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Magic Eden – Open Creator Protocol

Solana Program Security Audit

Prepared by: **Halborn**

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Visit: **Halborn.com**

DOCUMENT REVISION HISTORY

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0.6	Draft Review	12/07/2022	Gabi Urrutia

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EXECUTIVE OVERVIEW

1.1 INTRODUCTION

Open Creator Protocol (OCP) is an open protocol for creators to build utilities and the policy engine for their tokens. The policy engine can be configured to support the following features:

- Protected royalties: the protocol allows creators to ban market-places that have not protected royalties on their collection.
- Freeze trading until mint is done: Creators can use Open Creator Protocol to limit trading until after mint is complete
- Create rules for NFT transfers: Creators can gamify transferability for collections, including completely non-transferable tokens.

Magic Eden engaged Halborn to conduct a security audit on their Solana programs beginning on November 23rd, 2022 and ending on December 7th, 2022 . The security assessment was scoped to the programs provided in the Open Creator Protocol GitHub repository. Commit hashes and further details can be found in the Scope section of this report.

1.2 AUDIT SUMMARY

The team at Halborn was provided 2 weeks for the engagement and assigned 1 full-time security engineer to audit the security of the programs in scope. The security engineer is a blockchain and Solana program security expert with advanced penetration testing and Solana program hacking skills, and deep knowledge of multiple blockchain protocols.

The purpose of this audit is to:

- Identify potential security issues within the programs

In summary, Halborn identified some improvements to reduce the likelihood and impact of risks, which should be addressed by Magic Eden . The main ones are the following:

- The Policy Managed Authority has full control over all OCP policies, even those that are created and managed by another users. In case this address is compromised, all defined policies can be modified by an attacker. It is recommended to either remove the managed authority or add multisig support.
- Invalid or malformed policies lead to program crashes. Proper error handling and propagation should be in place to ensure that state is not affected by panics.

1.3 TEST APPROACH & METHODOLOGY

Halborn performed a combination of a manual review of the source code and automated security testing to balance efficiency, timeliness, practicality, and accuracy in regard to the scope of the program audit. While manual testing is recommended to uncover flaws in business logic, processes, and implementation; automated testing techniques help enhance coverage of programs and can quickly identify items that do not follow security best practices.

The following phases and associated tools were used throughout the term of the audit:

- Research into the architecture, purpose, and use of the platform.
- Manual program source code review to identify business logic issues.
- Mapping out possible attack vectors
- Thorough assessment of safety and usage of critical Rust variables and functions in scope that could lead to arithmetic vulnerabilities.
- Finding unsafe Rust code usage (cargo-geiger)
- Scanning dependencies for known vulnerabilities (cargo audit).

- Local runtime testing (solana-test-framework)
- Scanning for common Solana vulnerabilities (soteria)

RISK METHODOLOGY:

Vulnerabilities or issues observed by Halborn are ranked based on the risk assessment methodology by measuring the **LIKELIHOOD** of a security incident and the **IMPACT** should an incident occur. This framework works for communicating the characteristics and impacts of technology vulnerabilities. The quantitative model ensures repeatable and accurate measurement while enabling users to see the underlying vulnerability characteristics that were used to generate the Risk scores. For every vulnerability, a risk level will be calculated on a scale of 5 to 1 with 5 being the highest likelihood or impact.

RISK SCALE - LIKELIHOOD

5 - Almost certain an incident will occur.
4 - High probability of an incident occurring.
3 - Potential of a security incident in the long term.
2 - Low probability of an incident occurring.
1 - Very unlikely issue will cause an incident.

RISK SCALE - IMPACT

5 - May cause devastating and unrecoverable impact or loss.
4 - May cause a significant level of impact or loss.
3 - May cause a partial impact or loss to many.
2 - May cause temporary impact or loss.
1 - May cause minimal or un-noticeable impact.

The risk level is then calculated using a sum of these two values, creating a value of 10 to 1 with 10 being the highest level of security risk.

CRITICAL	HIGH	MEDIUM	LOW	INFORMATIONAL

10 - CRITICAL

9 - 8 - HIGH

7 - 6 - MEDIUM

5 - 4 - LOW

3 - 1 - VERY LOW AND INFORMATIONAL

1.4 SCOPE

Code repositories:

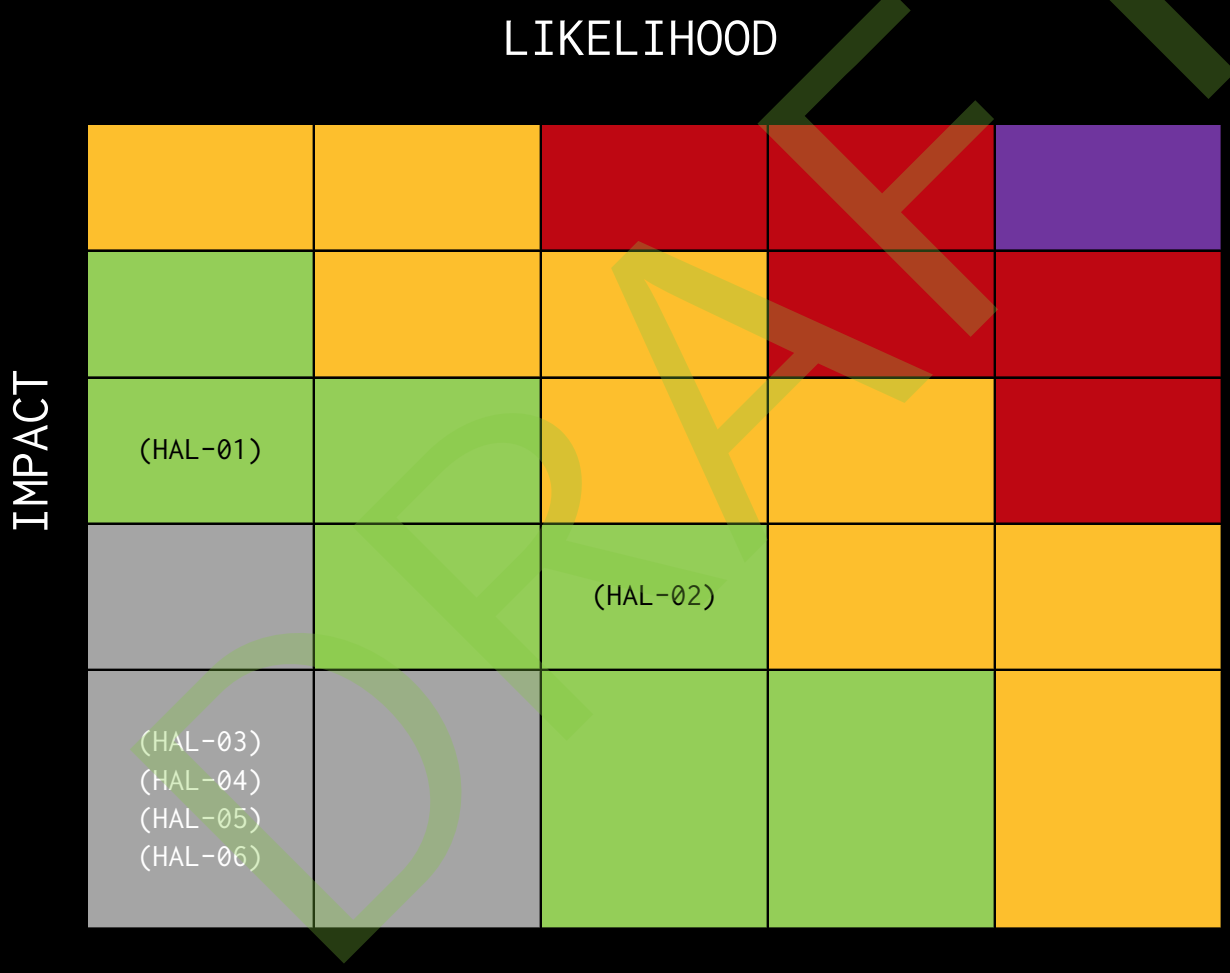
1. Project Name

- Repository: Open Creator Protocol
- Commit ID: 0ad875da0b7081bb88f5c9f897d7bed561bfc1bb
- Programs in scope:
    1. (programs/open_creator_protocol/)

