from $19 billion value within a week.

Fiat-backed

The total value of stablecoins was US$140 billion at the end of 2022, representing 17 percent of the US$800 billion in total virtual assets. The three largest stablecoins — Tether (USDT), USD Coin (USDC), and Binance USD Coin (BUSD) — represent over 90 percent of total stablecoin value and are all backed with fiat currency reserves.

Although these fiat-backed stablecoins have maintained their pegs over the years, no stablecoin has been able to gain complete trust from the marketplace.

Some issuers are unregulated and are subject to compliance concerns. Tether, with insufficient transparency, experiences occasional price deviation due to concerns around the adequacy of its reserves.

AED-backed

This whitepaper presents a stablecoin backed by the UAE dirham (AED), as an alternative to stablecoins backed by the U.S. Dollar.

The UAE dirham stands out in safety and reliability among fiat currencies pegged to the U.S. Dollar. Since the AED-USD peg was officially established in 1997, the dirham has been fixed to the U.S. Dollar at 3.6725 USD per AED. This peg has been uninterrupted through its history, including during the 2011 United States credit rating downgrade and periods of low energy prices.

Today, the UAE's resources and credibility uphold the dirham as a reliable store of value. The UAE has over $1 trillion in sovereign wealth fund assets and proven oil reserves of 100 billion barrels, and consistently generates a trade surplus and attracts foreign capital inflows. Its secure environment and independence amid geopolitical tensions bolster its role as an attractive safe haven for the world.

Introducing AED Universal

AED Universal (AEDU) is a conservative fiat-backed stablecoin to be launched in the United Arab Emirates.

AEDU is a joint-venture project led by His Highness Sheikh Juma Maktoum Juma Al Maktoum, and supported by virtual assets infrastructure provider Aquanow as the technology and implementation partner. AEDU is fully collateralized by dirham deposits at UAE financial institutions regulated by the Central Bank of the United Arab Emirates (CBUAE). The issuer, Universal Digital INTZ FZE ("Universal Digital") is an entity established in the Dubai World Trade Centre (DWTC) jurisdiction of the UAE and will be regulated by the Virtual Assets Regulatory Authority (VARA). Its regulated status and transparency are expected to provide users with a high level of confidence.

The project will distribute AEDU through registered exchanges and brokerages, and not directly to retail customers.

Objectives

As a transparent stablecoin issuer backed by the credibility of the UAE, AEDU aims to enable stability and efficient payments in the UAE virtual assets and traditional economies, and to become a leading digital currency globally:

1. Virtual assets economy

Work with UAE industry participants and regulators to develop the virtual assets market denominated in local currency

2. UAE local economy

Foster financial efficiency in the UAE economy with open digital payments, with merchant processing and payroll

3. Global economy

Facilitate efficient settlement of global trade and remittances, and be an attractive savings alternative to USD-backed stablecoins

Use cases

1. Virtual assets economy

Trading

UAE exchanges and market participants can trade and hedge virtual assets into local currency, and move funds across venues to capture opportunities and manage risks

Decentralized finance

Decentralized finance (DeFi) applications, including exchanges, lending pools, and metaverse, can be supported by AEDU as digital currency

Asset tokenization

Blockchain projects can utilize smart contracts to automatically distribute payments in AEDU, including interest, dividends, rent, fees, and taxes

2. UAE local economy

Merchant payments

Payment processors can reduce fees for small value transactions, and enable large value transactions outside of banking hours

Payroll

Employee payroll programs benefit from more efficient processing, customized frequency, and without need for bank accounts

3. Global economy

Trade

Global trading partners can speed up and reduce the complexity of payment and finance with funds transfers in AEDU

Remittances

Workers can send AEDU abroad via blockchain-based payment services, for quicker, cheaper, more reliable conversion and settlement

Savings

Savings can shift to AEDU as an alternative store of value for those looking to diversify their holdings away from USD-backed stablecoins

Example: Large transactions during the weekend

1.

Sam wants to pay AED 30 million to Company A on Sunday when the banks are closed.

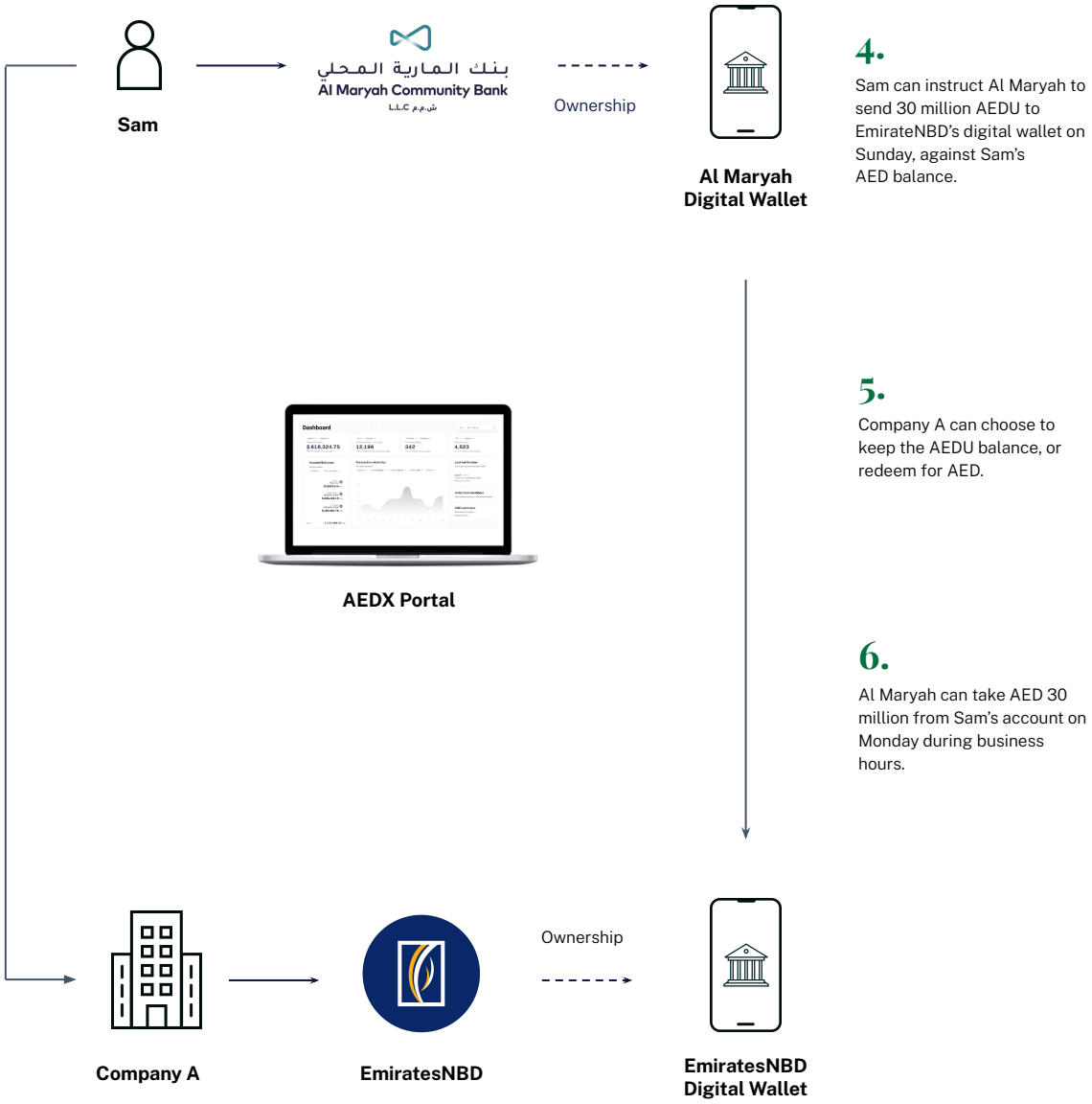
2.

