CredShields

Smart Contract Audit

Feb 7th, 2023 • CONFIDENTIAL

Description

This document details the process and result of the Digital Invoice Smart Contract audit performed by CredShields Technologies PTE. LTD. on behalf of Obius between Feb 11th, 2023, and Feb 18th, 2023. **And a retest was performed on Feb 28th, 2023.**

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Prepared for

Obius

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1. Executive Summary

Obius engaged CredShields to perform a smart contract audit from Feb 11th, 2023, to Feb 18th, 2023. During this timeframe, Ten (10) vulnerabilities were identified. **A retest was performed on Feb 28th, 2023, and all the bugs have been addressed.**

During the audit, one (1) vulnerability was found with a severity rating of either High or Critical. These vulnerabilities represent the greatest immediate risk to "Obius" and should be prioritized for remediation.

The table below shows the in-scope assets and a breakdown of findings by severity per asset. Section 2.3 contains more information on how severity is calculated.

Assets in Scope	Critical	High	Medium	Low	info	Gas	Σ
Digital Invoice Smart Contract	0	1	1	3	1	4	**10**
	0	**1**	**1**	**3**	**1**	**4**	**10**

Table: Vulnerabilities Per Asset in Scope

The CredShields team conducted the security audit to focus on identifying vulnerabilities in Digital Invoice Smart Contract's scope during the testing window while abiding by the policies set forth by Digital Invoice Smart Contract's team.

State of Security

To maintain a robust security posture, it is essential to continuously review and improve upon current security processes. Utilizing CredShields' continuous audit feature allows both Obius's internal security and development teams to not only identify specific vulnerabilities, but also gain a deeper understanding of the current security threat landscape.

To ensure that vulnerabilities are not introduced when new features are added, or code is refactored, we recommend conducting regular security assessments. Additionally, by analyzing the root cause of resolved vulnerabilities, the internal teams at Obius can implement both manual and automated procedures to eliminate entire classes of vulnerabilities in the future. By taking a proactive approach, Obius can future-proof its security posture and protect its assets.

2. Methodology

Obius engaged CredShields to perform an Obius Smart Contract audit. The following sections cover how the engagement was put together and executed.

2.1 Preparation phase

The CredShields team meticulously reviewed all provided documents and comments in the smart-contract code to gain a thorough understanding of the contract's features and functionalities. They meticulously examined all functions and created a mind map to systematically identify potential security vulnerabilities, prioritizing those that were more critical and business-sensitive for the refactored code. To confirm their findings, the team deployed a self-hosted version of the smart contract and performed verifications and validations during the audit phase.

A testing window from Feb 11th, 2023, to Feb 18th, 2023, was agreed upon during the preparation phase.

2.1.1 Scope

During the preparation phase, the following scope for the engagement was agreed-upon:

IN SCOPE ASSETS
https://github.com/Akestor/Digital-Invoice

Table: List of Files in Scope

2.1.2 Documentation

Documentation was not required as the code was self-sufficient for understanding the project.

2.1.3 Audit Goals

CredShields uses both in-house tools and manual methods for comprehensive smart contract security auditing. The majority of the audit is done by manually reviewing the contract source code, following SWC registry standards, and an extended industry standard self-developed checklist. The team places emphasis on understanding core concepts, preparing test cases, and evaluating business logic for potential vulnerabilities.

2.2 Retesting phase

Obius is actively partnering with CredShields to validate the remediations implemented towards the discovered vulnerabilities.

2.3 Vulnerability classification and severity

CredShields follows OWASP's Risk Rating Methodology to determine the risk associated with discovered vulnerabilities. This approach considers two factors - Likelihood and Impact - which are evaluated with three possible values - **Low**, **Medium**, and **High**, based on factors such as Threat agents, Vulnerability factors, Technical and Business Impacts. The overall severity of the risk is calculated by combining the likelihood and impact estimates.

Overall Risk Severity				
Impact	HIGH	Medium	High	Critical
	MEDIUM	Low	Medium	High
	LOW	Note	Low	Medium
		LOW	MEDIUM	HIGH
	Likelihood			

Overall, the categories can be defined as described below -

1. Informational

We prioritize technical excellence and pay attention to detail in our coding practices. Our guidelines, standards, and best practices help ensure software stability and reliability. Informational vulnerabilities are opportunities for improvement and do not pose a direct risk to the contract. Code maintainers should use their own judgment on whether to address them.