Out-of-scope:
- Community Managed Token (CMT) Program
- Dynamic Royalties Feature
- Third-party libraries and dependencies
- Financial-related attacks

2. ASSESSMENT SUMMARY & FINDINGS OVERVIEW

CRITICAL	HIGH	MEDIUM	LOW	INFORMATIONAL
0	0	0	2	4



SECURITY ANALYSIS	RISK LEVEL	REMEDIATION DATE
HAL-01 - HARDCODED MANAGEMENT ADDRESS	Low	-
HAL-02 - POLICY VALIDATION PANIC	Low	-
HAL-03 - INTEGER UNDERFLOW	Informational	-
HAL-04 - LACK OF TEST COVERAGE	Informational	-
HAL-05 - POSSIBLE RUST PANICS DUE TO UNSAFE UNWRAP USAGE	Informational	-
HAL-06 - MISSING CARGO OVERFLOW CHECKS	Informational	-

FINDINGS & TECH DETAILS

3.1 (HAL-01) HARDCODED MANAGEMENT ADDRESS - LOW

Description:

The MANAGED_AUTHORITY address, which can modify any existing policy, even those that were created by a different authority, is hardcoded in state.rs. In case this address is compromised, all existing policies could be modified, and the program owner would have to redeploy the program to update it.

Code Location:

Listing 1: programs/open_creator_protocol/src/state.rs (Line 47)

```
44 impl Policy {
45     pub const LEN: usize = Policy::JSON_RULE_MAX_LEN + 200 /* with
↳  padding */;
46     pub const SEED: &'static str = "policy";
47     pub const MANAGED_AUTHORITY: &'static str = "
↳ RULERZZDGsXqd9TeJu5ikLfbXzBFpoDPT8N3FHRhq1T";
48     pub const JSON_RULE_MAX_LEN: usize = 1000;
49     [...]
```

Listing 2: programs/open_creator_protocol/src/instructions/policy/update_policy.rs (Lines 20,25,26)

```
16 #[account(
17     // only policy.authority or MANAGED_AUTHORITY can update the
↳ policy
18     constraint = (
19         authority.key() == policy.authority ||
20         authority.key().to_string() == Policy::MANAGED_AUTHORITY
21     ) @ OCPErrorCode::InvalidAuthority,
22
23     // only MANAGED_AUTHORITY can set the arg.authority to be
↳ MANAGED_AUTHORITY
24     constraint = (
25         arg.authority.to_string() != Policy::MANAGED_AUTHORITY ||
```

```
26             authority.key().to_string() == Policy::MANAGED_AUTHORITY
27         ) @ OCPErrorCode::InvalidAuthority,
28     )]
29     authority: Signer<'info>,
```

Risk Level:

Likelihood - 1
Impact - 3

Recommendation:

Consider removing the hardcoded MANAGED_AUTHORITY, adding multisig support or making the administrative addresses modifiable and implement a function to update these addresses in case they are compromised.

3.2 (HAL-02) POLICY VALIDATION PANIC - LOW

Description:

OCP policies are JSON Objects which are validated with the Policy::valid() function against a json_rules_engine_fork::rule rule. Since the function returns a Rule or an Error, submitting invalid JSON Policies causes a panic when the program tries to unwrap an Error.

Code Location:

Listing 3: programs/open_creator_protocol/src/state.rs (Line 55)

```
50 pub fn valid(&self) -> Result<()> {
51     if self.json_rule.len() > Policy::JSON_RULE_MAX_LEN {
52         return Err(OCPErrorCode::InvalidPolicyCreation.into());
53     }
54     // make sure the rule is valid
55     serde_json::from_str::<Rule>(&self.json_rule).unwrap();
56     Ok(())
57 }
```

Risk Level:

Likelihood - 3
Impact - 2

Recommendation:

It is recommended not to use the unwrap function in the production environment because its use causes panic! and may crash the program without verbose error messages. Crashing the system will result in a loss of availability and, in some cases, even private information stored in the state. Some alternatives are possible, such as propagating the error with ? instead of unwrapping, or using the error-chain crate for

errors.

3.3 (HAL-03) INTEGER UNDERFLOW - INFORMATIONAL

Description:

An underflow or overflow happens when an arithmetic operation attempts to create a numeric value that is outside the range that can be represented with a given number of bits. If it is not, in Rust the resulting value is specified to wrap as two's complement, resulting in a value either too low or too high considering the circumstances.

Code Location:

Listing 4: programs/open_creator_protocol/src/action_ctx.rs (Lines 207,208)

```
198     MintStateCtx {
199         version: mint_state.version,
200         policy: mint_state.policy.to_string(),
201         locked_by: mint_state.locked_by.map(|x| x.to_string()),
202         last_approved_at: mint_state.last_approved_at,
203         last_transferred_at: mint_state.last_transferred_at,
204         transferred_count: mint_state.transferred_count,
205
206         derived_cooldown: min(
207             max(0, now - mint_state.last_approved_at),
208             max(0, now - mint_state.last_transferred_at),
209         ),
210         derived_datetime: now.into(),
211     }
212 }
```

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

Consider using `checked_sub` or `saturating_sub` arithmetic operations instead of regular arithmetic operators to handle overflows gracefully.

3.4 (HAL-04) LACK OF TEST COVERAGE - INFORMATIONAL

Description:

Checking the code by automated testing (unit testing or functional testing) is a good practice to ensure that all lines of the code work correctly. It was observed that only a few tests for initializing and updating a policy were defined, but no tests for the NFT proxy instructions set were present.

Code Location:

- tests/

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

It is recommended to implement as many test cases as possible to cover all scenarios in the program flow.

3.5 (HAL-05) POSSIBLE RUST PANICS DUE TO UNSAFE UNWRAP USAGE - INFORMATIONAL

Description:

The use of helper methods in Rust, such as unwrap, is allowed in dev and testing environment because those methods are supposed to throw an error (also known as panic!) when called on Option::None or a Result which is not Ok. However, keeping unwrap functions in production environment is considered bad practice because they may lead to program crashes, which are usually accompanied by insufficient or misleading error messages.

Code Location:

Listing 5: programs/open_creator_protocol/src/state.rs (Lines 26,30)

```
21 impl MintState {
22     pub const LEN: usize = 200;
23     pub const SEED: &'static str = "mint_state";
24
25     pub fn record_transfer(&mut self) {
26         self.last_transferred_at = Clock::get().unwrap().
↳ unix_timestamp;
27         self.transferred_count = self.transferred_count.
↳ checked_add(1).unwrap_or(u32::MAX);
28     }
29     pub fn record_approve(&mut self) {
30         self.last_approved_at = Clock::get().unwrap().
↳ unix_timestamp;
31     }
32 }
```

Listing 6: programs/open_creator_protocol/src/state.rs (Line 55)

```
50 pub fn valid(&self) -> Result<()> {
51     if self.json_rule.len() > Policy::JSON_RULE_MAX_LEN {
52         return Err(OCPErrorCode::InvalidPolicyCreation.into());
```

```
53      }
54      // make sure the rule is valid
55      serde_json::from_str::<Rule>(&self.json_rule).unwrap();
56      Ok(())
57  }
```

Listing 7: programs/open_creator_protocol/src/state.rs (Lines 68,69)

```
63  pub fn matches(&self, ctx: &ActionCtx) -> Result<()> {
64      if self.json_rule.is_empty() {
65          return Ok(());
66      }
67
68      let rule: Rule = serde_json::from_str::<Rule>(&self.json_rule)
↳ .unwrap();
69      let fact: &Value = &serde_json::to_value::<&ActionCtx>(ctx).
↳ unwrap();
70      let result = rule.check_value(fact);
71      if result.condition_result.status != Status::Met {
72          msg!("Policy does not match: {}", result.condition_result.
↳ name);
73          msg!("fact: {}", fact);
74          msg!("json_rule: {}", self.json_rule);
75          return Err(OCPErrorCode::InvalidPolicyEvaluation.into());
76      }
77      Ok(())
78  }
```

