AUDITEK SECURITY

COMPLETE AUDIT REPORT

Security Assessment

PAWztoken

Aug 22nd, 2021

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Table of Contents

Summary

This report has been prepared for PAWZToken to discover issues and vulnerabilities in the source code of the PAWZToken project as well as any contract dependencies that were not part of an ofcially recognized library. A comprehensive examination has been performed, utilizing Static Analysis and Manual Review techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifcations and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

The security assessment resulted in fndings that ranged from critical to informational. We recommend addressing these fndings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective:

- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verifed in public;
- Provide more transparency on privileged activities once the protocol is live.

Overview

Project Summary

Project Name	PAWZToken
Platform	BSC
Language	Solidity
Codebase	• https://bscscan.com/address/0xd92aacc1c84e6a4ada48bb2648598b30adf1d1bd#code • https://bscscan.com/address/0xcb5f9b3f12aef688416d1405df0e45b591fa6bc#code • https://bscscan.com/address/0xa54a5e77b126b0e920af521133e0f3e735b6fa0
Commit	

Audit Summary

Delivery Date	Aug 22, 2021
Audit Methodology	Static Analysis, Manual Review
Key Components	

Vulnerability Summary

Vulnerability Level	Total	Pending	Declined	Acknowledged	Partially Resolved	Resolved
Critical	0	0	0	0	0	0
Major	2	0	0	0	0	2
Medium	3	0	0	1	0	2
Minor	3	0	0	3	0	0
Informational	8	0	0	3	0	5
Discussion	0	0	0	0	0	0

Audit Scope

ID	File	SHA256 Checksum
PAW	PAWZToken.sol	01fb4807fba0eda416a41fc03f78f4bb44dd1e78490193357fd29dcadada7ead

Review Notes

Dependencies

There are a few depending injection contracts or addresses in the current project:

- `marketingAddress`, `charityAddress`, `buybackAddress`, and PancakeSwap Router address for the contract `PAWZToken`.

We assume these contracts or addresses are valid and non-vulnerable actors and implementing proper logic to collaborate with the current project.

Privileged Functions

The `owner` role of the contract `PAWZToken` can operate on the many privileged functions as we grouped below.

Account management functions for inclusion and exclusion in the fee and reward system:

- `PAWZToken.excludeFromReward(address)`
- `PAWZToken.includeInReward(address)`
- `PAWZToken.excludeFromFee(address)`
- `PAWZToken.includeInFee(address)`

Modifcation of fees, threshold token amount, and proportion of BNB allocation:

- `PAWZToken.setTaxFeePercent(uint256, uint256)`
- `PAWZToken.setMaxTxAmount(uint256)`
- `PAWZToken.setCharityDivisor(uint256)`
- `PAWZToken.setMarketingDivisor(uint256)`
- `PAWZToken.setBuyBackDivisor(uint256)`
- `PAWZToken.setLPDivisor(uint256)`
- `PAWZToken.setNumTokensSellToAddToLiquidity(uint256)`

Confguration of charity, buyback, and marketing addresses:

- `PAWZToken.setCharityAddress(address)`
- `PAWZToken.setBuyBackAddress(address)`
- `PAWZToken.setMarketingAddress(address)`

Toggle feature of the LP acquisition mechanism and sale phases:

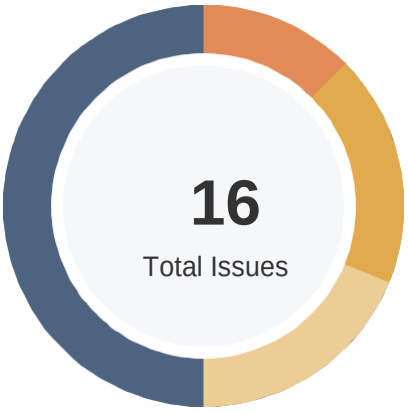
- `PAWZToken.setSwapAndLiquifyEnabled(bool)`
- `PAWZToken.setLPEnabled(bool)`
- `PAWZToken.prepareForPreSale()`
- `PAWZToken.afterPreSale()`

Manipulation of the contract ownership:

- `Ownable.renounceOwnership()`
- `Ownable.transferOwnership(address)`

To improve the trustworthiness of the project, dynamic runtime updates in the project should be notifed to the community. Any plan to invoke the aforementioned functions should be also considered to move to the execution queue of the `Timelock` contract.

