

$$P(x) = \sum_{i=0}^n y_i \cdot l_i(x), \quad l_i(x) = \prod_{j \neq i} \frac{x - x_j}{x_i - x_j}$$

$$X_k = \sum_{j=0}^{n-1} a_j \cdot \omega^{jk} \pmod{p}$$

$\omega$  is an  $n$ -th root of unity in  $F_p$



# Security Review Report

## NM-0679 - Celo-Hokulea Integration

---

November 25, 2025



NETHERMIND  
**SECURITY**

# Contents

<b>1</b>	<b>Executive Summary</b>	<b>2</b>
<b>2</b>	<b>Audited Files</b>	<b>3</b>
2.1	op-succinct PR 572	3
2.2	op-succinct diff	3
2.3	Celo-kona	4
<b>3</b>	<b>Summary of Issues</b>	<b>4</b>
<b>4</b>	<b>System Overview</b>	<b>5</b>
4.1	PR 572	5
4.2	op-succinct diff	5
4.3	Celo-kona	5
<b>5</b>	<b>Risk Rating Methodology</b>	<b>6</b>
<b>6</b>	<b>Issues</b>	<b>7</b>
6.1	[Low] Insecure crate used	7
6.2	[INFO] Duplicate code leading to redundant cycles	7
6.3	[Best Practice] Gas behavior differs if precompile is used outside GoldToken	7
6.4	[Best Practice] Missing STATICCALL guard allows state-changing precompile to be invoked in static context	8
<b>7</b>	<b>Documentation Evaluation</b>	<b>9</b>
<b>8</b>	<b>Test Suite Evaluation</b>	<b>10</b>
<b>9</b>	<b>About Nethermind</b>	<b>11</b>

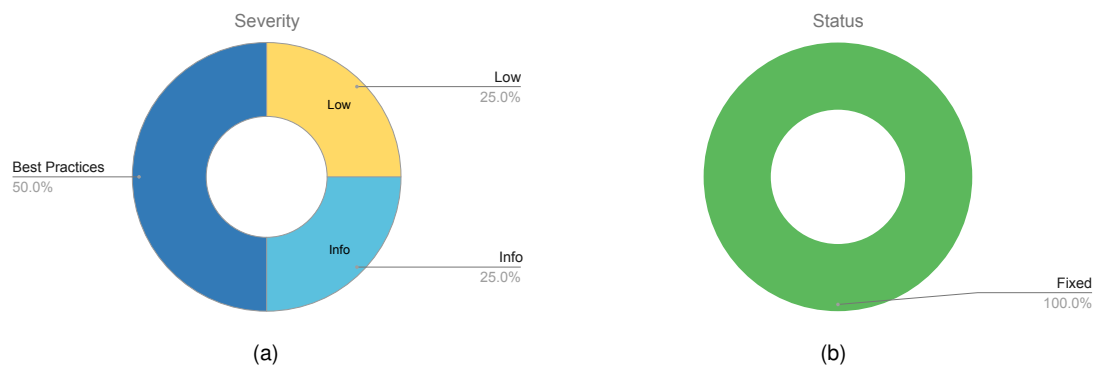
# 1 Executive Summary

This document presents the results of the security review conducted by [Nethermind Security](#) for Celo's integration of EigenDA Hokulea. Specifically on the op-succinct side we review [PR 572](#) and a diff with the op-succinct upstream. As well as changes made to Celo-kona.

This audit focused on the end-to-end review of the above described changes. **The audit comprises 1381 lines of Rust and Solidity code combined.** The audit was performed using (a) manual analysis of the codebase, and (b) automated analysis tools.