Listing 8: programs/open_creator_protocol/src/instructions/nft_proxy/wrap.rs (Line 78)

```
72  pub fn handler<'info>(ctx: Context<'_, '_, '_, 'info, WrapCtx<'
↳ info>>) -> Result<()> {
73      let action_ctx: ActionCtx = ctx.accounts.into();
74      let policy = &ctx.accounts.policy;
75      ctx.accounts.policy.matches(&action_ctx)?;
76
77      let mint_state = &mut ctx.accounts.mint_state;
78      mint_state.bump = [*ctx.bumps.get("mint_state").unwrap()];
79      mint_state.policy = policy.key();
80      mint_state.mint = ctx.accounts.mint.key();
81      mint_state.version = 0;
```

Listing 9: programs/open_creator_protocol/src/instructions/policy/init_policy.rs (Line 29)

```
26 pub fn handler(ctx: Context<InitPolicyCtx>, arg: InitPolicyArg) ->
↳  Result<()> {
27     let policy = &mut ctx.accounts.policy;
28     policy.version = 0;
29     policy.bump = [*ctx.bumps.get("policy").unwrap()];
30     policy.uuid = arg.uuid;
31     policy.authority = ctx.accounts.authority.key();
32     policy.json_rule = arg.json_rule;
33     policy.valid()
34 }
35
```

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

It is recommended not to use the unwrap function in the production environment because its use causes panic! and may crash any affected module, program or in the worst case the runtime without verbose error messages. Crashing the system will result in a loss of availability and, in some cases, even private information stored in the state. Some alternatives are possible, such as propagating the error with ? instead of unwrapping, or using the error-chain crate for errors.

3.6 (HAL-06) MISSING CARGO OVERFLOW CHECKS - INFORMATIONAL

Description:

It was observed that there is no overflow-checks=true in Cargo.toml. By default, overflow checks are disabled in optimized release builds. Hence, if there is an overflow on release builds, it will be silenced, leading to unexpected behavior of an application. Even if checked arithmetic is used through checked_*, it is recommended to have that check in Cargo.toml.

Code Location:

- programs/open_creator_protocol/Cargo.toml

Risk Level:

Likelihood - 1
Impact - 1

Recommendation:

It is recommended to add overflow-checks=true under your release profile in Cargo.toml.

MANUAL TESTING

In the manual testing phase, the following scenarios were simulated. The scenarios listed below were selected based on the severity of the vulnerabilities Halborn was testing the program for.

4.1 POLICY BYPASS

Description:

In the open_creator_protocol, the policy accounts are used to enforce specific rules when an action is performed. This is a key feature of the OCP; thus, multiple tests were performed to ensure the following:

- Only the authority or the MANAGED_AUTHORITY can update the policy.
- The policy is validated correctly.
- Policies are enforced, and it is not possible to perform any unintended action, such as transfer a token if a policy denies it.
- The policy validation process of an action can't be bypassed.

Results:

Some observations about the policy validation are documented as HAL-02 in the previous section of the report.

```
[2022-12-07T16:36:53.480700011Z INFO  solana_runtime::bank] accounts hash slot: 0 stats: BankHashStats { num_updated_accounts: 154, num_removed_accounts: 0, num_lamports_stored: 400000541436259S, total_data_len: 761744, num_executable_accounts
: 31 }
[2022-12-07T16:36:53.481040481Z DEBUG solana_runtime::accounts_db] no recycle stores max: 0 min: 18446744073709551615 len: 0 looking: 20744, 18446744073709551615 avail: 0
[2022-12-07T16:36:53.481217271Z DEBUG solana_runtime::accounts_db] creating store: 3 slot: 1 len: 0 size: 4194304 from: store path: "/tmp/.tmppLVvYy/1.3"
[2022-12-07T16:36:53.481773691Z DEBUG solana_runtime::bank::executor_cache] Executor Cache Stats -- Hits: 0, Misses: 0, Evictions: 0, Insertions: 0, Replacements: 0, One-Hit-Wonders: 0
[2022-12-07T16:36:53.484723911Z DEBUG solana_runtime::bank] processing transactions: 1
[2022-12-07T16:36:53.485169161Z DEBUG solana_runtime::message_processor::stable_log] Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E invoke [1]
[2022-12-07T16:36:53.485244371Z DEBUG solana_runtime::message_processor::stable_log] Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E invoke [1]
[2022-12-07T16:36:53.485571291Z DEBUG solana_runtime::message_processor::stable_log] Program log: Instruction: UpdatePolicy
[2022-12-07T16:36:53.485593291Z DEBUG solana_runtime::message_processor::stable_log] Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E success
[2022-12-07T16:36:53.486667111Z DEBUG solana_runtime::message_processor::stable_log] Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E success
[2022-12-07T16:36:53.485821731Z DEBUG solana_runtime::bank] check: 58us load: 143us execute: 757us txs_len=1
[2022-12-07T16:36:53.486451931Z DEBUG solana_runtime::bank] store: 562us txs_len=1
[2022-12-07T16:36:53.486606271Z DEBUG solana_runtime::accounts] bank unlock accounts
    Doc-tests open_creator_protocol
cargo-test-sbf child: /home/ubuntu/.local/share/solana/install/active_release/bin/cargo-build-sbf --manifest-path /home/ubuntu/open_creator_protocol/programs/open_creator_protocol/Cargo.toml --sbf-out-dir /home/ubuntu/open_creator_protocol/tar
get/deploy --arch bpf
cargo-test-sbf child: /home/ubuntu/.rustup/toolchains/nightly-x86_64-unknown-linux-gnu/bin/cargo test --manifest-path /home/ubuntu/open_creator_protocol/programs/open_creator_protocol/Cargo.toml --features test-bpf -- --nocapture --test update
_policy_bypass

running 0 tests

test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 8 filtered out; finished in 0.00s


running 1 test
Payer pubkey: 2yVMsfW358pUzHGHvGHGBMdC3NbR7tebE6rYHVUaHEYb
Authority pubkey: 9hmEonoaLv34ghGdjmCDDBLa3FeVmNTWq3cCikkkMkRq
UUID: 4uQeVj5tqViQh7yWWGStvkEG1Zmhx6uasJtWCJziofM
PDA 8ZH2AbsybBqBN8zcXyQQcEBx19cfKjj35BHdANjre7ri
JSON RULE: {"conditions":{"and":[{"field":"action","operator":"string_not_equals","value":""}]},"events":[]}
Policy {
    version: 0,
    bump: [
        252,
    ],
    uuid: 4uQeVj5tqViQh7yWWGStvkEG1Zmhx6uasJtWCJziofM,
    authority: 9hmEonoaLv34ghGdjmCDDBLa3FeVmNTWq3cCikkkMkRq,
    json_rule: "{\"conditions\":{\"and\":[{\"field\":\"action\",\"operator\":\"string_not_equals\",\"value\":\"\"}]},\"events\":[]}",
}
test update_policy_bypass ... ok

test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 5 filtered out; finished in 0.12s


running 0 tests

test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s
```

4.2 TOKEN LOCKED DUE TO UNEXPECTED BEHAVIOR

Description:

Multiple edge cases were simulated to exclude all chances of users or the protocol being locked out of their funds due to unexpected program behavior.

Results:

No code vulnerabilities were identified.

```
Program ComputeBudget111111111111111111111111111111 invoke [1]
Program ComputeBudget111111111111111111111111111111 success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E invoke [1]
Program log: Instruction: Unlock
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E consumed 210102 of 1400000 compute units
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E invoke [1]
Program log: Instruction: InitAccount
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV invoke [2]
Program log: ManagedTokenInstruction::InitializeAccount
Program ATokenGPvbdGVxr1b2hvZbsiqW5xWH25efTNsLJA8knL invoke [3]
Program log: Create
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [4]
Program log: Instruction: GetAccountDataSize
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 1622 of 947228 compute units
Program return: TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA pQAAAAAAAAA=
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program 11111111111111111111111111111111 invoke [4]
Program 11111111111111111111111111111111 success
Program log: Initialize the associated token account
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [4]
Program log: Instruction: InitializeImmutableOwner
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 1405 of 940738 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [4]
Program log: Instruction: InitializeAccount3
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 4241 of 936854 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program ATokenGPvbdGVxr1b2hvZbsiqW5xWH25efTNsLJA8knL consumed 20394 of 952703 compute units
Program ATokenGPvbdGVxr1b2hvZbsiqW5xWH25efTNsLJA8knL success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [3]
Program log: Instruction: FreezeAccount
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 4265 of 924343 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV consumed 40811 of 960305 compute units
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E consumed 272140 of 1189898 compute units
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E invoke [1]
Program log: Instruction: Transfer
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV invoke [2]
Program log: ManagedTokenInstruction::Transfer
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [3]
```

4.3 INTENDED FLOW BYPASS

Description:

The open_creator_protocol program provides several instructions allowing specific operations. Multiple test cases were simulated to ensure that the intended work-flow cannot be bypassed nor altered in an unexpected way. The following were tested:

- The ownership chain is enforced in all instructions.
- Only authorized accounts can perform specific operations on specific accounts.
- Signature requirements are in place.
- Unchecked Accounts are validated by Community Managed Token program via CPI.