Findings



Critical	**0** (0.00%)
Major	**2** (12.50%)
Medium	**3** (18.75%)
Minor	**3** (18.75%)
Informational	**8** (50.00%)
Discussion	**0** (0.00%)

ID	Title	Category	Severity	Status
PAW-01	Centralization Risk in `addLiquidity`	**Centralization / Privilege**	**Major**	Resolved
PAW-02	Disproportionate BNB Allocation and Liquidity Tokens	Logical Issue	Major	Resolved
PAW-03	Centralization Risk	**Centralization / Privilege**	**Medium**	Acknowledged
PAW-04	Non-Guaranteed Sum of Divisors	Logical Issue	Medium	Resolved
PAW-05	Possible to Gain Ownership after Renouncing the Contract Ownership	**Logical Issue, Centralization / Privilege**	**Medium**	Resolved
PAW-06	Incorrect Error Message	Logical Issue	Minor	Acknowledged
PAW-07	Third Party Dependencies	Control Flow	Minor	Acknowledged
PAW-08	Potential Sandwich Attack	Volatile Code	Minor	Acknowledged
PAW-09	Typo in the Contract	Coding Style	Informational	Resolved
PAW-10	Return Value Not Handled	Volatile Code	Informational	Acknowledged
PAW-11	Missing Event Emitting	Coding Style	Informational	Acknowledged

ID	Title	Category	Severity	Status
PAW-12	Unused Event	Coding Style	Informational	Acknowledged
PAW-13	Variable Could Be Declared As `constant`	Gas Optimization	Informational	Resolved
PAW-14	Function and Variable Naming Doesn't Match the Operating Environment	Coding Style	Informational	Resolved
PAW-15	Division Before Multiplication	Language Specifc	Informational	Resolved
PAW-16	Liquidity Can Only Be Added When Selling the Token	Logical Issue	Informational	Resolved

PAW-01 | Centralization Risk in [redacted]ity

Category	Severity	Location	Status
Centralization / Privilege	**Major**	PAWZToken.sol: 711	Resolved

Description

The `addLiquidity` function calls the `uniswapV2Router.addLiquidityETH` function listed below with the `to` address specifed as `owner()` for acquiring the generated LP tokens from the `PAWZ-BNB` pool. As a result, over time the `owner` address will accumulate a signifcant portion of LP tokens. If the `_owner` is an EOA (Externally Owned Account), mishandling of its private key can have devastating consequences to the project as a whole.

```
715  // add the liquidity
716  uniswapV2Router.addLiquidityETH{value: ethAmount}(
717      address(this),
718      tokenAmount,
719      0, // slippage is unavoidable
720      0, // slippage is unavoidable
721      owner(),
722      block.timestamp
723  );
```

Recommendation

We advise the `to` address of the `uniswapV2Router.addLiquidityETH` function call to be replaced by the contract itself, i.e. `address(this)`, and to restrict the management of the LP tokens within the scope of the contract's business logic. This will also protect the LP tokens from being stolen if the `_owner` account is compromised. In general, we strongly recommend centralized privileges or roles in the protocol to be improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g., Multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Time-lock with reasonable latency, e.g. 48 hours, for awareness on privileged operations;
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

The client heeded our advice and resolved this issue by setting the recipient of the liquidity tokens to `address(this)`. The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