**Along this document, we report 4 points of attention, where 1 is classified as Low, and 3 are classified as Informational or Best Practices severity. The issues are summarized in Fig. 1. It is important to note that the codebase does not include a test suite. Implementing a comprehensive suite of tests before deployment is essential to validate the protocol's behavior and ensure its correctness. We recommend that the Fileverse team develop and maintain such a suite, covering both expected workflows and edge-case scenarios.**

**This document is organized as follows.** Section 2 presents the files in the scope. Section 3 summarizes the issues. Section 4 presents the system overview. Section 5 discusses the risk rating methodology. Section 6 details the issues. Section 7 discusses the documentation provided by the client for this audit. Section 8 presents the test suite evaluation and automated tools used. Section 9 concludes the document.



**Fig. 1: Distribution of issues: Critical (0), High (0), Medium (0), Low (1), Undetermined (0), Informational (1), Best Practices (2).**

**Distribution of status: Fixed (4), Acknowledged (0), Mitigated (0), Unresolved (0)**

## Summary of the Audit

<b>Audit Type</b>	Security Review
<b>Initial Report</b>	October 13, 2025
<b>Final Report</b>	November 25, 2025
<b>Initial op-succinct PR 572 Commit Hash</b>	<a href="#">b62d805e71838a2ab1dce25876e8617e20bc8673</a>
<b>Initial op-succinct diff Commit Hash</b>	<a href="#">54657eb0e9ba100915808bb1c0fb72bb575eafbf</a>
<b>Initial Celo-kona Commit Hash</b>	<a href="#">0a5129b4d58f4d878c96852de843fa813fe84113</a>
<b>Final op-succinct Commit Hash</b>	<a href="#">fb8a7766f699af5f04c381b54156906dfd240936</a>
<b>Final Celo-kona Commit Hash</b>	<a href="#">a90700bd2853d8f10b7f292b5efe3a2a5b0e1320</a>
<b>Documentation Assessment</b>	High
<b>Test Suite Assessment</b>	High

## Summary of Engagement

Dates	Methods	Consultants Engaged	Level of Effort
Sept. 29 - Oct. 10, 2025	Manual	2	2-person weeks

## 2 Audited Files

### 2.1 op-succinct PR 572

	Contract	LoC
1	fault-proof/src/proposer.rs	1
2	programs/range/eigenda/Cargo.toml	35
3	programs/range/eigenda/src/main.rs	44
4	scripts/prove/bin/agg.rs	8
5	scripts/prove/src/lib.rs	8
6	utils/build/src/lib.rs	5
7	scripts/utils/bin/cost_estimator.rs	2
8	utils/client/src/client.rs	5
9	utils/client/src/witness/mod.rs	20
10	utils/eigenda/client/Cargo.toml	28
11	utils/eigenda/client/src/executor.rs	76
12	utils/eigenda/client/src/lib.rs	1
13	utils/eigenda/host/Cargo.toml	37
14	utils/eigenda/host/src/host.rs	85
15	utils/eigenda/host/src/witness_generator.rs	2
16	utils/eigenda/host/src/witness_generator.rs	181
17	utils/elfs/src/lib.rs	5
18	utils/host/Cargo.toml	3
19	utils/host/src/host.rs	15
20	utils/proof/Cargo.toml	2
21	utils/proof/src/lib.rs	14
22	validity/Cargo.toml	1
23	validity/Dockerfile.eigenda	65
24	validity/src/proof_requester.rs	6
<b>Total</b>		<b>649</b>

