1inch

Limit Order Protocol v2

SMART CONTRACT AUDIT

16.10.2021

Made in Germany by Chainsulting.de

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1. Disclaimer

The audit makes no statements or warrantees about utility of the code, safety of the code, suitability o
advice, endorsement of the platform or its products, regulatory regime for the business model, or any
the contracts to purpose, or their bug free status. The audit documentation is for discussion purposes

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Major Versions / Date	Description
0.1 (12.10.2021)	Layout
0.5 (13.10.2021)	Manual & Automated Security Testing
0.6 (14.10.2021)	Testing SWC Checks
0.7 (15.10.2021)	Verify Claims
0.9 (16.10.2021)	Summary and Recommendation
1.0 (16.10.2021)	Final document
1.1 (TBA)	Added deployed contract addresses

2. About the Project and Company

Company address:

1Inch Limited
Quijano Chambers, P.O. Box 3159, Road Town
Tortola, British Virgin Islands

Sergej Kunz Co-Founder & Chief Executive Officer
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Discord: https://discord.gg/FZADkCZ

Blog: https://blog.1inch.io

Medium: https://medium.com/@1inch.exchange

Website: https://app.1inch.io

Twitter: https://twitter.com/1inchExchange

Reddit: https://www.reddit.com/r/1inch_exchange

Telegram: https://t.me/OneInchExchange

Forum: https://gov.1inch.io

2.1 Project Overview

The 1inch Network unites decentralized protocols whose synergy enables the most lucrative, fastest a
DeFi space. The initial protocol of the 1inch Network is a DEX aggregator solution that searches deals
sources, offering users better rates than any individual exchange.

This protocol incorporates the Pathfinder algorithm which finds the best paths among different markets
Ethereum, 20+ liquidity sources on Binance Smart Chain and 8+ liquidity sources on Polygon. In just t
aggregator surpassed $50B in overall volume on the Ethereum network alone. The 1inch Aggregation
and secure swap transactions across multiple liquidity sources.

The 1inch Liquidity Protocol is a next-generation automated market maker that protects users from fro
attractive opportunities to liquidity providers. The 1inch Limit Order Protocol facilitates the most innova
opportunities in DeFi. The protocol's features, such as dynamic pricing, conditional orders and extra R
implementations, including stop-loss and trailing stop orders, as well as auctions.

1inch limit order protocol is a set of smart contracts, that can work on any EVM based blockchains (Et
Polygon, etc.). Key features of the protocol is extreme flexibility and high gas efficiency that achieved
types - regular Limit Order and RFQ Order. Smart Contract allows users to place limit orders and RFQ
on-chain. Both type of orders is a data structure created off-chain and signed according to EIP-712.

3. Vulnerability & Risk Level

Risk represents the probability that a certain source-threat will exploit vulnerability, and the impact of t
system. Risk Level is computed based on CVSS version 3.0.

Level	Value	Vulnerability	Risk (Required Action
Critical	9 – 10	A vulnerability that can disrupt the contract functioning in a number of scenarios, or creates a risk that the contract may be broken.	Immediate action to re
High	7 – 8.9	A vulnerability that affects the desired outcome when using a contract, or provides the opportunity to use a contract in an unintended way.	Implementation of cor possible.
Medium	4 – 6.9	A vulnerability that could affect the desired outcome of executing the contract in a specific scenario.	Implementation of cor period.
Low	2 – 3.9	A vulnerability that does not have a significant impact on possible scenarios for the use of the contract and is probably subjective.	Implementation of cer accepting the risk.
Informational	0 – 1.9	A vulnerability that have informational character but is not effecting any of the code.	An observation that d

4. Auditing Strategy and Techniques Applied

Throughout the review process, care was taken to evaluate the repository for security-related issues, c
specification and best practices. To do so, reviewed line-by-line by our team of expert pentesters and
documenting any issues as there were discovered.