PAW-02 | Disproportionate BNB Allocation and Liquidity Tokens

Category	Severity	Location	Status
Logical Issue	Major	PAWZToken.sol: 654~672	Resolved

Description

Assume all parameters are set to default values. In function `PAWZToken.swapTokens(uint256)`, $\frac{7}{8}$ of `contractTokenBalance` PAWZ tokens is used to swap for BNB and the rest $\frac{1}{8}$ PAWZ tokens are used to add liquidity to the 'PAWZ-BNB' pool. Specifcally, $\frac{3}{7}$ of the swapped BNB is evenly transferred to the charity, marketing, and buyback address; $\frac{1}{14}$ of the swapped BNB is used to add liquidity to the 'PAWZ-BNB' pool. Here raise the following two major concerns:

1. There will be half of the swapped BNB accumulated in the contract for each call of function `PAWZToken.swapTokens(uint256)`. Meanwhile, the contract does not appear to provide a way to withdraw those BNB, and they will be locked in the contract forever.
2. While adding liquidity, the value of 'tokenAmountForLP' PAWZ tokens (i.e., $\frac{1}{8}$ of `contractTokenBalance` PAWZ tokens) does not match that of `ETHAmountForLP` BNB (i.e., $\frac{1}{14}$ of the swapped BNB).

We expect the PAWZ team to provide more details about their design in terms of allocating swapped BNB and adding liquidity.

Alleviation

The client updated the allocation of swapped BNB. Specifcally, $\frac{6}{7}$ of the swapped BNB is evenly transferred to the charity, marketing, and buyback address; $\frac{1}{7}$ of the swapped BNB is used to add liquidity to the 'PAWZ-BNB' pool. The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

PAW-03 | Centralization Risk

Category	Severity	Location	Status
Centralization / Privilege	**Medium**	PAWZToken.sol: 585, 595, 866, 870, 874, 879, 883, 887, 891, 895, 901, 905, 908, 911, 915, 920, 924, 931	Acknowledged

Description

With the modifer `onlyOwner`, the 'owner' has the authority to call the following 18 sensitive functions to change the settings of the `PAWZToken` contract.

- `PAWZToken.excludeFromReward(address)`
- `PAWZToken.includeInReward(address)`
- `PAWZToken.excludeFromFee(address)`
- `PAWZToken.includeInFee(address)`
- `PAWZToken.setTaxFeePercent(uint256, uint256)`
- `PAWZToken.setMaxTxAmount(uint256)`
- `PAWZToken.setCharityDivisor(uint256)`
- `PAWZToken.setMarketingDivisor(uint256)`
- `PAWZToken.setBuyBackDivisor(uint256)`
- `PAWZToken.setLPDivisor(uint256)`
- `PAWZToken.setNumTokensSellToAddToLiquidity(uint256)`
- `PAWZToken.setCharityAddress(address)`
- `PAWZToken.setBuyBackAddress(address)`
- `PAWZToken.setMarketingAddress(address)`
- `PAWZToken.setSwapAndLiquifyEnabled(bool)`
- `PAWZToken.setLPEnabled(bool)`
- `PAWZToken.prepareForPreSale()`
- `PAWZToken.afterPreSale()`

Any compromise to the `owner` account may allow the hacker to adversarially manipulate the settings of the contract.

Recommendation

We advise the client to carefully manage the 'owner' account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol to be

improved via a decentralized mechanism or via smart-contract-based accounts with enhanced security practices, e.g., multisignature wallets.

Indicatively, here are some feasible solutions that would also mitigate the potential risk:

- Timelock with reasonable latency, e.g. 48 hours, for awareness on privileged operations; Assignment
- of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key;
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.