Neither Sam nor Company A is registered with the AEDU issuance portal (AEDX).

3.

Sam has an Al Maryah bank account, and Company A has an EmiratesNBD bank account.

Both banks are registered with AEDX and hold AEDU.



4.

Sam can instruct Al Maryah to send 30 million AEDU to EmirateNBD's digital wallet on Sunday, against Sam's AED balance.

5.

Company A can choose to keep the AEDU balance, or redeem for AED.

6.

Al Maryah can take AED 30 million from Sam's account on Monday during business hours.

With just a few participating banks, AEDU could become the digital currency for settling large business transactions in the UAE.

Design

AEDU is designed with the following attributes to create public trust in its stability, market liquidity, compliance, and user experience:

1. Centralization

Centralization provides the ability to revoke transactions in defined scenarios such as fraud. To balance the operational risk of providing powers to central parties, both the custodian and issuer will be fully regulated, and reserves will be audited monthly by a major accounting firm.

2. Compliance

Universal Digital, as the issuer of AEDU, will be regulated in the UAE by the Virtual Asset Regulatory Authority (VARA) in Dubai. Institutional-grade anti-money laundering (AML), know-your-client (KYC), and know-your-transaction (KYT) processes will be implemented, in-line with Aquanow's experience and industry best practices.

3. Convertibility

The issuance portal will offer conversion between AED and AEDU at minimal costs. The issuer will also utilize its treasury balance sheet to provide market liquidity across centralized and decentralized exchanges, including market-making activities to facilitate conversion between AEDU and major USD-pegged stablecoins.

4. Reliability

The project is regulated, audited, and transparent, and backed by a stable dirham currency. Unlike with other fiat-backed stablecoins, AEDU reserves will consist of bank deposits only at UAE financial institutions regulated by the Central Bank, and not in any risky or long duration investments.

	AED Universal (AEDU)	**Tether (USDT)**	**USD Coin (USDC)**
Cash and Bank Deposits	100%	9%	24%
US Treasury Bills	-	58%	76%
Other Short-Term Instruments	-	15%	-
Loans and Investments	-	18%	-

Source: Circle + Paxos Reserve Breakdowns
As of *June 2022*

Design

5. Availability

The issuance portal has redundancies to minimize any single point of failure. It will target 99.95% uptime and availability, consistent with the historical performance of infrastructure provider Aquanow. The issuer platform will operate on a 24/7/365 basis to process AEDU transactions, and the project aims to work with banking partners to provide AED deposit/withdrawal services during non-business hours.

6. Flexibility

AEDU will facilitate use cases across both the virtual assets and traditional economies, in the UAE and globally. Technology partner Aquanow will develop APIs for various use cases to facilitate adoption of AEDU by industry partners. The AEDU project will evolve to accommodate future use cases.

7. Security

The AEDU smart contracts will be audited by at least two top-ranked audit firms. The issuance portal AEDX will employ industry-leading custody standards for private key storage including multi-party computation (MPC), hold periods, and tiered access. Transaction revocation is available as a safety net in extreme situations.

Benchmarks

AEDU is designed with market-leading standards, making it an attractive comparable to other major stablecoins.

Name	**AED Universal**	**Tether**	**USD Coin**	**Binance USD Coin**	**True USD**	**Pax Dollar**	**Gemini Dollar**
Symbol	AEDU	USDT	USDC	BUSD	TUSD	USDP	GUSD
Market Cap (USD), Dec 2022	-	$65.9bn	$54.5bn	$17.9bn	$1.2bn	$871m	$176m
Launch Date	2023	2014	2018	2019	2018	2018	2018
Jurisdiction	UAE	BVI	US	US	China	US	US
Reserve Currency	AED	USD	USD	USD	USD	USD	USD
Reserve Attestation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Auditor	Big 6 expected	MHA Cayman	Deloitte	Withum	Armanino	Withum	BPM LLP
Reporting Frequency	Monthly[1]	Quarterly	Monthly	Monthly	Continuous	Monthly	Monthly
Native Integrations (# of blockchains)	2	11	9	2	4	1	1
Registrations	UAE: VARA issuer	US: Money service business	US: Money transmitter; UK: e-money issuer	US: New York trust charter	US: Money service business	US: New York trust charter	US: New York trust charter
Custodian	Banks regulated by Central Bank of UAE	Tether Ltd	BNY Mellon, NY Community Bank, Signature, Silvergate, US Bancorp, others	Paxos Trust Company	Signature, Silvergate, Prime Trust, First Digital Trust, BitGo	Paxos Trust Company	State Street
Minimum Redemption Amount	AED 500k	$100k	$100	$60k for individuals; $500k institutions	$10k	n/a	n/a

[1] Seek continuous attestation if banking and auditor partners can support

Implementation

Portal

The AEDX issuance portal is designed for **minting, burning, deposit, and withdrawal.** The separation of deposit and minting functions, and of burning and withdrawal functions, allows Universal Digital the flexibility to custody client fiat and virtual assets through qualified banks and custodians in the future.

This provides flexibility for various payment use cases of AEDU, including during non-business hours.

(Please see Appendix 2 for user interfaces).