### 2.2 op-succinct diff

	Contract	LoC
1	contracts/script/fp/ConfigureDeploymentSafe.s.sol	147
2	contracts/script/fp/DeployOPSuccinctFDG.s.sol	137
3	contracts/script/fp/UpgradeOPSuccinctFDG.s.sol	10
4	contracts/test/helpers/JSONDecoder.sol	5
5	fault-proof/bin/proposer.rs	2
6	fault-proof/src/config.rs	9
7	fault-proof/src/lib.rs	12
8	fault-proof/src/proposer.rs	7
9	fault-proof/tests/common/env.rs	5
10	fault-proof/tests/common/process.rs	1
11	programs/range/utils/src/lib.rs	20
12	scripts/prove/bin/multi.rs	2
13	scripts/utils/bin/cost_estimator.rs	3
14	scripts/utils/bin/fetch_fault_dispute_game_config.rs	44
15	utils/celestia/client/src/executor.rs	11
16	utils/client/src/boot.rs	10
17	utils/client/src/client.rs	37
18	utils/client/src/witness/executor.rs	42
19	utils/eigenda/client/src/executor.rs	11
20	utils/eigenda/host/src/host.rs	8
21	utils/eigenda/host/src/witness_generator.rs	21
22	utils/ethereum/client/src/executor.rs	11
23	utils/ethereum/host/src/host.rs	10
24	utils/host/src/fetcher.rs	27
25	utils/host/src/host.rs	5
26	utils/host/src/witness_generation/traits.rs	20
<b>Total</b>		<b>617</b>

## 2.3 Celo-kona

	Contract	LoC
1	<a href="#">transfer.rs</a>	115
<b>Total</b>		<b>115</b>

## 3 Summary of Issues

	Finding	Severity	Update
0	<a href="#">Insecure crate used</a>	Low	Fixed
1	<a href="#">Duplicate code leading to redundant cycles</a>	Info	Fixed
2	<a href="#">Gas behavior differs if precompile is used outside 'GoldToken'</a>	Best Practice	Fixed
3	<a href="#">Missing STATICCALL guard allows state-changing precom pile to be invoked in static context</a>	Best Practice	Fixed

## 4 System Overview

### 4.1 PR 572

The primary objective of [PR 572](#) is to implement comprehensive Eigen DA support within the Hokulea component of the OP Succinct stack. Specifically, it extends Hokulea's derivation and batch-processing pipeline to natively interact with EigenDA as a data availability backend. This includes enabling the system to submit, retrieve, and verify data blobs via the EigenDA proxy, manage KZG commitment verification, and ensure robust failover handling.

By introducing these capabilities, the PR allows rollups built on OP Succinct to seamlessly operate using EigenDA as their data availability layer, thereby enhancing modularity, scalability, and interoperability across different DA solutions.

### 4.2 op-succinct diff

The OP-Succinct zero-knowledge proof system has been updated with several key shifts. First, it now supports the Celo blockchain instead of just Optimism. All core types were replaced to integrate Celo's OP Stack-based L2, enabling validity proofs for Celo transactions that include its custom EVM extensions and transaction formats.

The ConfigureDeploymentSafe.s.sol script batches configuration calls via Safe delegate transactions, while the main script (DeployOPSuccinctFDG.s.sol) now separates the rollout into three clear stages: deploy, configure, and activate.

Finally, the SP1 prover setup moved from FulfillmentStrategy::Hosted (which skipped simulation) to FulfillmentStrategy::Reserved (with simulation enabled). This ensures more rigorous validation and guarantees reserved prover capacity. A new configurable cycle limit parameter—defaulting to 3 billion cycles—was also introduced for finer-grained control over proof execution.

### 4.3 Celo-kona

The transfer precompile was reviewed. The transfer precompile enables the sending of the native token of a different user to that who is calling the contract on-chain.

The precompile takes in the context, input, caller address, and the gas limit. The initial checks it performs are that the gas cost is greater than the minimum transfer gas cost of 9 thousand, that the caller address is the celo token address and that the input length is 96 bytes. The input contains the from, to and value values in one array.

Then it stores the warmth (cold or warm) of the to address and performs the transfer based on the input values. This applies a state change to the journal. Finally, it resets the warmth of the address to its initial value.

## 5 Risk Rating Methodology

The risk rating methodology used by [Nethermind Security](#) follows the principles established by the [OWASP Foundation](#). The severity of each finding is determined by two factors: **Likelihood** and **Impact**.

**Likelihood** measures how likely the finding is to be uncovered and exploited by an attacker. This factor will be one of the following values:

- a) **High**: The issue is trivial to exploit and has no specific conditions that need to be met;
- b) **Medium**: The issue is moderately complex and may have some conditions that need to be met;
- c) **Low**: The issue is very complex and requires very specific conditions to be met.