Results:

No code vulnerabilities were identified.

```
Program log: Instruction: Wrap
Program 11111111111111111111111111111111 invoke [2]
Program 11111111111111111111111111111111 success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [2]
Program log: Instruction: SetAuthority
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 3167 of 1131024 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [2]
Program log: Instruction: SetAuthority
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 3007 of 1123758 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E consumed 246453 of 1365570 compute units
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E invoke [1]
Program log: Instruction: InitAccount
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV invoke [2]
Program log: ManagedTokenInstruction::InitializeAccount
Program ATokenGPvbdGVxr1b2hvZbsiqW5xWH25efTNsLJA8knL invoke [3]
Program log: Create
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [4]
Program log: Instruction: GetAccountDataSize
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 1622 of 821979 compute units
Program return: TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA pQAAAAAAAAA=
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program 11111111111111111111111111111111 invoke [4]
Program 11111111111111111111111111111111 success
Program log: Initialize the associated token account
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [4]
Program log: Instruction: InitializeImmutableOwner
Program log: Please upgrade to SPL Token 2022 for immutable owner support
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 1405 of 815489 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [4]
Program log: Instruction: InitializeAccount3
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 4241 of 811607 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program ATokenGPvbdGVxr1b2hvZbsiqW5xWH25efTNsLJA8knL consumed 20293 of 827376 compute units
Program ATokenGPvbdGVxr1b2hvZbsiqW5xWH25efTNsLJA8knL success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [3]
Program log: Instruction: FreezeAccount
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 4265 of 802117 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV consumed 37574 of 834863 compute units
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E consumed 323576 of 1119117 compute units
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E invoke [1]
Program log: Instruction: MintTo
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV invoke [2]
Program log: ManagedTokenInstruction::MintTo
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [3]
Program log: Instruction: ThawAccount
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 4267 of 507219 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [3]
Program log: Instruction: MintTo
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 4538 of 500126 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA invoke [3]
Program log: Instruction: FreezeAccount
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA consumed 4265 of 492750 compute units
Program TokenkegQfeZyiNwAJbNbGKPFXCWuBvf9Ss623VQ5DA success
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV consumed 25272 of 513307 compute units
Program CMTQqjzH6Anr9XcPVt73EFDTjWkJWPzH7H6DtvhHcyzV success
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E consumed 309521 of 795541 compute units
Program ocp4vWUzA2z2XMYJ3QhM9vWdyoyoQwAFJhRdVTbvo9E success
```

AUTOMATED TESTING

5.1 AUTOMATED VULNERABILITY SCANNING

Description:

Halborn used automated security scanners to assist with the detection of well-known security issues, and to identify low-hanging fruits on the targets for this engagement. Among the tools used was Soteria, a security analysis service for Solana programs. Soteria performed a scan on all the programs in scope and sent the compiled results to analyzers to locate well-known vulnerabilities.

Results:

Soteria reported two issues related to unsafe math, which are already covered in HAL-03.

```
============This arithmetic operation may be UNSAFE!===============
Found a potential vulnerability at line 225, column 24 in programs/mtoken/src/state.rs
The div operation may result in overflows:

 219|            policy: mint_state.policy.to_string(),
 220|            locked_by: mint_state.locked_by.map(|x| x.to_string()),
 221|            last_approved_at: mint_state.last_approved_at,
 222|            last_transfered_at: mint_state.last_transfered_at,
 223|
 224|            derived_cooldown: min(
>225|                max(0, now - mint_state.last_approved_at),
 226|                max(0, now - mint_state.last_transfered_at),
 227|            ),
 228|            derived_now: now,
 229|        }
 230|    }
 231|}
>>>Stack Trace:
>>>mtoken::try_entry::h5af7617a3e70f656 [programs/mtoken/src/lib.rs:12]
>>>  mtoken::dispatch::ha512042334ac47be [programs/mtoken/src/lib.rs:12]
>>>    mtoken::__private::__global::mint_to::h445f23106e6663e8 [programs/mtoken/src/lib.rs:12]
>>>      mtoken::mtoken::mint_to::h46d63d2970e3d45e [programs/mtoken/src/lib.rs:12]
>>>        mtoken::instructions::nft_proxy::mint_to::handler::he9e13487f345a64b [programs/mtoken/src/lib.rs:63]
>>>          _$LT$T$u20$as$u20$core..convert..Into$LT$U$GT$$GT$::into::hc2c016b825b15586 [programs/mtoken/src/instructions/nft_proxy/mint_to.rs:68]
>>>            mtoken::instructions::nft_proxy::mint_to::_$LT$impl$u20$core..convert..From$LT$$RF$mut$u20$mtoken..instructions..nft_proxy..mint_to..MintToCtx$GT$$u20
$for$u20$mtoken..state..ActionCtx$GT$::from::hba2552f687bbcdb4 [/home/runner/work/bpf-tools/bpf-tools/out/rust/library/core/src/convert/mod.rs:550]
>>>              _$LT$T$u20$as$u20$core..convert..Into$LT$U$GT$$GT$::into::h78ef5c645c5de900 [programs/mtoken/src/instructions/nft_proxy/mint_to.rs:62]
>>>                _$LT$mtoken..state..MintStateCtx$u20$as$u20$core..convert..From$LT$mtoken..state..MintState$GT$$GT$::from::h19519253eb978a07 [/home/runner/work/bp
f-tools/bpf-tools/out/rust/library/core/src/convert/mod.rs:550]
============This arithmetic operation may be UNSAFE!===============
Found a potential vulnerability at line 226, column 24 in programs/mtoken/src/state.rs
The div operation may result in overflows:

 220|            locked_by: mint_state.locked_by.map(|x| x.to_string()),
 221|            last_approved_at: mint_state.last_approved_at,
 222|            last_transfered_at: mint_state.last_transfered_at,
 223|
 224|            derived_cooldown: min(
 225|                max(0, now - mint_state.last_approved_at),
>226|                max(0, now - mint_state.last_transfered_at),
 227|            ),
 228|            derived_now: now,
 229|        }
 230|    }
 231|}
 232|
>>>Stack Trace:
>>>mtoken::try_entry::h5af7617a3e70f656 [programs/mtoken/src/lib.rs:12]
>>>  mtoken::dispatch::ha512042334ac47be [programs/mtoken/src/lib.rs:12]
>>>    mtoken::__private::__global::mint_to::h445f23106e6663e8 [programs/mtoken/src/lib.rs:12]
>>>      mtoken::mtoken::mint_to::h46d63d2970e3d45e [programs/mtoken/src/lib.rs:12]
>>>        mtoken::instructions::nft_proxy::mint_to::handler::he9e13487f345a64b [programs/mtoken/src/lib.rs:63]
>>>          _$LT$T$u20$as$u20$core..convert..Into$LT$U$GT$$GT$::into::hc2c016b825b15586 [programs/mtoken/src/instructions/nft_proxy/mint_to.rs:68]
>>>            mtoken::instructions::nft_proxy::mint_to::_$LT$impl$u20$core..convert..From$LT$$RF$mut$u20$mtoken..instructions..nft_proxy..mint_to..MintToCtx$GT$$u20
$for$u20$mtoken..state..ActionCtx$GT$::from::hba2552f687bbcdb4 [/home/runner/work/bpf-tools/bpf-tools/out/rust/library/core/src/convert/mod.rs:550]
>>>              _$LT$T$u20$as$u20$core..convert..Into$LT$U$GT$$GT$::into::h78ef5c645c5de900 [programs/mtoken/src/instructions/nft_proxy/mint_to.rs:62]
>>>                _$LT$mtoken..state..MintStateCtx$u20$as$u20$core..convert..From$LT$mtoken..state..MintState$GT$$GT$::from::h19519253eb978a07 [/home/runner/work/bp
f-tools/bpf-tools/out/rust/library/core/src/convert/mod.rs:550]

 - ✔ [00m:03s] Building Static Happens-Before Graph
 - ✔ [00m:00s] Detecting Vulnerabilities
detected 0 untrustful accounts in total.
detected 2 unsafe math operations in total.

--------The summary of potential vulnerabilities in all.ll--------

        2 unsafe arithmetic issues
```