4.1 Methodology

The auditing process follows a routine series of steps:

1. Code review that includes the following:
   i. Review of the specifications, sources, and instructions provided to Chainsulting to make
      scope, and functionality of the smart contract.
   ii. Manual review of code, which is the process of reading source code line-by-line in an att
      vulnerabilities.
   iii. Comparison to specification, which is the process of checking whether the code does wh
      and instructions provided to Chainsulting describe.
2. Testing and automated analysis that includes the following:
   i. Test coverage analysis, which is the process of determining whether the test cases are a
      how much code is exercised when we run those test cases.
   ii. Symbolic execution, which is analysing a program to determine what inputs causes each
3. Best practices review, which is a review of the smart contracts to improve efficiency, effe
security, and control based on the established industry and academic practices, recommend
4. Specific, itemized, actionable recommendations to help you take steps to secure your sm

4.2 Used Code from other Frameworks/Smart Contracts (direct imports)

Dependency / Import Path	Source
@openzeppelin/contracts/token/ERC1155/IERC1155.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/token/ERC1155
@openzeppelin/contracts/token/ERC20/IERC20.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/token/ERC20/I
@openzeppelin/contracts/token/ERC20/extensions/draft-IERC20Permit.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/token/ERC20/e
@openzeppelin/contracts/token/ERC20/utils/SafeERC20.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/token/ERC20/u
@openzeppelin/contracts/token/ERC721/IERC721.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/token/ERC721/
@openzeppelin/contracts/utils/Address.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/utils/Address.s
@openzeppelin/contracts/utils/cryptography/SignatureChecker.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/utils/cryptograp
@openzeppelin/contracts/utils/cryptography/draft-EIP712.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.3.2/contracts/utils/cryptograp