When defining the likelihood of a finding, other factors are also considered. These can include but are not limited to motive, opportunity, exploit accessibility, ease of discovery, and ease of exploit.

**Impact** is a measure of the damage that may be caused if an attacker exploits the finding. This factor will be one of the following values:

- a) **High**: The issue can cause significant damage, such as loss of funds or the protocol entering an unrecoverable state;
- b) **Medium**: The issue can cause moderate damage, such as impacts that only affect a small group of users or only a particular part of the protocol;
- c) **Low**: The issue can cause little to no damage, such as bugs that are easily recoverable or cause unexpected interactions that cause minor inconveniences.

When defining the impact of a finding, other factors are also considered. These can include but are not limited to Data/state integrity, loss of availability, financial loss, and reputation damage. After defining the likelihood and impact of an issue, the severity can be determined according to the table below.

		Likelihood		
		Low	Medium	High
Impact	High	Medium	High	Critical
	Medium	Low	Medium	High
	Low	Info/Best Practices	Low	Medium
	Undetermined	Undetermined	Undetermined	Undetermined

To address issues that do not fit a High/Medium/Low severity, [Nethermind Security](#) also uses three more finding severities: **Informational**, **Best Practices**, and **Undetermined**.

- a) **Informational** findings do not pose any risk to the application, but they carry some information that the audit team intends to pass to the client formally;
- b) **Best Practice** findings are used when some piece of code does not conform with development best practices;
- c) **Undetermined** findings are used when we cannot predict the impact or likelihood of the issue.

## 6 Issues

### 6.1 [Low] Insecure crate used

**File(s):** [cargo.toml](#)

**Description:** Usage of tracing-subscriber package version 0.3.19 is deemed insecure as logging user input may result in poisoning logs with ANSI escape sequences explained in [RUSTSEC](#).

**Recommendation(s):** Upgrade to version  $\geq 0.3.20$ .

**Status:** Fixed

**Update from the client:** Created patch PR in both celo-kona and op-succinct:

[PR 78](#)

[PR 33](#)

### 6.2 [INFO] Duplicate code leading to redundant cycles

**File(s):** [main.rs](#), [lib.rs](#)

**Description:** In both [main.rs](#) and [lib.rs/run\\_range\\_program\(...\)](#) the function `get_oracle_and_blob_provider(...)` is called to create an oracle and a blob store. This means the same code is executed twice and can thus slow down the proving time of the code.

**Recommendation(s):** Editing the function `run_range_program(...)` to take as parameters the oracle and blob store, as this would mean that it would not need to be recalculated.

**Status:** Fixed

**Update from the client:** Included in the following PR: [PR 38](#).

### 6.3 [Best Practice] Gas behavior differs if precompile is used outside GoldToken

**File(s):** [precompiles/transfer.rs](#)

**Description:** The transfer precompile's `run(...)` function restores the warmness of the `to` address after performing a balance transfer but does not restore the warmness of the `from` address. In the current system, this behavior is correct and has no side effects because the precompile is always invoked through the GoldToken contract.

Before calling the precompile, GoldToken performs a balance check on the `from` address, which triggers the EVM BALANCE opcode:

```
function balanceOf(address owner) public view returns (uint256) {
    // @audit BALANCE opcode warms `owner`
    return owner.balance;
}
```

According to EVM semantics, any address accessed via the BALANCE opcode is automatically added to the access list and becomes warm. Therefore, by the time the precompile executes, the `from` account is already warm, and restoring its warmness state is unnecessary.

However, this assumption only holds as long as the precompile is invoked through GoldToken. If the precompile were to be called directly by another contract or address that does not access `from` beforehand, the `from` address could start as cold. In such a case, the internal `journal.transfer(...)` call would mark it warm and alter gas metering for the remainder of the transaction.

**Recommendation(s):** Consider documenting that the `from` address is guaranteed to be warm when the precompile is called through GoldToken.