5.2 AUTOMATED ANALYSIS

Description:

Halborn used automated security scanners to assist with the detection of well-known security issues and vulnerabilities. Among the tools used was cargo-audit, a security scanner for vulnerabilities reported to the RustSec Advisory Database. All vulnerabilities published in https://crates.io are stored in a repository named The RustSec Advisory Database. cargo audit is a human-readable version of the advisory database which performs a scanning on Cargo.lock. Security Detections are only in scope. All vulnerabilities shown here were already disclosed in the above report. However, to better assist the developers maintaining this code, the auditors are including the output with the dependencies tree, and this is included in the cargo audit output to better know the dependencies affected by unmaintained and vulnerable crates.

Results:

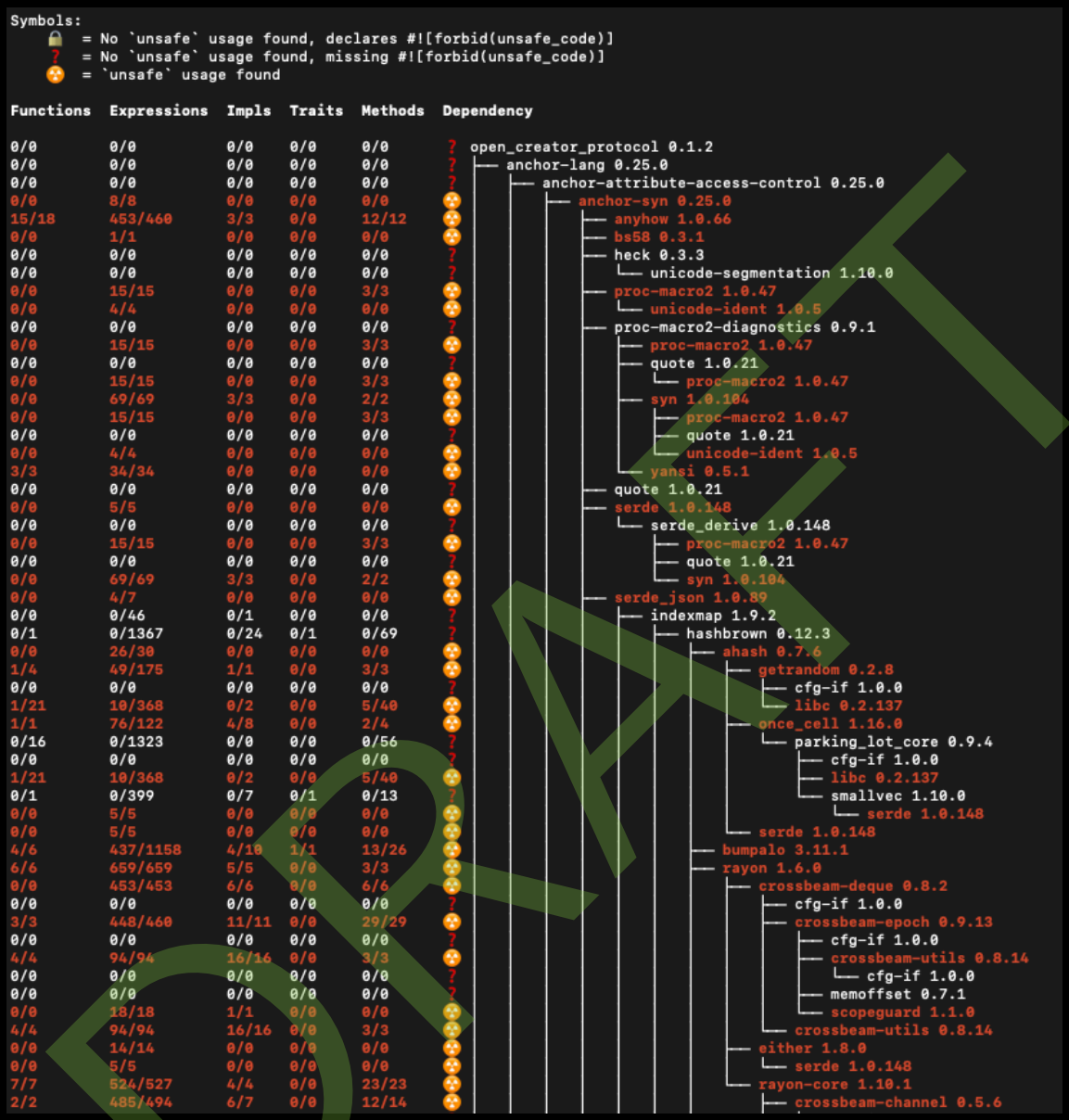
No vulnerabilities were identified.

5.3 UNSAFE RUST CODE DETECTION

Description:

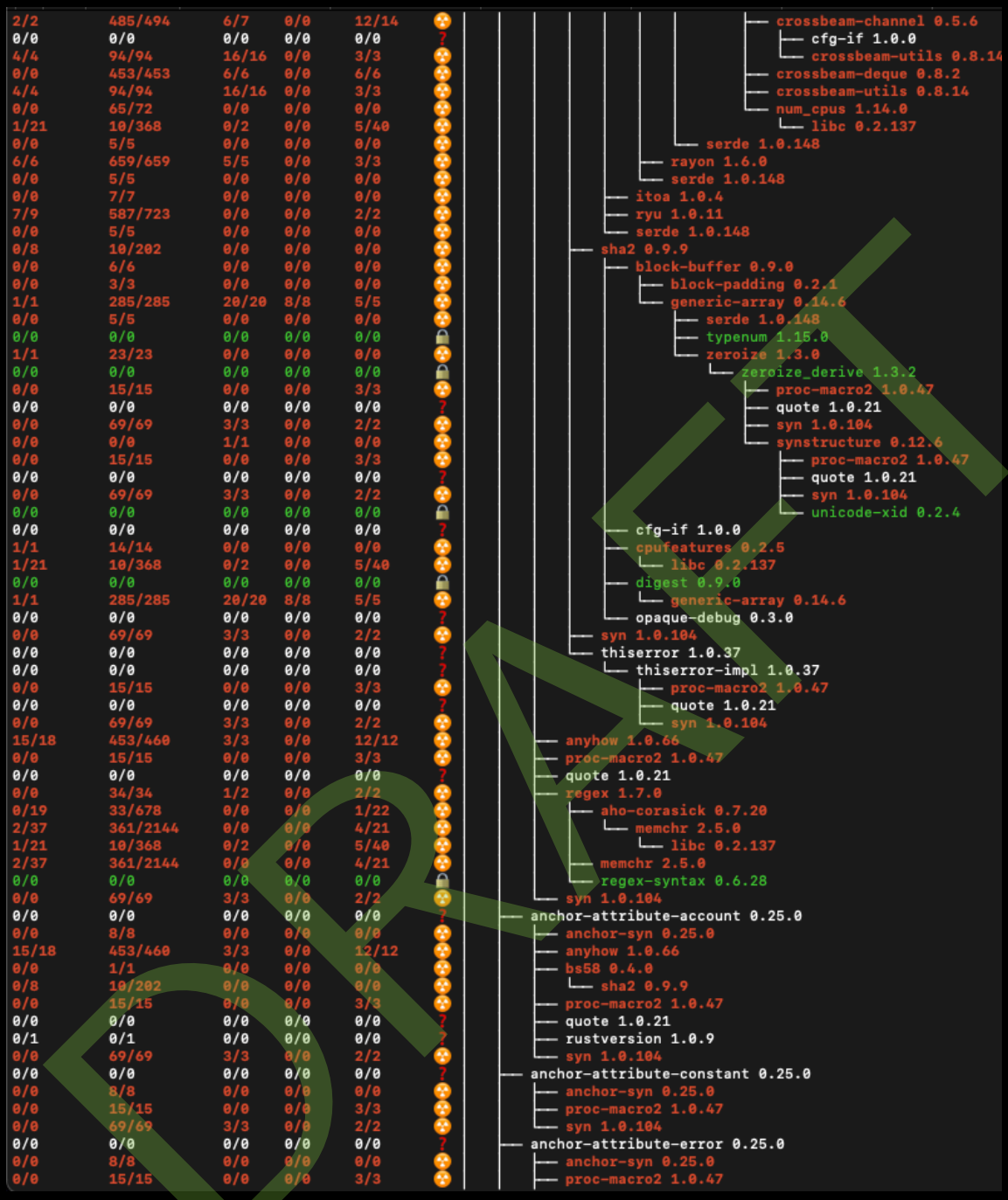
Halborn used automated security scanners to assist with the detection of well-known security issues and vulnerabilities. Among the tools used was cargo-geiger, a security tool that lists statistics related to the usage of unsafe Rust code in a core Rust codebase and all its dependencies.