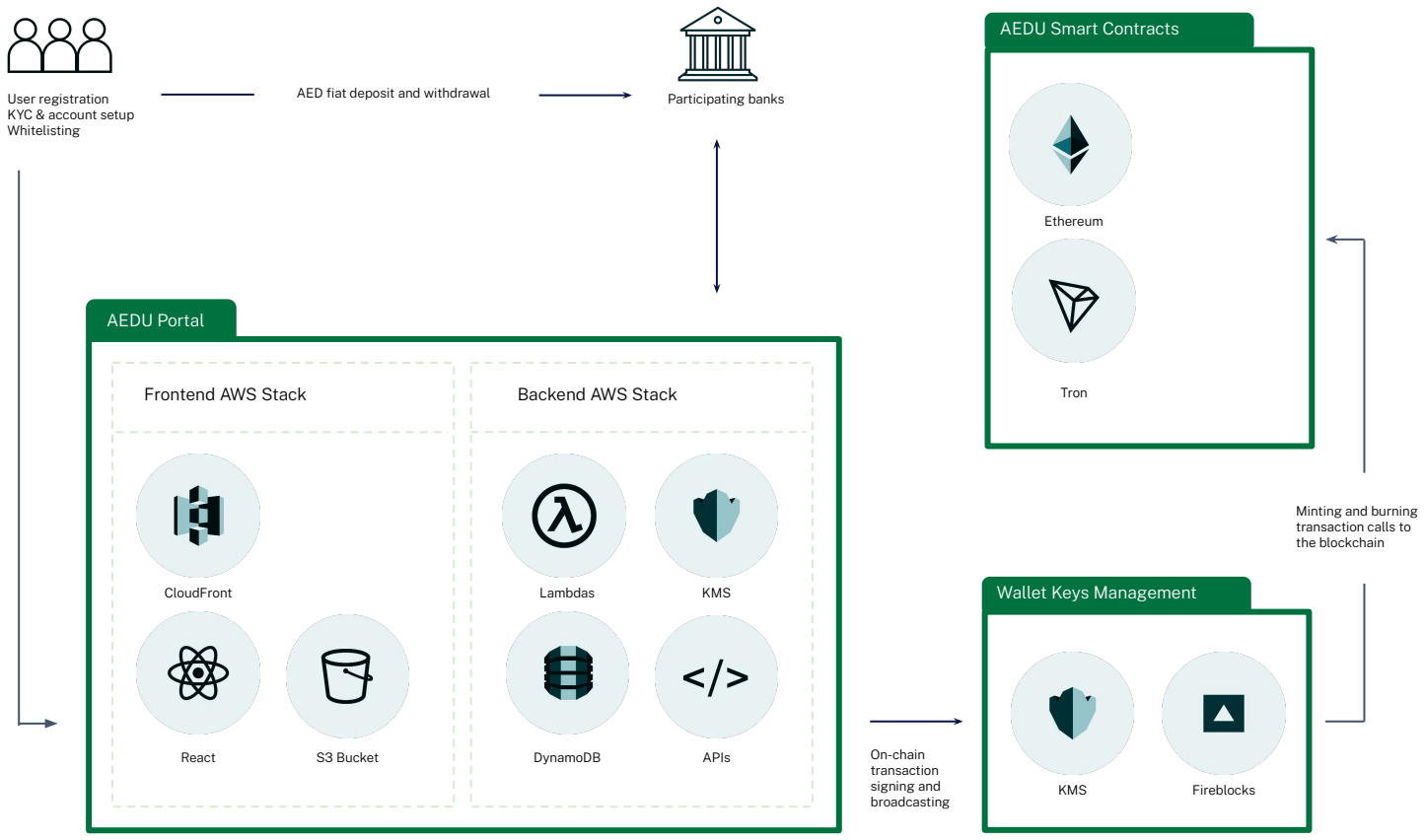
Ethereum and TRON have been selected as the initial blockchains for deployment. Ethereum is the most popular blockchain with high security and widespread adoption of the ERC-20 token standard, while TRON has lower gas fees which make it more feasible for small transactions. Ethereum and TRON are the most active blockchains for stablecoin transactions today — over 95 percent of Tether transactions occur on these two networks.

The AEDX interface will not be available to retail customers. Initially, it will only onboard a limited number of institutional clients, including leading virtual asset exchanges and banks. All parties must complete know-your-client (KYC) authorization, and wallets and bank accounts seeking to withdraw assets will need to be checked and whitelisted. All virtual asset transfers in and out will be subject to know-your-transaction (KYT) checks.

The system will only accept AED fiat and AEDU for deposit, and only process AED fiat and AEDU for withdrawal. It will not accept other fiat or virtual asset currencies, but AEDX reserves the flexibility to add to its offering in future.