Alleviation

N/A

PAW-04 | Non-Guaranteed Sum of Divisors

Category	Severity	Location	Status
Logical Issue	Medium	PAWZToken.sol: 934	Resolved

Description

`_liquidityFee` should equal the sum of `charityDivisor`, `marketingDivisor`, `buyBackDivisor` and `LPDivisor`. However, it is not guaranteed that the sum would be 12 because these divisors can be modifed by `PAWZToken.setCharityDivisor()`, `PAWZToken.setMarketingDivisor()`, `PAWZToken.setBuyBackDivisor()` and `PAWZToken.setLPDivisor()`.

Recommendation

We recommend setting `_liquidityFee` to be the sum of `charityDivisor`, `marketingDivisor`, `buyBackDivisor` and `LPDivisor` instead of the constant 12.

Alleviation

The client heeded our advice and resolved this issue by setting `_liquidityFee` to be the sum of `charityDivisor`, `marketingDivisor`, `buyBackDivisor` and `LPDivisor`. The fixing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

PAW-05 | Possible to Gain Ownership after Renouncing the Contract Ownership

Category	Severity	Location	Status
Logical Issue, Centralization / Privilege	**Medium**	PAWZToken.sol: 189	Resolved

Description

An owner is possible to gain ownership of the contract even if he/she calls the function `renounceOwnership` to renounce the ownership. This can be achieved by performing the following operations:

1. Call `lock` to lock the contract. The variable `_previousOwner` is set to the current owner.
2. Call `unlock` to unlock the contract.
3. Call `renounceOwnership` to leave the contract without an owner.
4. Call `unlock` to regain ownership.

Recommendation

We advise updating/removing `lock` and `unlock` functions in the contract, or removing the `renounceOwnership` if such a privilege retains at the protocol level. If timelock functionality could be introduced, we recommend using the implementation of Compound fnance as a reference.

Reference: https://github.com/compound-fnance/compound-protocol/blob/master/contracts/Timelock.sol

Alleviation

The client heeded our advice and resolved this issue by removing the function `Ownable.lock(uint256)` and `Ownable.unlock()`. Meanwhile, they also removed `Ownable.getUnlockTime()` and `Ownable.getTime()`. The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

PAW-06 | Incorrect Error Message

Category	Severity	Location	Status
Logical Issue	Minor	PAWZToken.sol: 596	Acknowledged

Description

The error message in `require(_isExcluded[account], "Account is already excluded")` does not describe the error correctly.

Recommendation

The message "Account is already excluded" should be changed to "Account is not excluded" .

Alleviation

N/A

PAW-07 | Third Party Dependencies

Category	Severity	Location	Status
Control Flow	Minor	PAWZToken.sol: 484	Acknowledged

Description

The contract is serving as the underlying entity to interact with third-party PancakeSwap protocols. The scope of the audit treats third-party entities as black boxes and assumes their functional correctness. However, in the real world, third-party entities can be compromised and this may lead to lost or stolen assets. In addition, upgrades of third-party entities can possibly create severe impacts, such as increasing fees of third-party entities, migrating to new LP pools, etc.

Recommendation

We understand that the business logic of the PAWZ protocol requires the interaction PancakeSwap protocol for adding liquidity to the PAWZ-BNB pool and swapping tokens. We encourage the team to constantly monitor the statuses of those third-party entities to mitigate the side efects when unexpected activities are observed.

Alleviation

N/A

PAW-08 | Potential Sandwich Attack

Category	Severity	Location	Status
Volatile Code	Minor	PAWZToken.sol: 680~686, 701~706, 716~723	Acknowledged

Description

Potential sandwich attacks could happen if calling `uniswapV2Router.swapExactTokensForETHSupportingFeeOnTransferTokens`, `uniswapV2Router.swapExactTokensForETHSupportingFeeOnTransferTokens`, and `uniswapV2Router.addLiquidityETH` without setting restrictions on slippage.

For example, when we want to make a transaction of swapping 100 AToken for 1 ETH, an attacker could raise the price of ETH by adding AToken into the pool before the transaction so we might only get 0.1 ETH. After the transaction, the attacker would be able to withdraw more than he deposited because the total value of the pool increases by 0.9 ETH.