2. **Low**

   Low-risk vulnerabilities are those that either have a small impact or can't be exploited repeatedly or those the client considers insignificant based on their specific business circumstances.

3. **Medium**

   Medium-severity vulnerabilities are those caused by weak or flawed logic in the code and can lead to exfiltration or modification of private user information. These vulnerabilities can harm the client's reputation under certain conditions and should be fixed within a specified timeframe.

4. **High**

   High-severity vulnerabilities pose a significant risk to the Smart Contract and the organization. They can result in the loss of funds for some users, may or may not require specific conditions, and are more complex to exploit. These vulnerabilities can harm the client's reputation and should be fixed immediately.

5. **Critical**

   Critical issues are directly exploitable bugs or security vulnerabilities that do not require specific conditions. They often result in the loss of funds and Ether from Smart Contracts or users and put sensitive user information at risk of compromise or modification. The client's reputation and financial stability will be severely impacted if these issues are not addressed immediately.

6. **Gas**

   To address the risk and volatility of smart contracts and the use of gas as a method of payment, CredShields has introduced a "Gas" severity category. This category deals with optimizing code and refactoring to conserve gas.

2.4 CredShields staff

The following individual at CredShields managed this engagement and produced this report:

- **Shashank, Co-founder CredShields**
    - shashank@CredShields.com

Please feel free to contact this individual with any questions or concerns you have around the engagement or this document.

3. Findings

This chapter contains the results of the security assessment. Findings are sorted by their severity and grouped by the asset and SWC classification. Each asset section will include a summary. The table in the executive summary contains the total number of identified security vulnerabilities per asset per risk indication.

3.1 Findings Overview

3.1.1 Vulnerability Summary

During the security assessment, Ten (10) security vulnerabilities were identified in the asset.

VULNERABILITY TITLE	SEVERITY	SWC | Vulnerability Type
Floating and Outdated Pragma versions	Low	Floating Pragma (SWC-103)
Unused Variables	Informational	Dead Code
Functions should be declared External	Gas	Gas Optimization
Gas Optimization in Require Statements	Gas	Gas Optimization
Custom Errors instead of Revert	Gas	Gas Optimization
Missing Price Feed Validation	Medium	Input Validation
Gas Optimization with Counters	Gas	Gas Optimization

Missing Input Validation in Prefix-URL	Low	Input Validation
Missing Input Validation in Metadata	High	Input Validation
Improper Function Visibility and Missing Validation	Low	Business Logic
Missing Input Validation in Fee Percentage	Low	Input Validation
Missing Events in important functions	Low	Missing Best Practices
Private Invoice’s Information Disclosure	Medium	Information Disclosure
Incorrect Invoice Price Calculation	High	Business Logic

Table: Findings in Smart Contracts

3.1.2 Findings Summary

SWC ID	SWC Checklist	Test Result	Notes
SWC-100	Function Default Visibility	Not Vulnerable	Not applicable after v0.5.X (Currently using solidity v >= 0.8.6)
SWC-101	Integer Overflow and Underflow	Not Vulnerable	The issue persists in versions before v0.8.X.
SWC-102	Outdated Compiler Version	Not Vulnerable	Version 0^.8.0 and above is used
SWC-103	Floating Pragma	Not Vulnerable	Contract uses floating pragma
SWC-104	Unchecked Call Return Value	Not Vulnerable	call() is not used
SWC-105	Unprotected Ether Withdrawal	Not Vulnerable	Appropriate function modifiers and require validations are used on sensitive functions that allow token or ether withdrawal.
SWC-106	Unprotected SELFDESTRUCT Instruction	Not Vulnerable	selfdestruct() is not used anywhere
SWC-107	Reentrancy	Not Vulnerable	No notable functions were vulnerable to it.
SWC-108	State Variable Default Visibility	Not Vulnerable	Not Vulnerable
SWC-109	Uninitialized Storage Pointer	Not Vulnerable	Not vulnerable after compiler version, v0.5.0