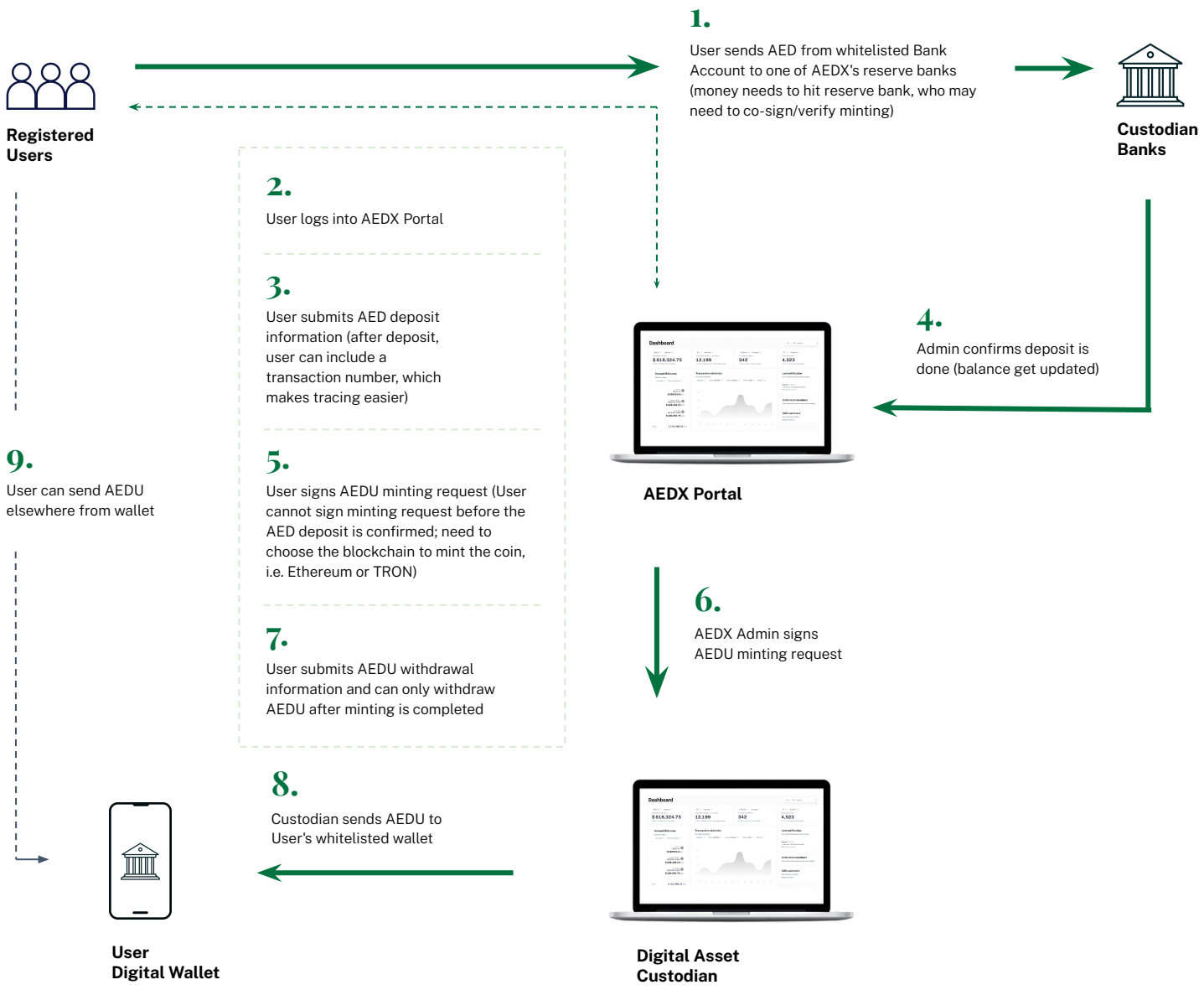
Implementation

Technical Workflow



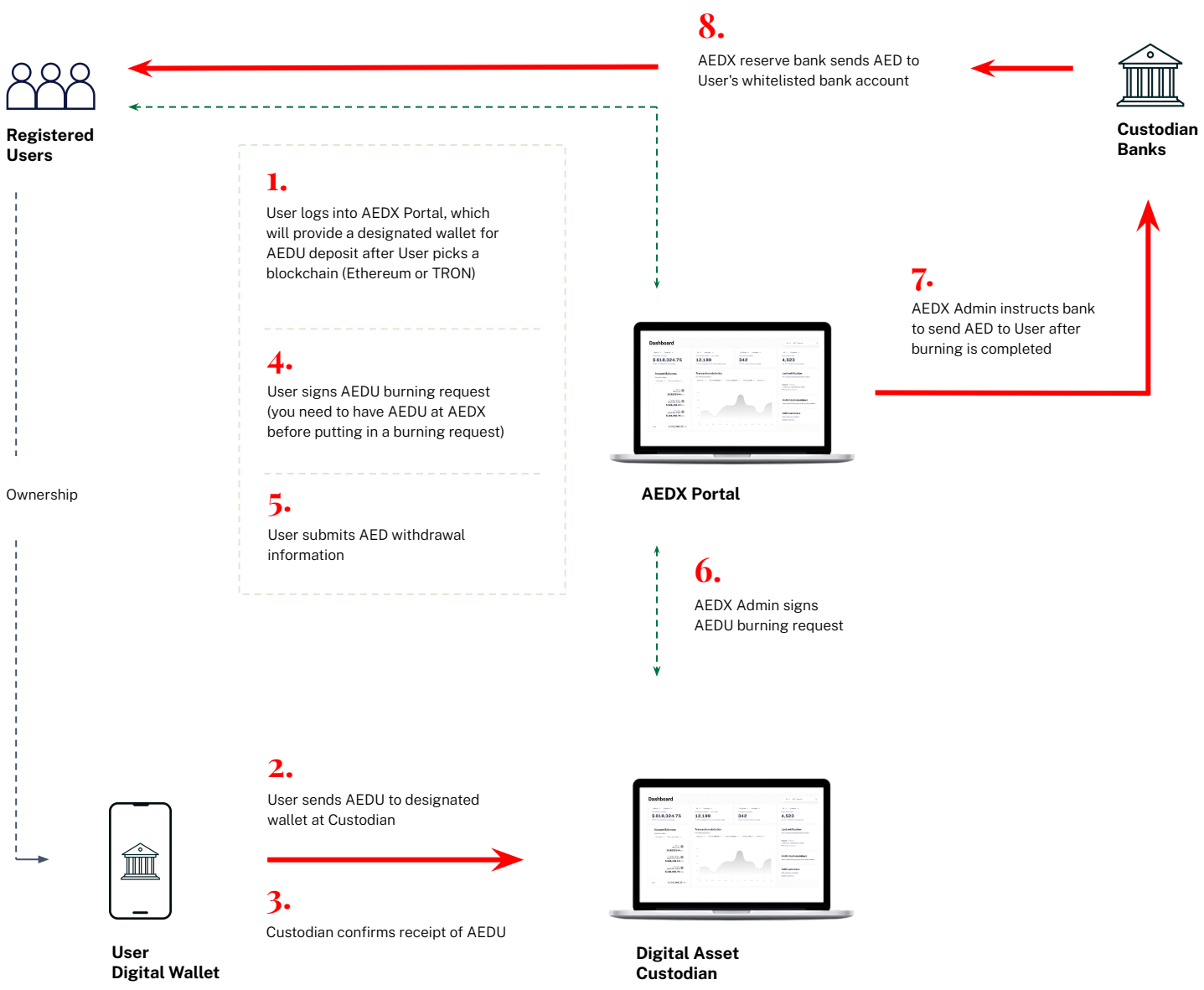
Implementation

Deposit and Minting Sequence



Implementation

Burning and Withdrawal Sequence



Adoption strategy

Universal Digital will encourage adoption of AEDU across virtual assets, UAE local, and global economies in the following sequence.

1. Setup

- List AEDU on leading local virtual asset exchanges
- List AEDU on leading decentralized exchanges (DEX)
- List AEDU on leading decentralized lending protocols
- Conduct market-making function on AEDU/USDT and AEDU/USDC pairs, and at a later date, AEDU/ETH and AEDU/Bitcoin pairs

2. Adoption

- Enable UAE banks to settle in AEDU
- Enable UAE merchants and payment companies who already accept digital payments to settle in AEDU
- Promote usage of AEDU for large transactions, including outside of banking hours
- Promote usage of AEDU to trade digital assets at local exchanges
- Promote usage of AEDU for local and international remittance

3. Ecosystem

- Enable international merchants and payment companies who already accept digital payments to include AEDU
- Promote AEDU yield and investment opportunities
- Promote usage of AEDU as a reserve currency
- Promote usage of AEDU for employee payroll

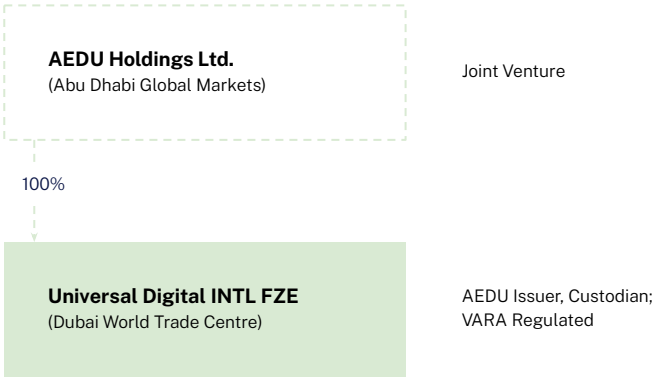
Additional Information:

Ownership

AEDU is being launched by a UAE partnership group represented by His Highness Sheikh Juma Maktoum Juma Al Maktoum. His Highness is a member of ruling family of the Emirates of Dubai and has extensive business interests in various industries.

The technology and implementation partner is Aquanow, a global virtual assets infrastructure provider. Founded in 2018, Aquanow is the leading liquidity and infrastructure provider in Canada, and services digital asset exchanges, brokerages, and payment companies in over 30 countries around the world.

Entities structure



Risks and mitigation

The following are major risks for the AEDU project:

1. Depeg risk
The most significant risk for stablecoins is depeg risk. The stability of a fiat-backed stablecoin peg is based on the perceived capability of the issuer to redeem the stablecoin 1:1 for its underlying asset. To address this issue, AEDU will be the most conservative among major stablecoins. with its reserves deposited only with financial institutions regulated by the CBUAE. Arbitrage opportunities will also provide incentives for market participants to maintain AEDU's parity. In addition, Universal Digital and its partners will provide liquidity to help maintain the peg as required.

2. Investment Loss Risk
There is general risk that stablecoin reserves will have investment losses from the various securities that they may be held in. However, AEDU reserves will be conservatively managed to minimize investment loss risk, being invested only in deposits with financial institutions regulated by the CBUAE.

3. Market liquidity risk
To mitigate the risk of insufficient trading in AEDU, Universal Digital and its partners have sourced treasury funds for market-making in leading centralized and decentralized exchanges. Other market-makers will also provide liquidity, by taking advantage of price discrepancies for arbitrage profit.

4. Issuer risk
There is operational risk that AEDU funds are stolen or that AEDU is issued without a corresponding AED deposit. To mitigate this risk, reserve assets will be clearly separated from treasury assets. Reserve accounts will be used only for minting and burning.

5. Asset-liability mismatch risk
Many stablecoin issuers invest reserves in longer-term and less-liquid assets, and may not have sufficient liquidity for redemption demand. AEDU reserves will be in liquid dirham deposits at UAE financial institutions.

6. Exploit risk
Weakness in the underlying code of a decentralized finance smart contract may be vulnerable to losses from exploits. AEDU smart contracts will be audited by at least two top audit firms. Additionally, AEDX has a central design with the capability of canceling or retracting invalid transactions in extreme situations.