Results:



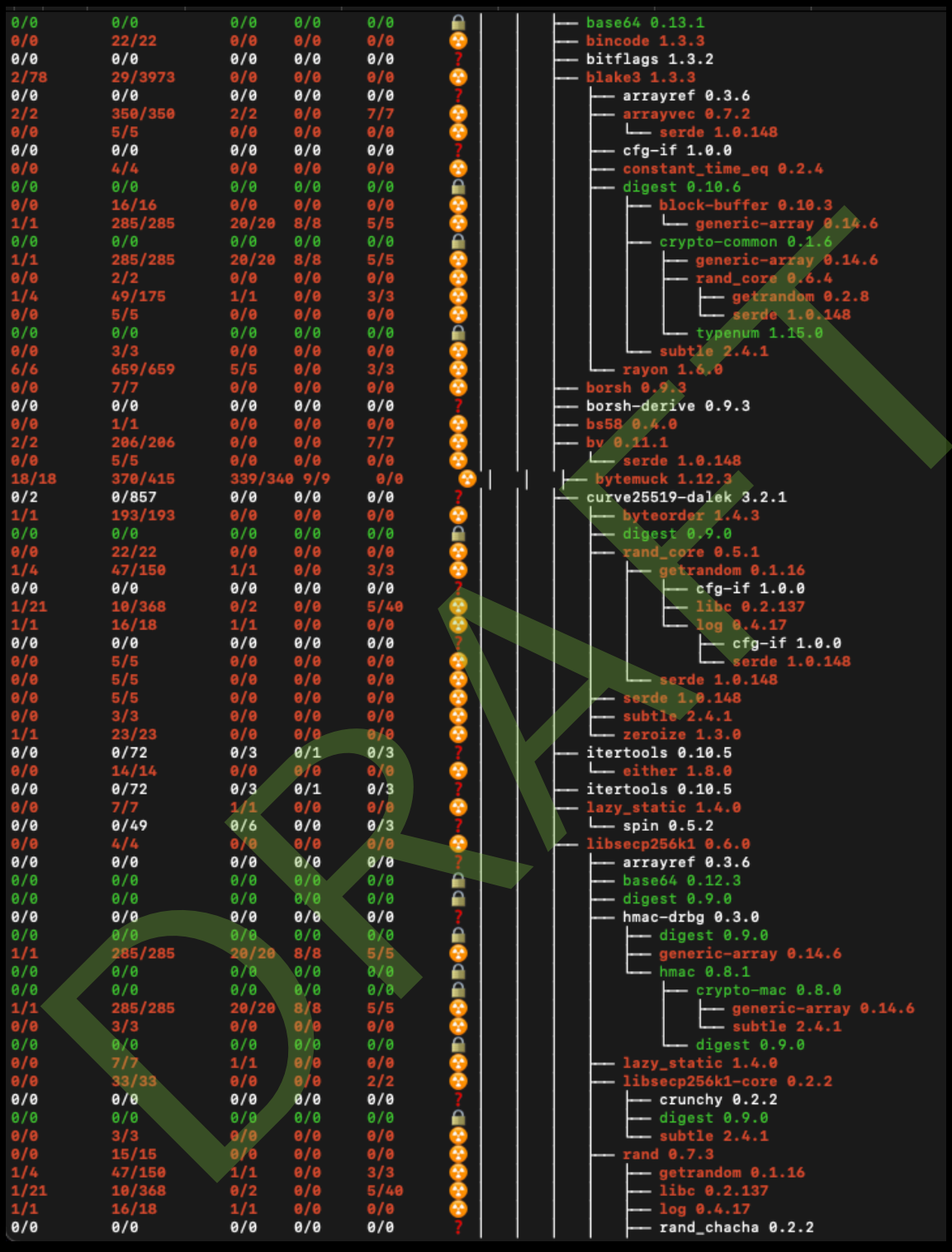
```
Symbols:
    🔒  = No `unsafe` usage found, declares #![forbid(unsafe_code)]
    ❓  = No `unsafe` usage found, missing #![forbid(unsafe_code)]
    ☢️  = `unsafe` usage found

Functions  Expressions  Impls  Traits  Methods  Dependency

0/0        0/0          0/0    0/0     0/0      ❓ open_creator_protocol 0.1.2
0/0        0/0          0/0    0/0     0/0      ❓ ├── anchor-lang 0.25.0
0/0        0/0          0/0    0/0     0/0      ❓ │   ├── anchor-attribute-access-control 0.25.0
0/0        8/8          0/0    0/0     0/0      ☢️ │   │   ├── anchor-syn 0.25.0
15/18      453/460      3/3    0/0     12/12    ☢️ │   │   │   ├── anyhow 1.0.66
0/0        1/1          0/0    0/0     0/0      ☢️ │   │   │   ├── bs58 0.3.1
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   ├── heck 0.3.3
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   └── unicode-segmentation 1.10.0
0/0        15/15        0/0    0/0     3/3      ☢️ │   │   │   ├── proc-macro2 1.0.47
0/0        4/4          0/0    0/0     0/0      ☢️ │   │   │   │   └── unicode-ident 1.0.5
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   ├── proc-macro2-diagnostics 0.9.1
0/0        15/15        0/0    0/0     3/3      ☢️ │   │   │   │   ├── proc-macro2 1.0.47
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   ├── quote 1.0.21
0/0        15/15        0/0    0/0     3/3      ☢️ │   │   │   │   │   └── proc-macro2 1.0.47
0/0        69/69        3/3    0/0     2/2      ☢️ │   │   │   │   ├── syn 1.0.104
0/0        15/15        0/0    0/0     3/3      ☢️ │   │   │   │   │   ├── proc-macro2 1.0.47
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   │   ├── quote 1.0.21
0/0        4/4          0/0    0/0     0/0      ☢️ │   │   │   │   │   └── unicode-ident 1.0.5
3/3        34/34        0/0    0/0     0/0      ☢️ │   │   │   │   └── yansi 0.5.1
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   ├── quote 1.0.21
0/0        5/5          0/0    0/0     0/0      ☢️ │   │   │   ├── serde 1.0.148
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   └── serde_derive 1.0.148
0/0        15/15        0/0    0/0     3/3      ☢️ │   │   │   │       ├── proc-macro2 1.0.47
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │       ├── quote 1.0.21
0/0        69/69        3/3    0/0     2/2      ☢️ │   │   │   │       └── syn 1.0.104
0/0        4/7          0/0    0/0     0/0      ☢️ │   │   │   ├── serde_json 1.0.89
0/0        0/46         0/1    0/0     0/0      ❓ │   │   │   │   ├── indexmap 1.9.2
0/1        0/1367       0/24   0/1     0/69     ❓ │   │   │   │   │   ├── hashbrown 0.12.3
0/0        26/30        0/0    0/0     0/0      ☢️ │   │   │   │   │   │   ├── ahash 0.7.6
1/4        49/175       1/1    0/0     3/3      ☢️ │   │   │   │   │   │   │   ├── getrandom 0.2.8
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   │   │   │   │   ├── cfg-if 1.0.0
1/21       10/368       0/2    0/0     5/40     ☢️ │   │   │   │   │   │   │   │   └── libc 0.2.137
1/1        76/122       4/8    0/0     2/4      ☢️ │   │   │   │   │   │   │   └── once_cell 1.16.0
0/16       0/1323       0/0    0/0     0/56     ❓ │   │   │   │   │   │   │       └── parking_lot_core 0.9.4
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   │   │   │           ├── cfg-if 1.0.0
1/21       10/368       0/2    0/0     5/40     ☢️ │   │   │   │   │   │   │           ├── libc 0.2.137
0/1        0/399        0/7    0/1     0/13     ❓ │   │   │   │   │   │   │           └── smallvec 1.10.0
0/0        5/5          0/0    0/0     0/0      ☢️ │   │   │   │   │   │   │               └── serde 1.0.148
0/0        5/5          0/0    0/0     0/0      ☢️ │   │   │   │   │   │   └── serde 1.0.148
4/6        437/1158     4/10   1/1     13/26    ☢️ │   │   │   │   │   ├── bumpalo 3.11.1
6/6        659/659      5/5    0/0     3/3      ☢️ │   │   │   │   │   ├── rayon 1.6.0
0/0        453/453      6/6    0/0     6/6      ☢️ │   │   │   │   │   │   ├── crossbeam-deque 0.8.2
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   │   │   │   ├── cfg-if 1.0.0
3/3        448/460      11/11  0/0     29/29    ☢️ │   │   │   │   │   │   │   ├── crossbeam-epoch 0.9.13
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   │   │   │   │   ├── cfg-if 1.0.0
4/4        94/94        16/16  0/0     3/3      ☢️ │   │   │   │   │   │   │   │   ├── crossbeam-utils 0.8.14
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   │   │   │   │   │   └── cfg-if 1.0.0
0/0        0/0          0/0    0/0     0/0      ❓ │   │   │   │   │   │   │   │   ├── memoffset 0.7.1
0/0        18/18        1/1    0/0     0/0      ☢️ │   │   │   │   │   │   │   │   └── scopeguard 1.1.0
4/4        94/94        16/16  0/0     3/3      ☢️ │   │   │   │   │   │   │   └── crossbeam-utils 0.8.14
0/0        14/14        0/0    0/0     0/0      ☢️ │   │   │   │   │   │   ├── either 1.8.0
0/0        5/5          0/0    0/0     0/0      ☢️ │   │   │   │   │   │   │   └── serde 1.0.148
7/7        524/527      4/4    0/0     23/23    ☢️ │   │   │   │   │   │   └── rayon-core 1.10.1
2/2        485/494      6/7    0/0     12/14    ☢️ │   │   │   │   │   │       ├── crossbeam-channel 0.5.6
```