SWC-110	Assert Violation	Not Vulnerable	Asserts are not in use.
SWC-111	Use of Deprecated Solidity Functions	Not Vulnerable	None of the deprecated functions like block.blockhash(), msg.gas, throw, sha3(), callcode(), suicide() are in use
SWC-112	Delegatecall to Untrusted Callee	Not Vulnerable	Not Vulnerable.
SWC-113	DoS with Failed Call	Not Vulnerable	No such function was found.
SWC-114	Transaction Order Dependence	Not Vulnerable	Not Vulnerable.
SWC-115	Authorization through tx.origin	Not Vulnerable	tx.origin is not used anywhere in the code
SWC-116	Block values as a proxy for time	Not Vulnerable	Block.timestamp is not used
SWC-117	Signature Malleability	Not Vulnerable	Not used anywhere
SWC-118	Incorrect Constructor Name	Not Vulnerable	All the constructors are created using the constructor keyword rather than functions.
SWC-119	Shadowing State Variables	Not Vulnerable	Not applicable as this won't work during compile time after version 0.6.0
SWC-120	Weak Sources of Randomness from Chain Attributes	Not Vulnerable	Random generators are not used.
SWC-121	Missing Protection against Signature Replay Attacks	Not Vulnerable	No such scenario was found

SWC-122	Lack of Proper Signature Verification	Not Vulnerable	Not used anywhere
SWC-123	Requirement Violation	Not Vulnerable	Not vulnerable
SWC-124	Write to Arbitrary Storage Location	Not Vulnerable	No such scenario was found
SWC-125	Incorrect Inheritance Order	Not Vulnerable	No such scenario was found
SWC-126	Insufficient Gas Griefing	Not Vulnerable	No such scenario was found
SWC-127	Arbitrary Jump with Function Type Variable	Not Vulnerable	Jump is not used.
SWC-128	DoS With Block Gas Limit	Not Vulnerable	Not Vulnerable.
SWC-129	Typographical Error	Not Vulnerable	No such scenario was found
SWC-130	Right-To-Left-Override control character (U+202E)	Not Vulnerable	No such scenario was found
SWC-131	Presence of unused variables	Not Vulnerable	No such scenario was found
SWC-132	Unexpected Ether balance	Not Vulnerable	No such scenario was found
SWC-133	Hash Collisions With Multiple Variable Length Arguments	Not Vulnerable	abi.encodePacked() or other functions are not used.
SWC-134	Message call with hardcoded gas amount	Not Vulnerable	Not used anywhere in the code
SWC-135	Code With No Effects	Not Vulnerable	No such scenario was found
SWC-136	Unencrypted Private Data On-Chain	Not Vulnerable	No such scenario was found

4. Remediation Status

Obius is actively partnering with CredShields from this engagement to validate the discovered vulnerabilities' remediations. **A retest was performed on Feb 28th, 2023, and all the issues have been addressed.**

Also, the table shows the remediation status of each finding.

VULNERABILITY TITLE	SEVERITY	REMEDIATION STATUS
Floating and Outdated Pragma versions	Low	**Fixed [06/02/2023]**
Unused Variables	Informational	**Fixed [06/02/2023]**
Functions should be declared External	Gas	**Fixed [06/02/2023]**
Gas Optimization in Require Statements	Gas	**Fixed [06/02/2023]**
Custom Errors instead of Revert	Gas	**Fixed [06/02/2023]**
Missing Price Feed Validation	Medium	**Fixed [06/02/2023]**
Gas Optimization with Counters	Gas	**Fixed [06/02/2023]**
Missing Input Validation in Prefix-URL	Low	**Fixed**

		[07/03/2023]
Missing Input Validation in Metadata	High	**Fixed [28/02/2023]**
Improper Function Visibility and Missing Validation	Low	**Fixed [06/02/2023]**
Missing Input Validation in Fee Percentage	Low	**Fixed [28/02/2023]**
Missing Events in important functions	Low	**Fixed [28/02/2023]**
Private Invoice’s Information Disclosure	Fixed	**Fixed [28/02/2023]**
Incorrect Invoice Price Calculation	Fixed	**Fixed [28/02/2023]**

Table: Summary of findings and status of remediation

5. Bug Reports

Bug ID#1 [Fixed]

Floating and Outdated Pragma versions

Vulnerability Type
Floating Pragma (SWC-103)

Severity
Low

Description
Locking the pragma helps ensure that the contracts do not accidentally get deployed using an older version of the Solidity compiler affected by vulnerabilities.
The contracts found in the repository were allowing floating or unlocked pragma to be used, i.e., **^0.8.0.** This allows the contracts to be compiled with all the solidity compiler versions above the limit specified. The following contracts were found to be affected -

Affected Code

- ^0.8.0 - ContractV2.sol
- ^0.8.0 - Base64.sol

Impacts
If the smart contract gets compiled and deployed with an older or too recent version of the solidity compiler, there's a chance that it may get compromised due to the bugs present in the older versions or unidentified exploits in the new versions.
Incompatibility issues may also arise if the contract code does not support features in other compiler versions, therefore, breaking the logic.
The likelihood of exploitation is really low therefore this is only informational.