7. Geopolitical risks
In a world of increasing geopolitical conflicts, some international participants may want diversification away from stablecoins backed by U.S. Dollar securities. AEDU has less exposure to the perceived risk of arbitrary asset seizure.

Terms and conditions

Universal Digital INTL FZE is the issuer of AED Universal (AEDU) and is a corporate entity registered in the Dubai World Trade Centre with a virtual assets license from the Virtual Asset Regulatory Authority (VARA) in Dubai.

AEDU is a UAE dirham-pegged stablecoin that is fully-reserved by dirham deposits held in financial institutions regulated by the Central Bank of the United Arab Emirates.

The issuance platform (AEDX) will provide services 24/7/365 except during normal system maintenance and down times.

AEDX expects to send funds within one business day of a withdrawal request. For unusual conditions, AEDX reserves the right to suspend withdrawals.

Institutional-grade AML/KYC/KYT processes will be in place. All parties must pass AML/KYC checks. All virtual asset in and out will be subject to know-your-transaction (KYT) screens. All outgoing wallets and bank accounts will be verified and/or whitelisted.

AEDU reserves will be separated from the treasury funds of the issuer.

AEDU reserves will be audited monthly by a major accounting firm, with reporting made public within seven days after month-end. AEDX will target continuous attestation if supported by its banking partners and auditor in the UAE.

AEDU smart contracts will be audited by at least two top audit firms.

AEDX will utilize market-leading custody solutions for private key storage, including multi-party computation (MPC), hold periods (no withdrawals to wallet addresses whitelisted within the last 12 hours), and tiered access.

Transaction revocation will be used as a last resort, as a safety net during extreme situations.

Ethereum and TRON will be the blockchains for initial implementation. It is expected that more blockchains will be added in the future.

The AEDU interface will not face retail customers. Initially, it will provide access only to a limited number of institutional clients, including leading virtual asset exchanges and banks.

The system will only accept AED fiat or AEDU deposits, and only issue AED fiat or AEDU withdrawals. Initially, it will not accept other fiat or virtual asset currencies.

Conclusion

AED Universal (AEDU) **is an AED-pegged stablecoin aiming to become the trusted digital currency for transfer and store of value use cases via blockchains** for virtual assets, UAE, and global economies.

The AEDU design offers the best of both worlds — it can transfer value anytime and anywhere via open blockchains without legacy banks, but is fully-reserved by UAE dirham currency held at regulated financial institutions for stability and security. The dirham itself is trusted as a reliable USD-pegged store of value.

As a digital currency, AEDU will provide opportunities for the UAE virtual assets industry. AEDU will encourage usage growth through strategic partnerships, and build tools to aid adoption. With the UAE's growing role as a virtual assets hub and global economic centre, and the reliability of the dirham,

AEDU has a promising future as a digital currency for the United Arab Emirates and the world.

Appendix 1 - Technical Details

Key management system

The AEDU system integrates with market-leading custody technology. Its platform is a multi-layer technology that provides next generation digital asset security from internal collusion, cyberattacks, and human error. It uses a custody MPC (multi-party computation) based wallet to secure the movement of funds and operates within a well-defined policy document for transfers.

Smart contract infrastructure

We envision the AEDU token to be usable on decentralized applications on popular blockchains. This token is designed to adhere to ERC-20 and TRC-20 standards which has been adopted across many Ethereum virtual machine (EVM) blockchains, and is interoperable across existing decentralized applications in the decentralized finance (DeFi) ecosystem.

The AEDU token can be minted, burned, and transferred. In designing the smart contracts that build the AEDU token, aspects such as security, upgradeability, whitelisting, and recoverability were considered. The AEDU token smart contract uses the proxy design pattern to enable the upgradability of the implementation contract.

There is a hierarchical role system that defines the access control of members such as administrator, master minters, and minters. There are thresholds defined for every minter. A multi-signature scheme is applied for high-risk operations.

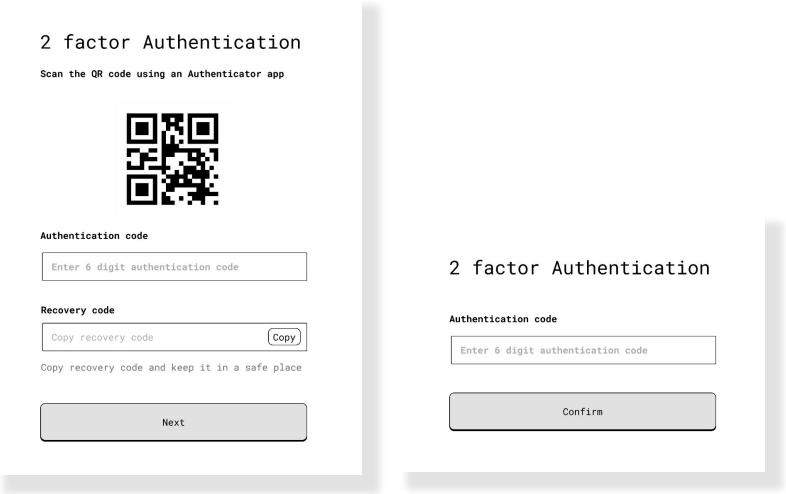
Appendix 2 - User Interface

System flowcharts

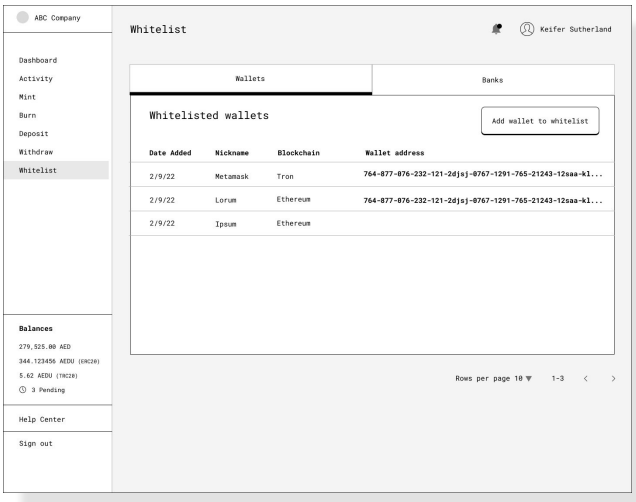
The following flowcharts (next page) represent the user journey through different workflows of the system: deposit, withdrawal, mint, and burn. Every user is provided with log-in access after completing the KYC requirements, and will only be able to submit requests for workflows with proper whitelisted address and bank account information, and if balances are sufficient. Confirmations are made both manually by an authorized operator and automatically by the system.