Recommendation

We recommend setting reasonable minimum output amounts, instead of 0, based on token prices when calling the aforementioned functions.

Alleviation

N/A

PAW-09 | Typo in the Contract

Category	Severity	Location	Status
Coding Style	Informational	PAWZToken.sol: 471	Resolved

Description

The variable name `tokensIntoLiqudity` should be `tokensIntoLiquidity`.

Recommendation

We recommend correcting this typo in the contract.

Alleviation

The client heeded our advice and resolved this issue by changing `tokensIntoLiqudity` to `tokensIntoLiquidity`. The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

PAW-10 | Return Value Not Handled

Category	Severity	Location	Status
Volatile Code	Informational	PAWZToken.sol: 716	Acknowledged

Description

The return values of function `addLiquidityETH` are not properly handled.

```
716         uniswapV2Router.addLiquidityETH{value: ethAmount}(
717             address(this),
718             tokenAmount,
719             0, // slippage is unavoidable
720             0, // slippage is unavoidable
721             owner(),
722             block.timestamp
723         );
```

Recommendation

We recommend using variables to receive the return value of the functions mentioned above and handle both success and failure cases if needed by the business logic.

Alleviation

N/A

PAW-11 | Missing Event Emitting

Category	Severity	Location	Status
Coding Style	Informational	PAWZToken.sol: 585, 595, 866, 870, 874, 879, 883, 887, 891, 895, 901, 905, 908, 911, 920, 924, 931	Acknowledged

Description

In the contract `PAWZToken`, there are a bunch of functions that can change state variables. However, these functions (as listed below) do not emit events to pass the changes out of the chain:

- `PAWZToken.excludeFromReward(address)`
- `PAWZToken.includeInReward(address)`
- `PAWZToken.excludeFromFee(address)`
- `PAWZToken.includeInFee(address)`
- `PAWZToken.setTaxFeePercent(uint256, uint256)`
- `PAWZToken.setMaxTxAmount(uint256)`
- `PAWZToken.setCharityDivisor(uint256)`
- `PAWZToken.setMarketingDivisor(uint256)`
- `PAWZToken.setBuyBackDivisor(uint256)`
- `PAWZToken.setLPDivisor(uint256)`
- `PAWZToken.setNumTokensSellToAddToLiquidity(uint256)`
- `PAWZToken.setCharityAddress(address)`
- `PAWZToken.setBuyBackAddress(address)`
- `PAWZToken.setMarketingAddress(address)`
- `PAWZToken.setLPEnabled(bool)`
- `PAWZToken.prepareForPreSale()`
- `PAWZToken.afterPreSale()`

Recommendation

We recommend declaring and emitting corresponding events for all the essential state variables that are possible to be changed during runtime.

Alleviation

N/A

PAW-12 | Unused Event

Category	Severity	Location	Status
Coding Style	Informational	PAWZToken.sol: 468, 469, 471	Acknowledged

Description

The events of `RewardLiquidityProviders` , `BuyBackEnabledUpdated` , and `SwapAndLiquify` are declared but never used.

Recommendation

We recommend removing these events or emitting them in the right places.

Alleviation

N/A

PAW-13 | Variable Could Be Declared A[redacted]ant

Category	Severity	Location	Status
Gas Optimization	Informational	PAWZToken.sol: 435, 439~441	Resolved

Description

Variables `_tTotal` , `_name` , `_symbol` , and `_decimals` could be declared as `constant` since these state variables are never to be changed.

Recommendation

We recommend declaring those variables as `constant` .

Alleviation

The client heeded our advice and resolved this issue by declaring aforementioned variables as `constant` .
The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc` .