Remediation
Keep the compiler versions consistent in all the smart contract files. Do not allow floating pragmas anywhere. It is suggested to use the 0.8.9 pragma version which is stable and not too recent.
Reference: https://swcregistry.io/docs/SWC-103

Retest:
The contract now uses a fixed pragma version which is 0.8.9

Bug ID#2 [Fixed]

Unused Variables

Vulnerability Type
Dead Code

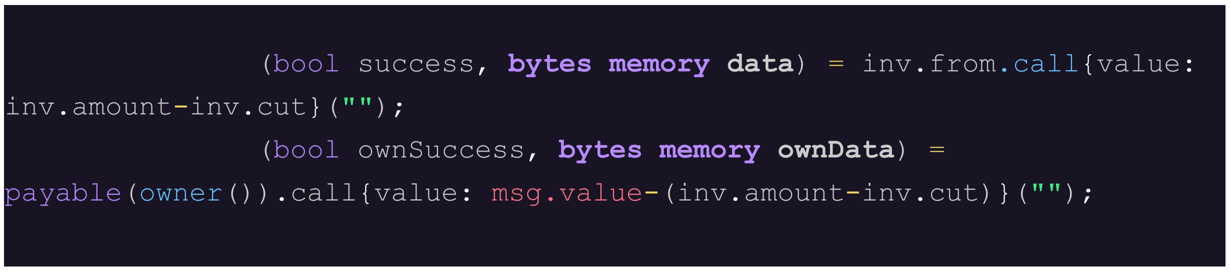
Severity
Informational

Description
It is recommended to keep the production repository clean to prevent confusion and the introduction of vulnerabilities.
The functions and parameters, contracts, and interfaces that are never used or called externally or from inside the contracts should be removed when the contract is deployed on the mainnet.
In this case, the function **getEthPrice()** defined the parameters **roundID**, **startedAt**, **timeStamp**, and **answeredInRound** which were never used or returned.
The other unused local variables were **data** and **ownData**.

Affected Code

- ContractV2.sol - Line 143, 144, 180

```
function getEthPrice() public view returns (int) {
    (
        uint80 roundID,
        int price,
        uint startedAt,
        uint timeStamp,
        uint80 answeredInRound
    ) = priceFeed.latestRoundData();
    return price;
}
```



```
                    (bool success, bytes memory data) = inv.from.call{value:
inv.amount-inv.cut}("");
                    (bool ownSuccess, bytes memory ownData) =
payable(owner()).call{value: msg.value-(inv.amount-inv.cut)}("");
```

Impacts
This does not impact the security aspect of the Smart contract but prevents confusion when the code is sent to other developers or auditors to understand and implement. This reduces the overall size of the contracts and also helps in saving gas.

Remediation
If the parameters are not used, it is recommended to just accept blank values like - (,price,,,) = priceFeed.latestRoundData();

Retest:
The function is now accepting blank values for unused return parameters.
https://github.com/Akestor/Digital-Invoice/blob/8ec62b225a36e3fef650634c3e210133643f1772/Contracts/ContractV2.sol#L199-L207

Bug ID#3 [Fixed]

Functions should be declared External

Vulnerability Type
Gas Optimization

Severity
Gas

Description
Public functions that are never called by a contract should be declared external in order to conserve gas.
The following functions were declared as public but were not called anywhere in the contract, making public visibility useless.

Affected Code
The following functions were affected -

- createInvoice() - Line 98
- payInvoice - Line 132

Impacts
Smart Contracts are required to have effective Gas usage as they cost real money and each function should be monitored for the amount of gas it costs to make it gas efficient.
"**public**" functions cost more Gas than "**external**" functions.

Remediation
Use the "**external**" state visibility for functions that are never called from inside the contract.