**Status:** Fixed

**Update from the client:** Made a PR for it and merged [PR 77](#).



## 6.4 [Best Practice] Missing STATICCALL guard allows state-changing precompile to be invoked in static context

**File(s):** [precompiles/transfer.rs](#)

**Description:** The `transfer_run(...)` flow exposes a state-changing precompile that debits and credits balances through `journal().transfer(...)`. This precompile is intended to be called only by the token contract in standard, non-static execution, and it charges gas before returning. However, the implementation does not verify whether the call is being executed under `STATICCALL` (static context). In static context, EVM semantics prohibit state changes. Despite that, the code proceeds to execute the transfer, which attempts to mutate state.

```
fn run<CTX>(  
    context: &mut CTX,  
    input: &Bytes,  
    caller_address: Address,  
    gas_limit: u64,  
) -> PrecompileResult  
where  
    CTX: ContextTr<Cfg: Cfg<Spec = OpSpecId>>,  
{  
    // ...  
    if input.len() != 96 {  
        return Err(PrecompileError::Other("invalid input length".to_string()));  
    }  
    // ...  
    // @audit This call mutates state but there is no STATICCALL guard before it.  
    let result = context.journal().transfer(from, to, value);  
    // ...  
}
```

**Recommendation(s):** Consider introducing a strict check that rejects execution when the precompile is invoked in a static context. The precompile should exit early with an error indicating that state changes are not allowed during static calls.

**Status:** Fixed

**Update from the client:** Opened a PR [PR 79](#).

## 7 Documentation Evaluation

Software documentation refers to the written or visual information that describes the functionality, architecture, design, and implementation of software. It provides a comprehensive overview of the software system and helps users, developers, and stakeholders understand how the software works, how to use it, and how to maintain it. Software documentation can take different forms, such as user manuals, system manuals, technical specifications, requirements documents, design documents, and code comments. Software documentation is critical in software development, enabling effective communication between developers, testers, users, and other stakeholders. It helps to ensure that everyone involved in the development process has a shared understanding of the software system and its functionality. Moreover, software documentation can improve software maintenance by providing a clear and complete understanding of the software system, making it easier for developers to maintain, modify, and update the software over time. SDK's can use various types of software documentation. Some of the most common types include:

- Technical whitepaper: A technical whitepaper is a comprehensive document describing the SDK's design and technical details. It includes information about the purpose of the contract, its architecture, its components, and how they interact with each other;
- User manual: A user manual is a document that provides information about how to use the SDK. It includes step-by-step instructions on how to perform various tasks and explains the different features and functionalities of the contract;
- Code documentation: Code documentation is a document that provides details about the code of the SDK. It includes information about the functions, variables, and classes used in the code, as well as explanations of how they work;
- API documentation: API documentation is a document that provides information about the API (Application Programming Interface) of the SDK. It includes details about the methods, parameters, and responses that can be used to interact with the contract;
- Testing documentation: Testing documentation is a document that provides information about how the SDK was tested. It includes details about the test cases that were used, the results of the tests, and any issues that were identified during testing;
- Audit documentation: Audit documentation includes reports, notes, and other materials related to the security audit of the SDK. This type of documentation is critical in ensuring that the SDK is secure and free from vulnerabilities.

These types of documentation are essential for SDK development and maintenance. They help ensure that the contract is properly designed, implemented, and tested, and they provide a reference for developers who need to modify or maintain the contract in the future.

### Remarks about Celo's documentation

Celo's team addressed all questions and concerns raised by the Nethermind Security team, providing valuable insights and a comprehensive understanding of the project's technical aspects.