AUTOMATED TESTING

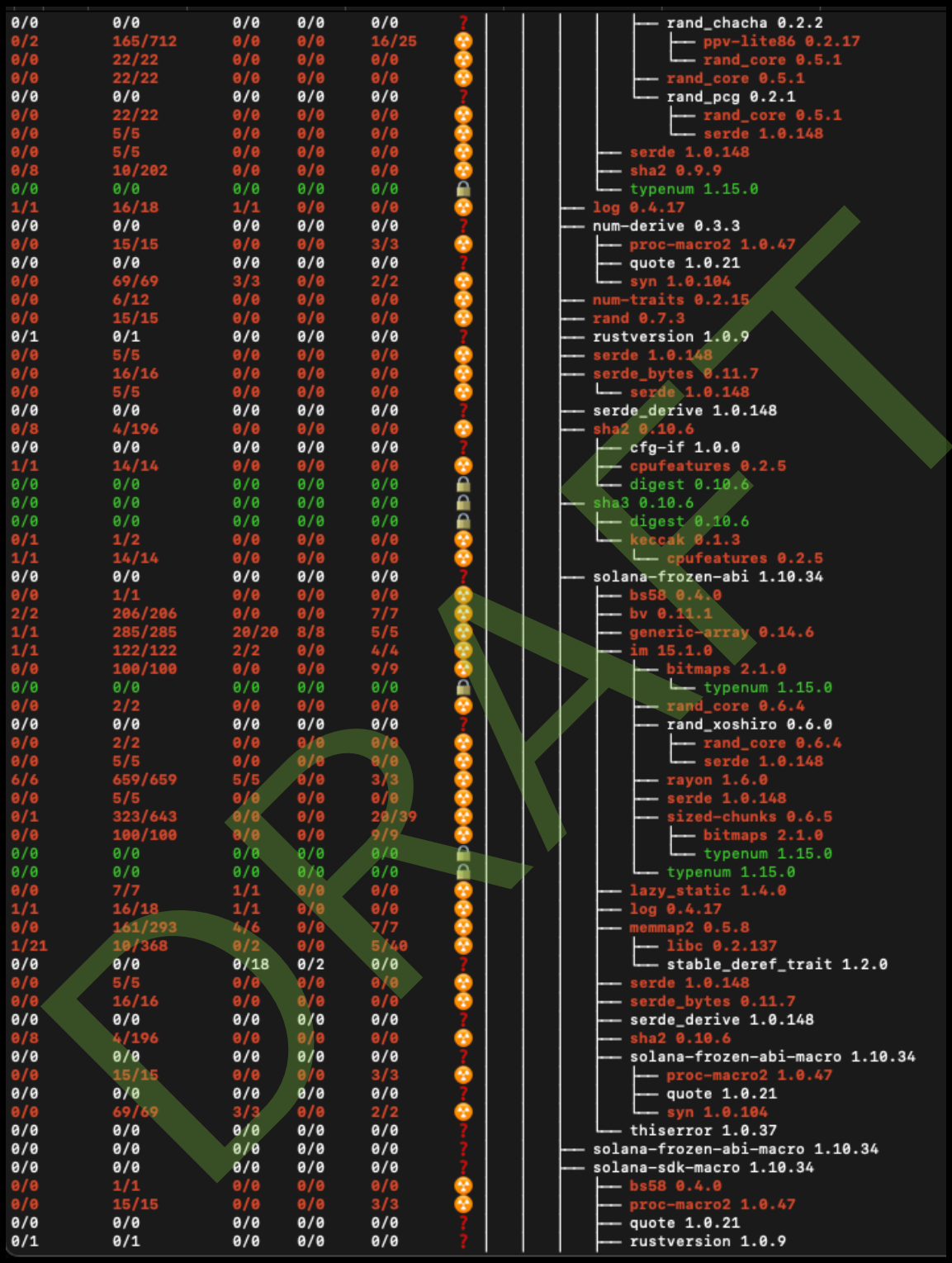


```
0/0    8/8        0/0     0/0  0/0    ☢  │   │   ├── anchor-syn 0.25.0
0/0    15/15      0/0     0/0  3/3    ☢  │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   ├── anchor-attribute-event 0.25.0
0/0    8/8        0/0     0/0  0/0    ☢  │   │   ├── anchor-syn 0.25.0
15/18  453/460    3/3     0/0  12/12  ☢  │   │   ├── anyhow 1.0.66
0/0    15/15      0/0     0/0  3/3    ☢  │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   ├── anchor-attribute-interface 0.25.0
0/0    8/8        0/0     0/0  0/0    ☢  │   │   ├── anchor-syn 0.25.0
15/18  453/460    3/3     0/0  12/12  ☢  │   │   ├── anyhow 1.0.66
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── heck 0.3.3
0/0    15/15      0/0     0/0  3/3    ☢  │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   ├── anchor-attribute-program 0.25.0
0/0    8/8        0/0     0/0  0/0    ☢  │   │   ├── anchor-syn 0.25.0
15/18  453/460    3/3     0/0  12/12  ☢  │   │   ├── anyhow 1.0.66
0/0    15/15      0/0     0/0  3/3    ☢  │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   ├── anchor-attribute-state 0.25.0
0/0    8/8        0/0     0/0  0/0    ☢  │   │   ├── anchor-syn 0.25.0
15/18  453/460    3/3     0/0  12/12  ☢  │   │   ├── anyhow 1.0.66
0/0    15/15      0/0     0/0  3/3    ☢  │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   ├── anchor-derive-accounts 0.25.0
0/0    8/8        0/0     0/0  0/0    ☢  │   │   ├── anchor-syn 0.25.0
15/18  453/460    3/3     0/0  12/12  ☢  │   │   ├── anyhow 1.0.66
0/0    15/15      0/0     0/0  3/3    ☢  │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   ├── arrayref 0.3.6
0/0    0/0        0/0     0/0  0/0    🔒 │   ├── base64 0.13.1
0/0    22/22      0/0     0/0  0/0    ☢  │   ├── bincode 1.3.3
0/0    5/5        0/0     0/0  0/0    ☢  │   │   └── serde 1.0.148
0/0    7/7        0/0     0/0  0/0    ☢  │   ├── borsh 0.9.3
0/0    0/0        0/0     0/0  0/0    ?  │   │   ├── borsh-derive 0.9.3
0/0    0/0        0/0     0/0  0/0    ?  │   │   │   ├── borsh-derive-internal 0.9.3
0/0    15/15      0/0     0/0  3/3    ☢  │   │   │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   │   │   ├── borsh-schema-derive-internal 0.9.3
0/0    15/15      0/0     0/0  3/3    ☢  │   │   │   │   ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │   │   │   ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │   │   │   └── syn 1.0.104
0/0    0/0        0/0     0/0  0/0    ?  │   │   │   ├── proc-macro-crate 0.1.5
0/0    0/0        0/0     0/0  0/0    🔒 │   │   │   │   └── toml 0.5.9
0/0    0/46       0/1     0/0  0/0    ?  │   │   │   │       ├── indexmap 1.9.2
0/0    5/5        0/0     0/0  0/0    ☢  │   │   │   │       └── serde 1.0.148
0/0    15/15      0/0     0/0  3/3    ☢  │   │   │   ├── proc-macro2 1.0.47
0/0    69/69      3/3     0/0  2/2    ☢  │   │   │   └── syn 1.0.104
2/2    1064/1198  19/22   1/1  51/58  ☢  │   │   └── hashbrown 0.11.2
0/0    26/30      0/0     0/0  0/0    ☢  │   │       ├── ahash 0.7.6
4/6    437/1158   4/10    1/1  13/26  ☢  │   │       ├── bumpalo 3.11.1
6/6    659/659    5/5     0/0  3/3    ☢  │   │       ├── rayon 1.6.0
0/0    5/5        0/0     0/0  0/0    ☢  │   │       └── serde 1.0.148
18/18  370/415    339/340 9/9  0/0    ☢  │   ├── bytemuck 1.12.3
0/0    0/0        0/0     0/0  0/0    ?  │   │   └── bytemuck_derive 1.3.0
0/0    15/15      0/0     0/0  3/3    ☢  │   │       ├── proc-macro2 1.0.47
0/0    0/0        0/0     0/0  0/0    ?  │   │       ├── quote 1.0.21
0/0    69/69      3/3     0/0  2/2    ☢  │   │       └── syn 1.0.104
3/3    426/426    1/1     0/0  3/3    ☢  │   ├── solana-program 1.10.34
0/0    0/0        0/0     0/0  0/0    🔒 │   │   ├── base64 0.13.1
```