PAW-14 | Function and Variable Naming Doesn't Match the Operating Environment

Category	Severity	Location	Status
Coding Style	Informational	PAWZToken.sol: 460, 674, 694	Resolved

Description

The PAWZToken contract uses PancakeSwap for swapping and adding liquidity to the PancakeSwap pool, but naming it Uniswap. Function `PAWZToken.swapTokensForEth(uint256)` swaps PAWZ token for BNB instead of ETH, and similily function `PAWZToken.swapETHForTokens(uint256)` swaps BNB instead of ETH for PAWZ token.

Recommendation

We recommend changing "Uniswap" and "ETH" to "PancakeSwap" and "BNB" in the contract respectively to match the operating environment and avoid confusion.

Alleviation

The client heeded our advice and resolved this issue by changing "Uniswap" and "ETH" to "PancakeSwap" and "BNB", respectively, in the contract. The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

PAW-15 | Division Before Multiplication

Category	Severity	Location	Status
Language Specifc	Informational	PAWZToken.sol: 655, 661, 663, 665, 667	Resolved

Description

In function `PAWZToken.swapTokens(uint256)`, the division operations are performed before the multiplication operations, while performing multiplication before division can sometimes reduce or avoid loss of precision.

Recommendation

We recommend performing multiplication before division to avoid the loss of precision.

Alleviation

The client heeded our advice and resolved this issue by performing multiplication before division in aforementioned places. The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

PAW-16 | Liquidity Can Only Be Added When Selling the Token

Category	Severity	Location	Status
Logical Issue	Informational	PAWZToken.sol: 637	Resolved

Description

To add liquidity, the condition `to == uniswapV2Pair` needs to be true. That is, assuming the rest three conditions are true, liquidity can only be added if and only if the current transaction sells the PAWZ token. We expect the PAWZ team to confrm whether this is the intended design.

Alleviation

The client removed the condition `to == uniswapV2Pair`. Therefore, adding liquidity does not depend on the sell transaction anymore. The fxing is refected in the code deployed at `0xcb5f9b3f12aef688416d1405dff0e45b591fa6bc`.

Appendix

Finding Categories

Centralization / Privilege

Centralization / Privilege fndings refer to either feature logic or implementation of components that act against the nature of decentralization, such as explicit ownership or specialized access roles in combination with a mechanism to relocate funds.

Gas Optimization

Gas Optimization fndings do not afect the functionality of the code but generate diferent, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.

Logical Issue

Logical Issue fndings detail a fault in the logic of the linked code, such as an incorrect notion on how block.timestamp works.

Control Flow

Control Flow fndings concern the access control imposed on functions, such as owner-only functions being invoke-able by anyone under certain circumstances.

Volatile Code

Volatile Code fndings refer to segments of code that behave unexpectedly on certain edge cases that may result in a vulnerability.

Language Specific

Language Specifc fndings are issues that would only arise within Solidity, i.e. incorrect usage of private or delete.

Coding Style

Coding Style fndings usually do not afect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

Checksum Calculation Method

The "Checksum" feld in the "Audit Scope" section is calculated as the SHA-256 (Secure Hash Algorithm 2 with digest size of 256 bits) digest of the content of each fle hosted in the listed source repository under the specifed commit.

The result is hexadecimal encoded and is the same as the output of the Linux "sha256sum" command against the target fle.

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Blockchain technology and cryptographic assets present a high level of ongoing risk. AuditeK's position is that each company and individual are responsible for their own due diligence and continuous security. AuditeK's goal is to help reduce the attack vectors and the high level of variance associated with utilizing new and consistently changing technologies, and in no way claims any guarantee of security or functionality of the technology we agree to analyze.

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Founded in 2017 by leading academics in the feld of Computer Science from both Yale and Columbia University, AuditeK is a leading blockchain security company that serves to verify the security and correctness of smart contracts and blockchain-based protocols. Through the utilization of our world-class technical expertise, alongside our proprietary, innovative tech, we're able to support the success of our clients with best-in-class security, all whilst realizing our overarching vision; provable trust for all throughout all facets of blockchain.