Retest
The public functions have been changed to external to save gas.
https://github.com/Akestor/Digital-Invoice/blob/8ec62b225a36e3fef650634c3e210133643f1772/Contracts/ContractV2.sol#L114

https://github.com/Akestor/Digital-Invoice/blob/8ec62b225a36e3fef650634c3e210133643f1772/Contracts/ContractV2.sol#L150

Bug ID#4 [Fixed]

Gas Optimization in Require Statements

Vulnerability Type

Gas Optimization

Severity

Gas

Description

The **require()** statement takes an input string to show errors if the validation fails.
The strings inside these functions that are longer than **32 bytes** require at least one additional MSTORE, along with additional overhead for computing memory offset and other parameters. For this purpose, having strings lesser than 32 bytes saves a significant amount of gas.

Vulnerable Code

- ContractV2.sol - Line 134
- ContractV2.sol - Line 233

```
    require(msg.sender==inv.to, "This invoice is not generated for
you");

    require(_exists(_tokenId),"ERC721Metadata: URI query for nonexistent
token");
```

Impacts

Having longer require strings than 32 bytes cost a significant amount of gas.

Remediation

It is recommended to shorten the strings passed inside **require()** statements to fit under **32 bytes**. This will decrease the gas usage at the time of deployment and at runtime when the validation condition is met.

Retest
Errors have now been updated to a smaller value to save gas.

Bug ID#5 [Fixed]

Custom Errors instead of Revert

Vulnerability Type
Gas Optimization

Severity
Gas

Description
The contract was found to be using **revert()** statements in multiple places. Since Solidity v0.8.4, custom errors have been introduced which are a better alternative to the revert.
This allows the developers to pass custom errors with dynamic data while reverting the transaction and also makes the whole implementation a bit cheaper than using revert.

Vulnerable Code
- ContractV2.sol - Line 112, 167

```
...
        }else{
            revert("Invalid payment mode");
        }
...
```

Impacts
Using revert() instead of error() costs more gas.

Remediation
It is recommended to replace the instances of revert() statements with error() to save gas.

Retest

The team is using a different method of validating errors using require statements with less than 32 bytes of data.

Bug ID#6 [Fixed]

Missing Price Feed Validation

Vulnerability Type

Input Validation

Severity

Medium

Description

Chainlink has a library **AggregatorV3Interface** with a function called **latestRoundData()**. This function returns the price feed among other details for the latest round.
The contract was found to be using **latestRoundData()** without proper input validations on the returned parameters which might result in a stale and outdated price.

Vulnerable Code

- ContractV2.sol - Line 187

```
function getEthPrice() public view returns (int) {
    (
        uint80 roundID,
        int price,
        uint startedAt,
        uint timeStamp,
        uint80 answeredInRound
    ) = priceFeed.latestRoundData();
    return price;
}
```

Impacts

Having oracles with functions to fetch price feed without any validation might introduce erroneous or invalid price values that could result in an invalid price calculation further in the contract.

Remediation

It is recommended to have input validations for all the parameters obtained from the Chainlink price feed. Ideally, the following validations should be implemented:

```
(uint80 roundID ,answer,, uint256 timestamp, uint80 answeredInRound) =
AggregatorV3Interface(chainLinkAggregatorMap[underlying]).latestRoundData();

require(answer > 0, "Chainlink price <= 0");
require(answeredInRound >= roundID, "Stale price");
require(timestamp != 0, "Round not complete");
```

Retest

The necessary price feed validations have been added to the function.
https://github.com/Akestor/Digital-Invoice/blob/8ec62b225a36e3fef650634c3e210133643f1772/Contracts/ContractV2.sol#L199-L207

Bug ID#7 [Fixed]

Gas Optimization with Counters

Vulnerability Type
Gas Optimization

Severity
Gas

Description
The OpenZeppelin’s Counters library makes the code more readable and at the same time streamlines the process of integer increment and decrement. But this costs more gas than a traditional way of using uint directly in the contract. This can be optimized if the contract uses uint instead of Counters library.

Affected Code

- ContractV2.sol - Line 33

```
contract InvoiceNFT is ERC721, Ownable {
    using Counters for Counters.Counter;
```

Impacts
Using OpenZeppelin’s Counters library costs more gas instead of using traditional uint variables. This happens because the EVM adds more code to jump to the Counters library to execute the respective code. This also increases the total deployment size.

Remediation
It is recommended to use a traditional uint variable directly in the contract instead of Counters to save some gas unless Counters is absolutely necessary.

Retest:

Counters have been removed in favor of custom incremental logic.