## 8 Test Suite Evaluation

```
> cargo test
test contracts::erc20::tests::test_credit_gas_fees_calldata_structure ... ok
test contracts::core_contracts::tests::test_get_intrinsic_gas ... ok
test api::default_ctx::test::default_run_celo ... ok
test contracts::core_contracts::tests::test_get_currencies ... ok
test contracts::core_contracts::tests::test_get_exchange_rates ... ok
test common::fee_currency_context::tests::test_new_from_evm ... ok
test contracts::erc20::tests::test_debit_gas_fees_calldata_structure ... ok
test evm::tests::test_deposit_tx ... ok
test evm::tests::test_halted_deposit_tx ... ok
test evm::tests::test_halted_tx_call_bls12_381_g1_add_input_wrong_size ... ok
test evm::tests::test_halted_tx_call_bls12_381_g1 MSM input wrong size ... ok
test evm::tests::test_halted_tx_call_bls12_381_g1_add_out_of_gas ... ok
test evm::tests::test_halted_tx_call_bls12_381_g1 MSM out of gas ... ok
test evm::tests::test_halted_tx_call_bls12_381_g1 MSM wrong input layout ... ok
test evm::tests::test_halted_tx_call_bls12_381_g2_add_input_wrong_size ... ok
test evm::tests::test_halted_tx_call_bls12_381_g2_add_out_of_gas ... ok
test evm::tests::test_halted_tx_call_bls12_381_g2 MSM out of gas ... ok
test evm::tests::test_halted_tx_call_bls12_381_g2 MSM input wrong size ... ok
test evm::tests::test_halted_tx_call_bls12_381_map_fp2_to_g2_out_of_gas ... ok
test evm::tests::test_halted_tx_call_bls12_381_map_fp_to_g1_out_of_gas ... ok
test evm::tests::test_halted_tx_call_bls12_381_map_fp2_to_g2 input wrong size ... ok
test evm::tests::test_halted_tx_call_bls12_381_pairing_input_wrong_size ... ok
test evm::tests::test_halted_tx_call_bls12_381_g2 MSM wrong input layout ... ok
test evm::tests::test_halted_tx_call_bls12_381_pairing_out_of_gas ... ok
test evm::tests::test_halted_tx_call_bls12_381_map_fp_to_g1 input wrong size ... ok
test evm::tests::test_tx_call_bls12_381_pairing_wrong_input_layout ... ok
test evm::tests::test_tx_call_p256verify ... ok
test handler::tests::test_consume_gas ... ok
test handler::tests::test_consume_gas_deposit_tx ... ok
test evm::tests::test_halted_tx_call_bn128_pair_granite ... ok
test handler::tests::test_commit_mint_value ... ok
test handler::tests::test_consume_gas_sys_deposit_tx ... ok
test evm::tests::test_log_inspector ... ok
test handler::tests::test_consume_gas_with_refund ... ok
test handler::tests::test_operator_fee_refund::case_1_deposit ... ok
test evm::tests::test_halted_tx_call_p256verify ... ok
test handler::tests::test_operator_fee_refund::case_2_dyn_fee ... ok
test handler::tests::test_remove_l1_cost_non_deposit ... ok
test handler::tests::test_remove_l1_cost ... ok
test evm::tests::test_halted_tx_call_bn128_pair_fjord ... ok
test handler::tests::test_remove_operator_cost ... ok
test handler::tests::test_remove_l1_cost_lack_of_funds ... ok
test handler::tests::test_validate_sys_tx ... ok
test handler::tests::test_revert_gas ... ok
test precompiles::tests::test_celo_precompiles_count ... ok
test precompiles::tests::test_transfer ... ok
test handler::tests::test_validate_deposit_tx ... ok
test precompiles::transfer::tests::test_basic_transfer_cold_account ... ok
test precompiles::transfer::tests::test_basic_transfer_oog ... ok
test precompiles::transfer::tests::test_basic_transfer_success ... ok
test handler::tests::test_validate_tx_against_state_deposit_tx ... ok
test transaction::abstraction::tests::test_cip64_transaction_fields ... ok
test precompiles::tests::test_token_duality ... ok

test result: ok. 53 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s
```

## 9 About Nethermind

Nethermind is a Blockchain Research and Software Engineering company. Our work touches every part of the web3 ecosystem - from layer 1 and layer 2 engineering, cryptography research, and security to application-layer protocol development. We offer strategic support to our institutional and enterprise partners across the blockchain, digital assets, and DeFi sectors, guiding them through all stages of the research and development process, from initial concepts to successful implementation.