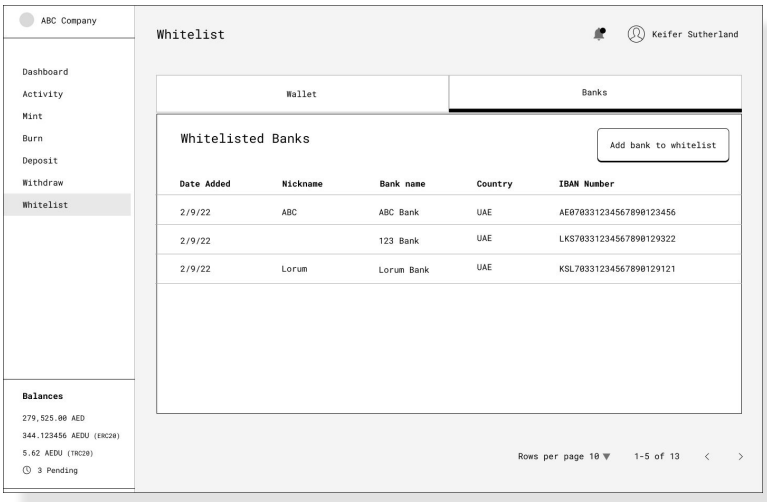
Appendix 2 - User Interface

Two Factor Authentication for Sign-in



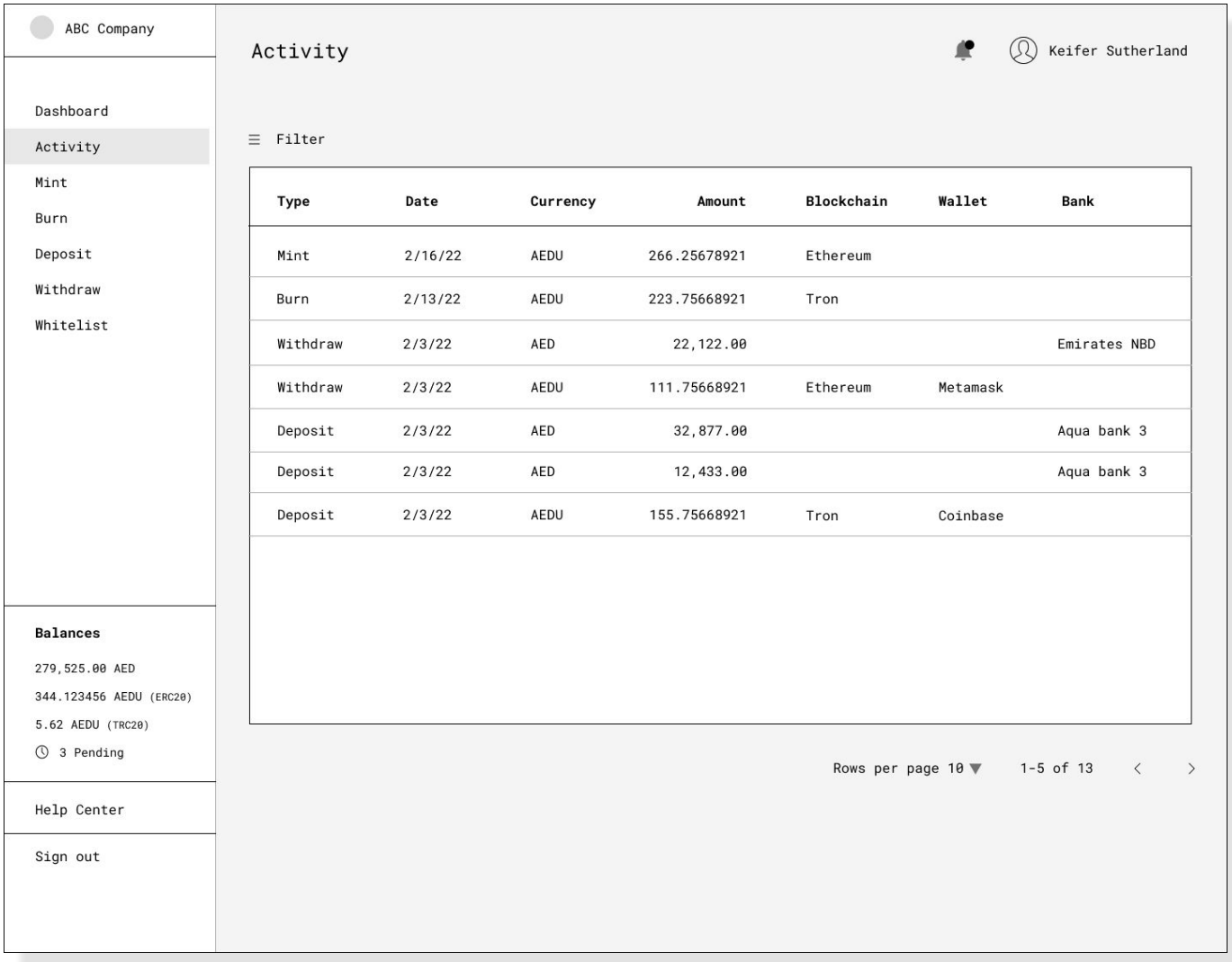
Wallet and Bank Account Whitelisting





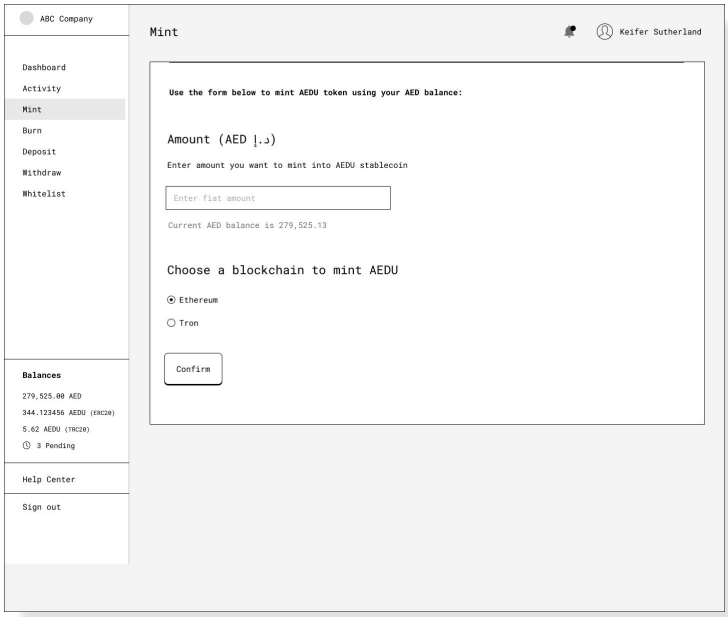
Appendix 2 - User Interface

Account Summary

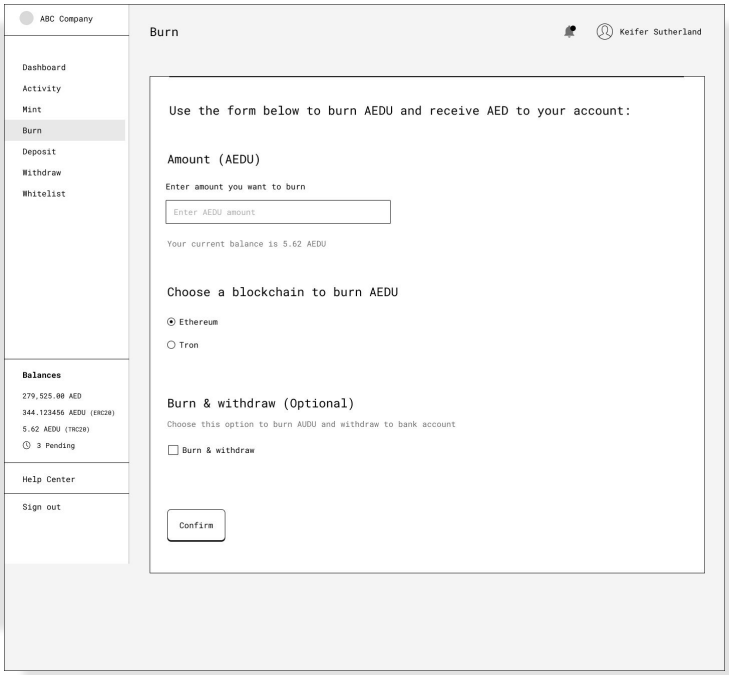


Appendix 2 - User Interface

Mint AEDU

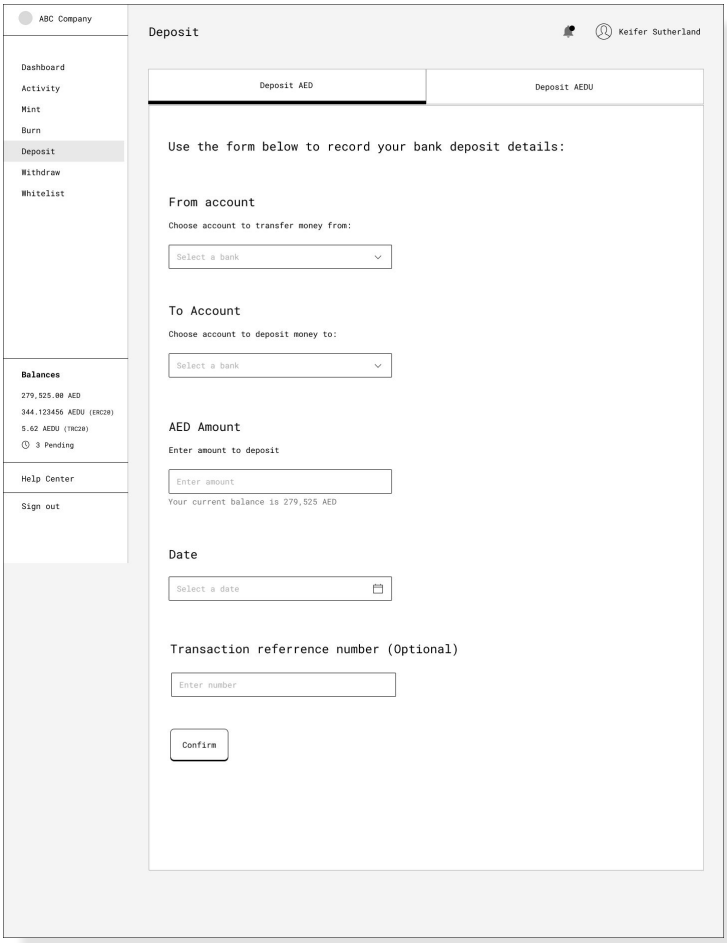


Burn AEDU

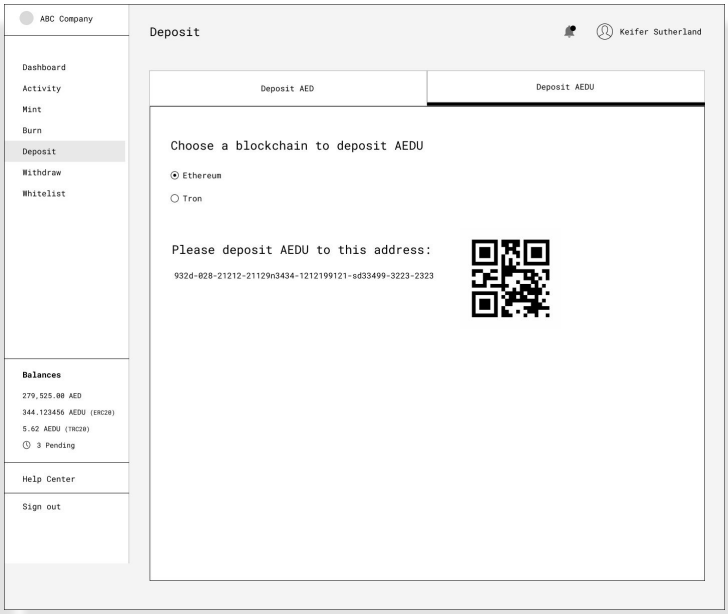


Appendix 2 - User Interface

Deposit AED

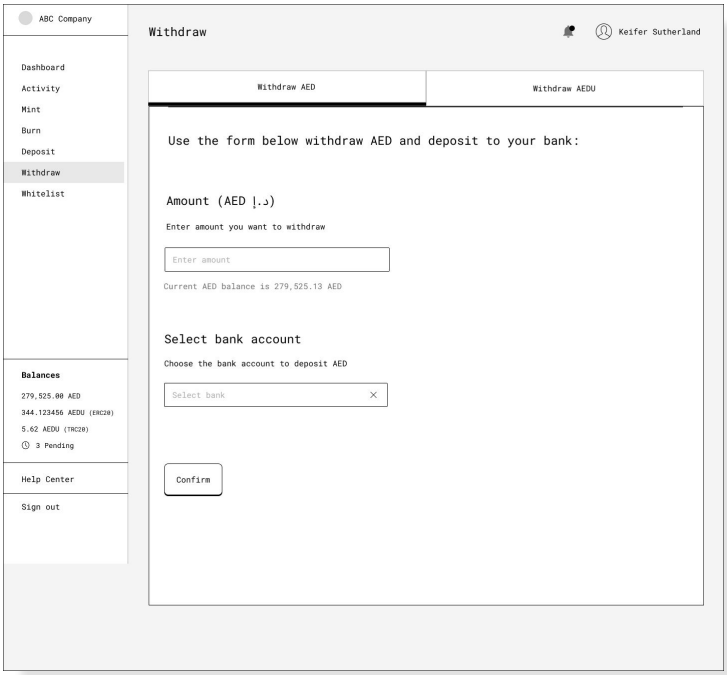


Deposit AEDU