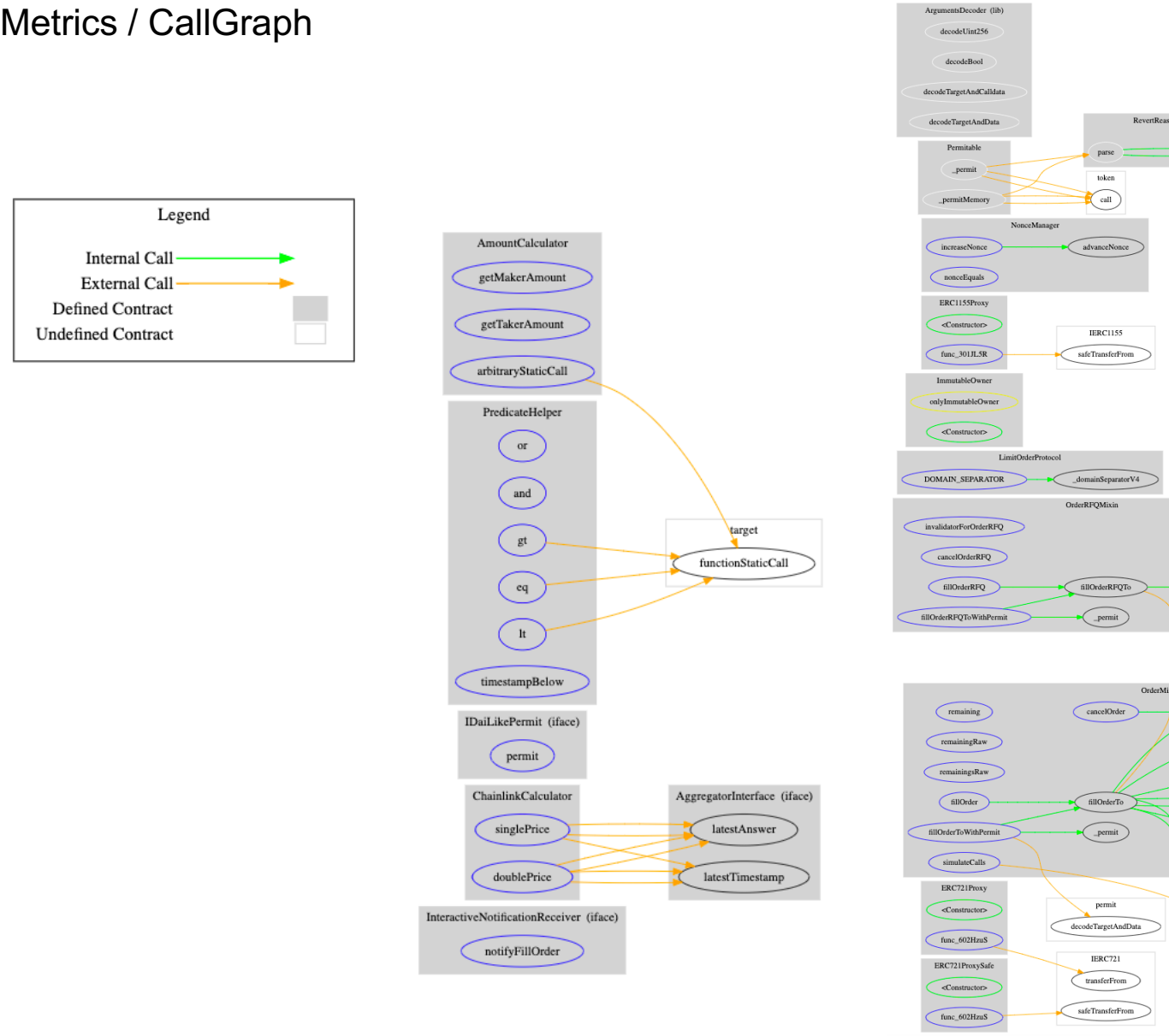
4.3 Tested Contract Files

The following are the MD5 hashes of the reviewed files. A file with a different MD5 hash has been mo
after the security review. You are cautioned that a different MD5 hash could be (but is not necessarily)
condition or potential vulnerability that was not within the scope of the review

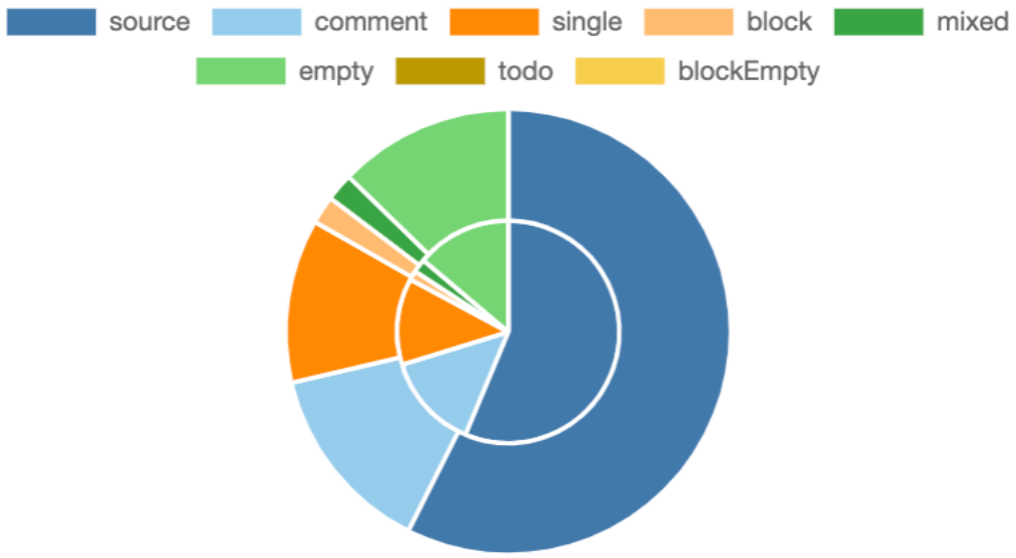
File	Fingerprint (MD5)
LimitOrderProtocol.sol	773875475cf314c7a56bdc546cac02d0
OrderMixin.sol	8a251bf265c4b3042d0fad3b11beb922
OrderRFQMixin.sol	a6a8b2c7d3afe4c2c64759f53c86c551
./helpers/AmountCalculator.sol	35c1214179db933fa1719d3cc33bd742
./helpers/ERC721Proxy.sol	f23e26a88f6acdf4a948c68384a20b15
./helpers/PredicateHelper.sol	75b8c3c5ce5ec6e37ae0101113e5fad2
./helpers/ChainlinkCalculator.sol	6ab30cc0cc4eeecc011cf1ab923240c9
./helpers/ImmutableOwner.sol	5eccf3977e9c2018b94a085f5e8fcfcc
./helpers/ERC721ProxySafe.sol	fabc4a8db094dd528d8832148dd3d12c
./helpers/ERC1155Proxy.sol	fe973bdba9b251d9e366c833f5de14d1
./helpers/NonceManager.sol	3428130d5b1e370ef7bd309d19b11499
./libraries/Permitable.sol	dcc7f03730b22d7dd55762bcafb9ba5c
./libraries/ArgumentsDecoder.sol	aa87cdf8aea0a80d278ff0ab67dafc39
./libraries/RevertReasonParser.sol	1b7f06f88c57f514c9a851ce5471ce9a
./interfaces/IDaiLikePermit.sol	de64a23241710e682a5851e47a23fc4d
./interfaces/AggregatorInterface.sol	f6187143d64146f2af9836ea2002deb7
./interfaces/InteractiveNotificationReceiver.sol	ff9a940e4220e4a76042f331980716e4