We offer security audits of projects built on EVM-compatible chains and Starknet. We are active builders of the Starknet ecosystem, delivering a node implementation, a block explorer, a Solidity-to-Cairo transpiler, and formal verification tooling. Nethermind also provides strategic support to our institutional and enterprise partners in blockchain, digital assets, and decentralized finance (DeFi). In the next paragraphs, we introduce the company in more detail.

**Blockchain Security:** At Nethermind, we believe security is vital to the health and longevity of the entire Web3 ecosystem. We provide security services related to Smart Contract Audits, Formal Verification, and Real-Time Monitoring. Our Security Team comprises blockchain security experts in each field, often collaborating to produce comprehensive and robust security solutions. The team has a strong academic background, can apply state-of-the-art techniques, and is experienced in analyzing cutting-edge Solidity and Cairo smart contracts, such as ArgentX and StarkGate (the bridge connecting Ethereum and StarkNet). Most team members hold a Ph.D. degree and actively participate in the research community, accounting for 240+ articles published and 1,450+ citations in Google Scholar. The security team adopts customer-oriented and interactive processes where clients are involved in all stages of the work.

**Blockchain Core Development:** Our core engineering team, consisting of over 20 developers, maintains, improves, and upgrades our flagship product - the Nethermind Ethereum Execution Client. The client has been successfully operating for several years, supporting both the Ethereum Mainnet and its testnets, and now accounts for nearly a quarter of all synced Mainnet nodes. Our unwavering commitment to Ethereum's growth and stability extends to sidechains and layer 2 solutions. Notably, we were the sole execution layer client to facilitate Gnosis Chain's Merge, transitioning from Aura to Proof of Stake (PoS), and we are actively developing a full-node client to bolster Starknet's decentralization efforts. Our core team equips partners with tools for seamless node set-up, using generated docker-compose scripts tailored to their chosen execution client and preferred configurations for various network types.

**DevOps and Infrastructure Management:** Our infrastructure team ensures our partners' systems operate securely, reliably, and efficiently. We provide infrastructure design, deployment, monitoring, maintenance, and troubleshooting support, allowing you to focus on your core business operations. Boasting extensive expertise in Blockchain as a Service, private blockchain implementations, and node management, our infrastructure and DevOps engineers are proficient with major cloud solution providers and can host applications in-house or on clients' premises. Our global in-house SRE teams offer 24/7 monitoring and alerts for both infrastructure and application levels. We manage over 5,000 public and private validators and maintain nodes on major public blockchains such as Polygon, Gnosis, Solana, Cosmos, Near, Avalanche, Polkadot, Aptos, and StarkWare L2. Sedge is an open-source tool developed by our infrastructure experts, designed to simplify the complex process of setting up a proof-of-stake (PoS) network or chain validator. Sedge generates docker-compose scripts for the entire validator set-up based on the chosen client, making the process easier and quicker while following best practices to avoid downtime and being slashed.

**Cryptography Research:** At Nethermind, our Cryptography Research team is dedicated to continuous internal research while fostering close collaboration with external partners. The team has expertise across a wide range of domains, including cryptography protocols, consensus design, decentralized identity, verifiable credentials, Sybil resistance, oracles, and credentials, distributed validator technology (DVT), and Zero-knowledge proofs. This diverse skill set, combined with strong collaboration between our engineering teams, enables us to deliver cutting-edge solutions to our partners and clients.