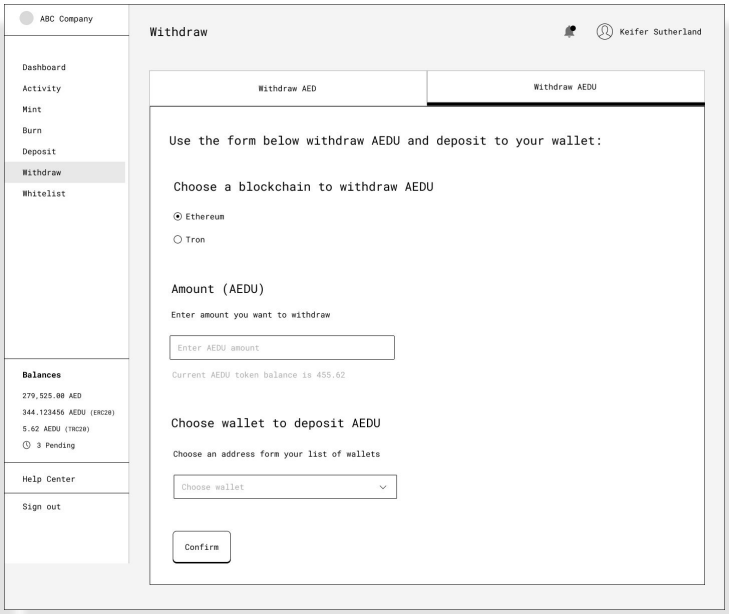


Appendix 2 - User Interface

Withdraw AED



Withdraw AEDU



Appendix 3 - Smart Contract Introduction

Overview

AEDU adheres to the ERC-20 token standard implementation. Specifications and motivations are listed out on EIP-20. The main smart contract is named TokenV1 which utilizes the use of OpenZeppelin's Implementation and other custom features. Also, applications are developed using latest tech stacks (e.g. React, Node.js)

```
contract TokenV1 is AbstractTokenV1, Ownable, Pausable, Blacklistable
```