Bug ID#8 [Fixed]

Missing Input Validation in Prefix-URL

Vulnerability Type
Input Validation

Severity
Low

Description
The contract accepts a prefix URL during contract creation inside the constructor and on the function **setPrefixUrl().** This prefix is used inside the function **buildMetadata()** to build JSON metadata. The JSON object can be broken by passing invalid characters such as a double quote inside the URL.

Affected Code

- ContractV2.sol - Line 81, 226

```
  constructor(string memory _prefix_url,address _USDT_ADDRESS, address
_USDC_ADDRESS, address _AGGREGATOR_ADDRESS) ERC721("Invoice", "INV") {

      prefixUrl = _prefix_url;
      USDT_ADDRESS = _USDT_ADDRESS;
      USDC_ADDRESS = _USDC_ADDRESS;
      tokenUSDT = IERC20(address(_USDT_ADDRESS));
      tokenUSDC = IERC20(address(_USDC_ADDRESS));
      priceFeed = AggregatorV3Interface(_AGGREGATOR_ADDRESS);
  }


  function setPrefixUrl(string memory _uri) external onlyOwner{
      prefixUrl = _uri;
```

```
    }
```

Impacts
The missing input validation can be exploited by privileged administrators to break the JSON metadata that is generated. This will break the frontend Dapp’s code wherever it is parsed.

Remediation
It is recommended to have input validation on the prefix URI parameter so that it does not accept invalid strings. It can also encode certain characters that could break the JSON. Add a regex check or encode the input value.

Retest:
A validation was added to the URL value
https://github.com/lazyCoder-max/Digital-Invoice-Solidity/blob/main/ContractV2.sol#L275

Bug ID#9 [Fixed]

Missing Input Validation in Metadata

Vulnerability Type
Input Validation

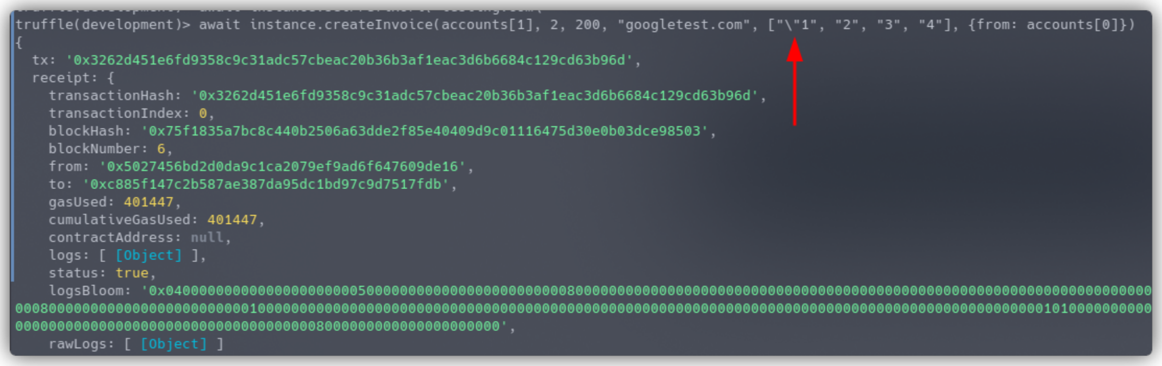
Severity
High

Description
The contract accepts metadata parameters during invoice creation inside the function **createInvoice().** These metadata values are used inside the function **buildMetadata()** to build JSON metadata. The JSON object can be broken by passing invalid characters such as a double quote inside the parameters.