**Smart Contract Development & DeFi Research:** Our smart contract development and DeFi research team comprises 40+ world-class engineers who collaborate closely with partners to identify needs and work on value-adding projects. The team specializes in Solidity and Cairo development, architecture design, and DeFi solutions, including DEXs, AMMs, structured products, derivatives, and money market protocols, as well as ERC20, 721, and 1155 token design. Our research and data analytics focuses on three key areas: technical due diligence, market research, and DeFi research. Utilizing a data-driven approach, we offer in-depth insights and outlooks on various industry themes.

**Our suite of L2 tooling:** Warp is Starknet's approach to EVM compatibility. It allows developers to take their Solidity smart contracts and transpile them to Cairo, Starknet's smart contract language. In the short time since its inception, the project has accomplished many achievements, including successfully transpiling Uniswap v3 onto Starknet using Warp.

- **Voyager** is a user-friendly Starknet block explorer that offers comprehensive insights into the Starknet network. With its intuitive interface and powerful features, Voyager allows users to easily search for and examine transactions, addresses, and contract details. As an essential tool for navigating the Starknet ecosystem, Voyager is the go-to solution for users seeking in-depth information and analysis;
- **Horus** is an open-source formal verification tool for StarkNet smart contracts. It simplifies the process of formally verifying Starknet smart contracts, allowing developers to express various assertions about the behavior of their code using a simple assertion language;
- **Juno** is a full-node client implementation for Starknet, drawing on the expertise gained from developing the Nethermind Client. Written in Golang and open-sourced from the outset, Juno verifies the validity of the data received from Starknet by comparing it to proofs retrieved from Ethereum, thus maintaining the integrity and security of the entire ecosystem.

Learn more about us at [nethermind.io](https://nethermind.io).

#### General Advisory to Clients

As auditors, we recommend that any changes or updates made to the audited codebase undergo a re-audit or security review to address potential vulnerabilities or risks introduced by the modifications. By conducting a re-audit or security review of the modified codebase, you can significantly enhance the overall security of your system and reduce the likelihood of exploitation. However, we do not possess the authority or right to impose obligations or restrictions on our clients regarding codebase updates, modifications, or subsequent audits. Accordingly, the decision to seek a re-audit or security review lies solely with you.

#### Disclaimer

This report is based on the scope of materials and documentation provided by you to [Nethermind](#) in order that [Nethermind](#) could conduct the security review outlined in **1. Executive Summary** and **2. Audited Files**. The results set out in this report may not be complete nor inclusive of all vulnerabilities. [Nethermind](#) has provided the review and this report on an as-is, where-is, and as-available basis. You agree that your access and/or use, including but not limited to any associated services, products, protocols, platforms, content, and materials, will be at your sole risk. Blockchain technology remains under development and is subject to unknown risks and flaws. The review does not extend to the compiler layer, or any other areas beyond the programming language, or other programming aspects that could present security risks. This report does not indicate the endorsement of any particular project or team, nor guarantee its security. No third party should rely on this report in any way, including for the purpose of making any decisions to buy or sell a product, service or any other asset. To the fullest extent permitted by law, [Nethermind](#) disclaims any liability in connection with this report, its content, and any related services and products and your use thereof, including, without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement. [Nethermind](#) does not warrant, endorse, guarantee, or assume responsibility for any product or service advertised or offered by a third party through the product, any open source or third-party software, code, libraries, materials, or information linked to, called by, referenced by or accessible through the report, its content, and the related services and products, any hyperlinked websites, any websites or mobile applications appearing on any advertising, and [Nethermind](#) will not be a party to or in any way be responsible for monitoring any transaction between you and any third-party providers of products or services. As with the purchase or use of a product or service through any medium or in any environment, you should use your best judgment and exercise caution where appropriate. FOR AVOIDANCE OF DOUBT, THE REPORT, ITS CONTENT, ACCESS, AND/OR USAGE THEREOF, INCLUDING ANY ASSOCIATED SERVICES OR MATERIALS, SHALL NOT BE CONSIDERED OR RELIED UPON AS ANY FORM OF FINANCIAL, INVESTMENT, TAX, LEGAL, REGULATORY, OR OTHER ADVICE.