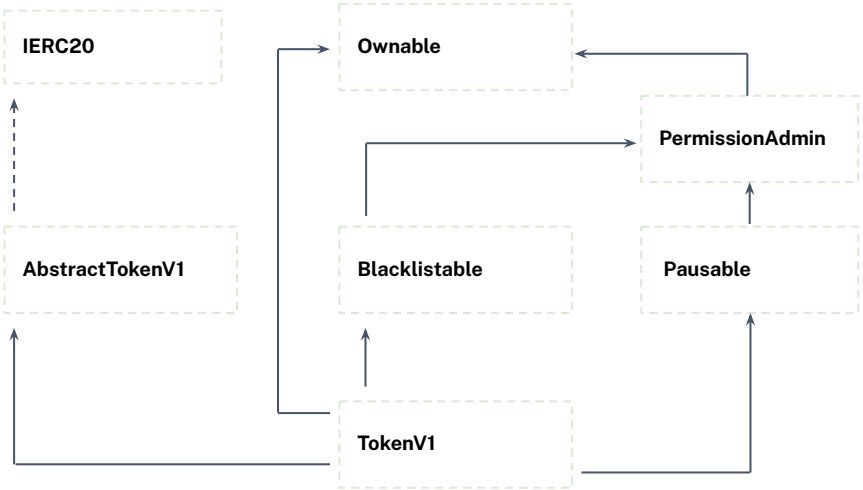
Notable custom features AEDU has for this implementation are:

- Blacklistable: the contract will not allow blacklisted addresses to perform actions such as approve, transfer, and transferFrom
- Pausable: the contract will not allow actions such as approve, transfer, and transferFrom if contract is paused
- Rescuable: the contract can move tokens accidentally sent to the TokenV1

System localization has been considered in this implementation

- Application will be hosted under AWS Dubai region
- User data will be stored within UAE to compile with data residency requirements

Technical structure



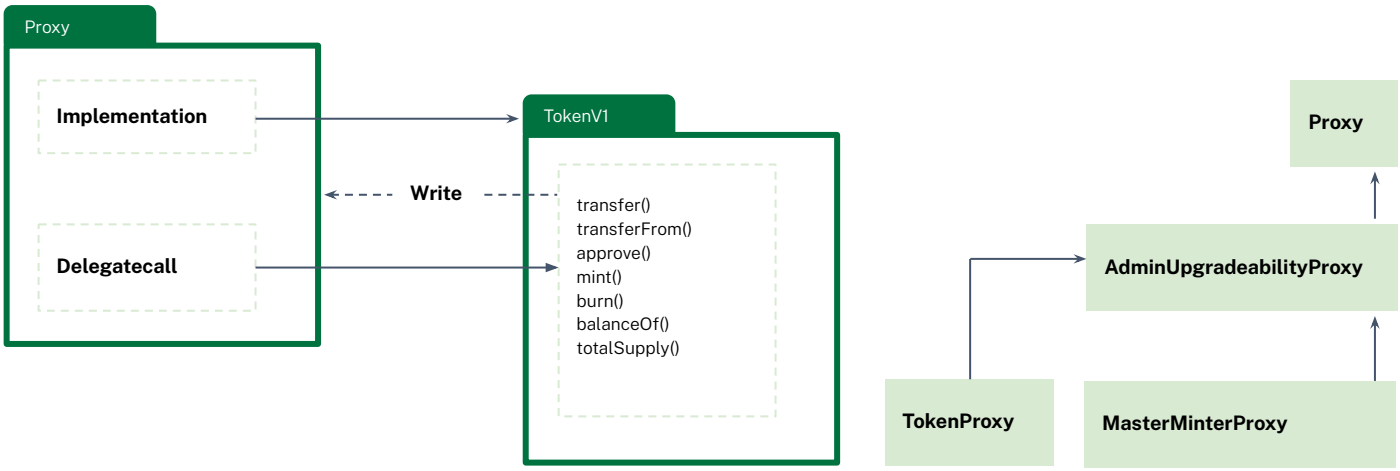
Upgradability

Smart contract code is immutable by the nature of the blockchain; however, it is a challenge when vulnerabilities on code or the environment itself is revealed. The design dictates:

1.
Changing the implementation contract has be simple, to be able to test properly

2.
There should only be one published contract address, valid after upgrades

3.
There should be an existing persistent storage contract for data



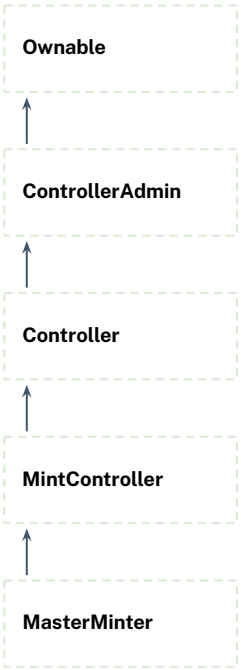
The AEDU team takes inspiration from existing stablecoins' customized Proxy pattern suggested by Consensys Diligence.
Before going into the AEDU Contract, all calls go directly to the Proxy Contract. This enables Admin to change the implementation contract of AEDU making it upgradable in case there are additional features or bugs.

The Proxy Contract implementation uses OpenZeppelin's proxy design pattern. Every call to the proxy is sent to the fallback function and then forwarded via Delegatecall to the current implementation contract. The main contract TokenV1 reads and writes directly to the storage of the Proxy Contract.

The design intends to hide implementation changes from users (always facing the Proxy Contract). Individuals and exchanges can and will continue to call the same published contract address.

Hierarchical structure

The AEDU token implementation has a role-based structure in which only certain addresses are allowed to perform actions. It also allows a multi-signature approach to change participants in the system. Operations such as minting, blacklisting, changing owner are governed by different participants. There is a clear separation of jobs within the smart contract



Roles in the system includes:

- **Owner -** can re-assign any roles
- **Admin -** upgrades the contract implementation and itself
- **MasterMinter -** appoints controllers that govern minters
- **Controllers -** configures minters
- **Minters -** mints AEDU tokens under constraints defined by controller
- **Pauser -** can change state of the contract from pause to unpause
- **Blacklister -** can add address to blacklist

Detail scenarios

Issuing and Destroying Tokens

Authorized entities are allowed to mint and burn AEDU tokens. Each minter is configured to have the following limits: mintingAllowance - the total amount of tokens can be minted, and maxAmountPerMint - maximum mint amount per transaction. These variables are configured by the MintController. Destroying tokens is also done by an authorized action that is only done by the minter.

Blacklisting

Certain addresses involved in suspicious activities can be blacklisted. These addresses will not be able to transfer, approve, mint, and burn. Only an appointed blacklister may add or remove an address from the blacklist.

Pausing

Pausing is done when serious scenarios such as a bug in the smart contract is being exploited or a key compromise is occurring. Actions such as transfer, minting, burning, upgrading is paused for all AEDU participants. Only the appointed pauser can call the pause() and unpause() functions.

Upgrading

The AEDU token uses the Unstructured-Storage Proxy pattern by OpenZeppelin. The upgrading of the implementation token can only be executed by the Admin.

Re-assigning Roles

All the roles mentioned in the previous section may be re-assigned only by the owner.

Recovering Tokens

Tokens sent accidentally to the AEDU contract can be recovered by an appointed rescuer. This is done by invoking the rescueERC20 function.

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