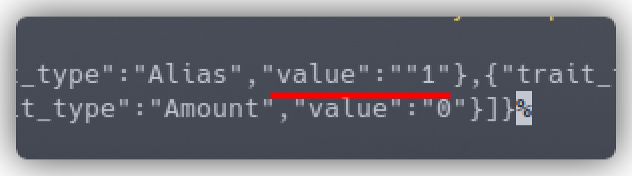
Affected Code

- ContractV2.sol - Line 98

```
   function createInvoice(address _to, uint _paymentMode, uint _amount,
string memory _invoiceUrl, string[] memory _meta) public
returns(uint){...}
```



```
truffle(development)> await instance.createInvoice(accounts[1], 2, 200, "googletest.com", ["\"1", "2", "3", "4"], {from: accounts[0]})
{
  tx: '0x3262d451e6fd9358c9c31adc57cbeac20b36b3af1eac3d6b6684c129cd63b96d',
  receipt: {
    transactionHash: '0x3262d451e6fd9358c9c31adc57cbeac20b36b3af1eac3d6b6684c129cd63b96d',
    transactionIndex: 0,
    blockHash: '0x75f1835a7bc8c440b2506a63dde2f85e40409d9c01116475d30e0b03dce98503',
    blockNumber: 6,
    from: '0x5027456bd2d0da9c1ca2079ef9ad6f647609de16',
    to: '0xc885f147c2b587ae387da95dc1bd97c9d7517fdb',
    gasUsed: 401447,
    cumulativeGasUsed: 401447,
    contractAddress: null,
    logs: [ [Object] ],
    status: true,
    logsBloom: '0x04000000000000000000000500000000000000000000000080000000000000000000000000000000000000000000000000000000000000000000000
00080000000000000000000000001000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000001010000000000
000000000000000000000000000000000000800000000000000000000',
    rawLogs: [ [Object] ]
```



```
_type":"Alias","value":""1"},{"trait_
t_type":"Amount","value":"0"}]}%
```

Impacts

The missing input validation can be exploited by any external user to break the JSON metadata that is generated. This will break the frontend Dapp's code wherever it is parsed.

Remediation

It is recommended to have input validation on the prefix URI parameter so that it does not accept invalid strings. It can also encode certain characters that could break the JSON. Add a regex check or encode the input value.

Retest:

This has been fixed by adding checks for characters that break JSON via the function "ContainsUnwantedSymbol"
https://github.com/Akestor/Digital-Invoice/blob/190b8e524f1d2e6ac5f62cf3be7c96dfe749174a/Contracts/ContractV2.sol#L400-L414

Bug ID#10 [Fixed]

Improper Function Visibility and Missing Validation

Vulnerability Type
Business Logic

Severity
Low

Description
The contract InvoiceNFT defines a public function called **tokenURI()** that accepts a token ID which is then validated if it exists or not. If the token exists, **buildMetadata()** is called with a valid token ID. However, there's no such validation in the **buildMetadata()** function and since its visibility is public, it can be called by any external user directly to generate a fake non-existent token's invoice.

Affected Code

- ContractV2.sol - Line 269

```
    function tokenURI(uint _tokenId) public view virtual override
returns (string memory) {
        require(_exists(_tokenId),"ERC721Metadata: URI query for
nonexistent token");
        return buildMetadata(_tokenId);
    }

    function buildMetadata(uint _tokenId) public view returns(string
memory) {...}
```

Impacts

The function **buildMetadata()** can be called by any external user to bypass the input validations on Line 233 to generate fake invoices for nonexistent tokens.

Remediation

It is recommended to change the visibility of the **buildMetadata()** function to internal so that it can't be called externally. The metadata can be generated using **tokenURI()** function that already has an input validation in place.

Retest:

This has been fixed and the function **buildMetadata()** has been marked as internal.
https://github.com/Akestor/Digital-Invoice/blob/8ec62b225a36e3fef650634c3e210133643f1772/Contracts/ContractV2.sol#L288

Bug ID#11 [Fixed]

Missing Input Validation in Fee Percentage

Vulnerability Type
Input Validation

Severity
Low

Description
The contract adds a payment mode using the function “**addPaymentMode()**” which also accepts a payment fee.
There’s no validation on this fee to check if the fee is not equal to zero.

Affected Code

- ContractV2.sol - Line 443

```
   function addPaymentMode(address creatorAddress,string memory
PaymentMethodName,address PaymentMethodAddress,bool isActive,bool
isToken,uint feePercentage,bool isPublic) public
   {
       require(msg.sender==contractOwner, "Method Not Allowed!");
       IERC20 candidate;
       if(length>0)
       {
           candidate = IERC20(PaymentMethodAddress);
       }
       PaymentMethod memory paymentMode =
PaymentMethod(length,creatorAddress,PaymentMethodName,PaymentMethodAddre
ss,candidate,isActive,isToken,feePercentage,isPublic);
       PAYMENT_MODE[length] = paymentMode; // adds the new payment
method
```

```
        length++;
    }
```

Impacts

Due to missing input validation, it will be possible to set the fee to 0 which will introduce errors during calculations.

Remediation

It is recommended to have input validation on the fee percentage similar to what is done in the **updatePaymentMode()** function.