AUTOMATED TESTING



AUTOMATED TESTING




0/0 0/0 0/0 0/0 0/0 ?
0/0 0/71 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0
1/21 10/368 0/2 0/0 5/40
0/0 0/79 0/0 0/0 0/0 ?
0/25 0/1834 0/102 0/1 0/69 ?
0/0 0/13 0/2 0/0 0/0 ?
0/0 0/36 0/0 0/0 0/0 ?
0/25 0/1834 0/102 0/1 0/69 ?
0/0 0/0 0/0 0/0 0/0 ?
0/0 5/5 0/0 0/0 0/0
1/1 16/18 1/1 0/0 0/0
0/0 0/2 0/0 0/0 0/0 ?
0/0 0/36 0/0 0/0 0/0 ?
1/1 76/122 4/8 0/0 2/4
0/0 0/3 0/0 0/0 0/0 ?
0/0 0/165 0/0 0/0 0/2 ?
0/0 0/5 0/0 0/0 0/0
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0
0/0 5/5 0/0 0/0 0/0
0/0 4/7 0/0 0/0 0/0
0/0 0/0 0/0 0/0 0/0
0/0 0/2 0/0 0/0 0/0 ?
0/0 0/3 0/0 0/0 0/0 ?
0/0 7/7 0/0 0/0 0/0
7/9 587/723 0/0 0/0 2/2
0/0 5/5 0/0 0/0 0/0
0/25 0/1834 0/102 0/1 0/69 ?
0/0 0/13 0/2 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/51 0/2 0/0 0/1 ?
0/0 0/0 0/0 0/0 0/0
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/2 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0
0/0 5/5 0/0 0/0 0/0
0/0 0/20 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0
0/0 5/5 0/0 0/0 0/0
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/3 0/0 0/0 0/0 ?
0/0 5/5 0/0 0/0 0/0
0/0 0/0 0/0 0/0 0/0 ?
0/0 5/5 0/0 0/0 0/0
0/0 4/7 0/0 0/0 0/0
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0 ?
0/0 15/15 0/0 0/0 3/3
0/0 0/0 0/0 0/0 0/0 ?
0/0 69/69 3/3 0/0 2/2
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0 ?
0/0 0/0 0/0 0/0 0/0 ?
0/0 5/5 0/0 0/0 0/0
0/0 4/7 0/0 0/0 0/0
3/3 426/426 1/1 0/0 3/3
0/0 0/0 0/0 0/0 0/0
0/0 0/0 0/0 0/0 0/0 ?
127/560 10023/38424 469/901 21/58 285/861
├── security-framework-sys 2.6.1
└── tempfile 3.3.0
├── cfg-if 1.0.0
├── fastrand 1.8.0
├── libc 0.2.137
└── remove_dir_all 0.5.3
├── tokio 1.14.1
└── tokio-native-tls 0.3.0
├── native-tls 0.2.11
└── tokio 1.14.1
├── ipnet 2.5.1
└── serde 1.0.148
├── log 0.4.17
├── mime 0.3.16
├── native-tls 0.2.11
├── once_cell 1.16.0
├── percent-encoding 2.2.0
├── pin-project-lite 0.2.9
├── rustls 0.20.7
├── rustls-native-certs 0.6.2
├── rustls-pemfile 1.0.1
├── serde 1.0.148
├── serde_json 1.0.89
├── serde_urlencoded 0.7.1
├── form_urlencoded 1.1.0
└── percent-encoding 2.2.0
├── itoa 1.0.4
├── ryu 1.0.11
└── serde 1.0.148
├── tokio 1.14.1
├── tokio-native-tls 0.3.0
├── tokio-rustls 0.23.4
├── tokio-util 0.7.2
├── tower-service 0.3.2
├── url 2.3.1
├── form_urlencoded 1.1.0
├── idna 0.3.0
├── unicode-bidi 0.3.8
└── serde 1.0.148
└── unicode-normalization 0.1.22
└── tinyvec 1.6.0
├── serde 1.0.148
└── tinyvec_macros 0.1.0
├── percent-encoding 2.2.0
└── serde 1.0.148
└── webpki-roots 0.22.5
├── serde 1.0.148
├── serde_json 1.0.89
├── strum 0.20.0
└── strum_macros 0.20.1
├── heck 0.3.3
├── proc-macro2 1.0.47
├── quote 1.0.21
└── syn 1.0.104
├── strum_macros 0.20.1
└── thiserror 1.0.37
├── mpl-token-metadata 1.6.1
├── serde 1.0.148
├── serde_json 1.0.89
├── solana-program 1.10.34
├── spl-associated-token-account 1.0.5
└── spl-token 3.3.1

THANK YOU FOR CHOOSING

// HALBORN