Retest:

A check for 0 value has been added
https://github.com/Akestor/Digital-Invoice/blob/909a8eb9b2932244c7508fb2b5891f265d656c84/Contracts/ContractV2.sol#L480

Bug ID#12 [Fixed]

Missing Events in important functions

Vulnerability Type
Missing Best Practices

Severity
Low

Description
Events are inheritable members of contracts. When you call them, they cause the arguments to be stored in the transaction's log—a special data structure in the blockchain. These logs are associated with the address of the contract which can then be used by developers and auditors to keep track of the transactions.

The contract was found to be missing these events on certain critical functions which would make it difficult or impossible to track these transactions off-chain.

Affected Code
The following functions were affected -

- ContractV2.sol - addPaymentMode() and updatePaymentMode()

```
    function addPaymentMode(address creatorAddress,string memory
PaymentMethodName,address PaymentMethodAddress,bool isActive,bool
isToken,uint feePercentage,bool isPublic) public
   {}

   function updatePaymentMode(uint index, address creatorAddress, bool
isActive, uint feePercentage, bool isPublic) public
   {}
```

Impacts

Events are used to track the transactions off-chain and missing these events on critical functions makes it difficult to audit these logs if they're needed at a later stage.

Remediation

Consider emitting events for the functions mentioned above. It is also recommended to have the addresses indexed.

Retest:

Events have been added to both functions.
https://github.com/Akestor/Digital-Invoice/blob/909a8eb9b2932244c7508fb2b5891f265d656c84/Contracts/ContractV2.sol#L488
https://github.com/Akestor/Digital-Invoice/blob/909a8eb9b2932244c7508fb2b5891f265d656c84/Contracts/ContractV2.sol#L502

Bug ID#13 [Fixed]

Private Invoice’s Information Disclosure

Vulnerability Type

Information Disclosure

Severity

Medium

Description

The contract InvoiceNFT implements an enum called “PRIVACY” during invoice creation that keeps track if an invoice is kept private from other users. This is being used along with a modifier “authorizedAccessForBoth()” which is validating the same when getting the invoice. On the blockchain, nothing is private and can be obtained by directly fetching data from the storage slots. Therefore, this approach can be bypassed.

Reference:
https://docs.soliditylang.org/en/v0.8.17/internals/layout_in_storage.html#mappings-and-dynamic-arrays

Affected Code

The following functions were affected -

- ContractV2.sol

```
function getInvoice(uint256 _tokenId)
    public
    view
    authorizedAccessForBoth(_tokenId)
    returns (INVOICE memory)
{
    require(_exists(_tokenId), "ERROR 114");
    return allInvoices[_tokenId];
    }
```

Impacts
This current implementation is vulnerable to invoice information disclosure if the user decides to keep their invoices private.

Remediation
The feature needs to be removed as this cannot be fixed.

Retest:
This issue cannot be fixed and hence it won’t be advertised a privacy feature anymore.

Bug ID#14 [Fixed]

Incorrect Invoice Price Calculation

Vulnerability Type
Business Logic

Severity
High

Description
The contract ContractV2.sol has a function to create invoices in which it is calculating the invoice cut "_cut" using the following calculations:

```
uint256 _cut = (_amount * (mode.feePercentage + privacyFee)) / 100;
OR
uint256 _cut = (_amount * mode.feePercentage) / 100;
```

During the invoice's payment, instead of this cut being deducted from the payer's balance, the function was not deducting that amount. Instead, the payer had to pay that much less amount when paying for the invoice.

```
   bool success = inv.paymentMode.PaymentMode.transferFrom(
       msg.sender,
       inv.from,
       inv.amount - inv.cut
   );
```

Attack Scenario

- Alice creates an invoice for 500 tokens for Bob using a payment mode with a fee percentage of 5%.
- Ideally, Bob should pay 500 + the amount calculated after incurring a 5% fee.
- But when this payment was initiated by Bob, he only paid 475.
- This rendered the fee percentage for the payment mode useless.

Affected Code
https://github.com/Akestor/Digital-Invoice/blob/9777cb9e61212c2d142812f69adc0b56bf983a4f/Contracts/ContractV2.sol#L215

Impacts
This vulnerability exploits the improper invoice amount calculation due to missing accounting for the fee percentage in the payment mode to pay less than the required amount for the invoice.

Remediation
It is recommended to calculate the fee properly and instead of deducting less amount from the payer, the fee amount should be added to their transaction.

Retest:
The price calculation has been updated to fix the issue.

6. Disclosure

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