Commit: https://github.com/1inch/limit-order-protocol/commit/9d118307df7acc3bcef73407f3964acd6a

4.4 Metrics / CallGraph



4.5 Metrics / Source Lines & Risk



4.6 Metrics / Capabilities

Solidity Versions observed	Experimental Features	Can Receive Funds	Uses Assembly
`^0.8.0`			`yes` (8 asm blocks)

Transfers ETH	Low-Level Calls	DelegateCall	Uses Hash Functions	ECRecove
			`yes`	

Exposed Functions

This section lists functions that are explicitly declared public or payable. Please note that getter methods for public st

Public	Payable
36	0

External	Internal	Private	Pure	View
32	30	6	9	21

StateVariables

Total	Public
9	4

4.7 Metrics / Source Unites in Scope

Type	File	Logic Contracts	Interfaces	Lines	nLines	nSLOC
🔍	contracts/interfaces/InteractiveNotificationReceiver.sol		1	15	7	3
🔍	contracts/interfaces/AggregatorInterface.sol		1	8	6	3
🔍	contracts/interfaces/IDaiLikePermit.sol		1	8	7	3
📝	contracts/helpers/AmountCalculator.sol	1		29	26	12
📝	contracts/helpers/ERC721Proxy.sol	1		24	24	12
📝	contracts/helpers/PredicateHelper.sol	1		72	45	29
📝	contracts/helpers/ChainlinkCalculator.sol	1		42	42	22
🎨	contracts/OrderRFQMixin.sol	1		132	114	79
🎨	contracts/OrderMixin.sol	1		311	269	213
📝	contracts/LimitOrderProtocol.sol	1		19	19	13
📝	contracts/helpers/ImmutableOwner.sol	1		17	17	11

Type	File	Logic Contracts	Interfaces	Lines	nLines	nSLOC
	contracts/helpers/ERC721ProxySafe.sol	1		24	24	12
	contracts/helpers/ERC1155Proxy.sol	1		24	24	12
	contracts/helpers/NonceManager.sol	1		23	23	14
	contracts/libraries/Permitable.sol	1		47	47	38
	contracts/libraries/ArgumentsDecoder.sol	1		33	33	26
	contracts/libraries/RevertReasonParser.sol	1		62	62	39
	Totals	**14**	**3**	**890**	**789**	**541**

Legend: [━]

- **Lines**: total lines of the source unit
- **nLines**: normalized lines of the source unit (e.g. normalizes functions spanning multiple lines)
- **nSLOC**: normalized source lines of code (only source-code lines; no comments, no blank lines)
- **Comment Lines**: lines containing single or block comments
- **Complexity Score**: a custom complexity score derived from code statements that are known to introduce co external interfaces, ...)

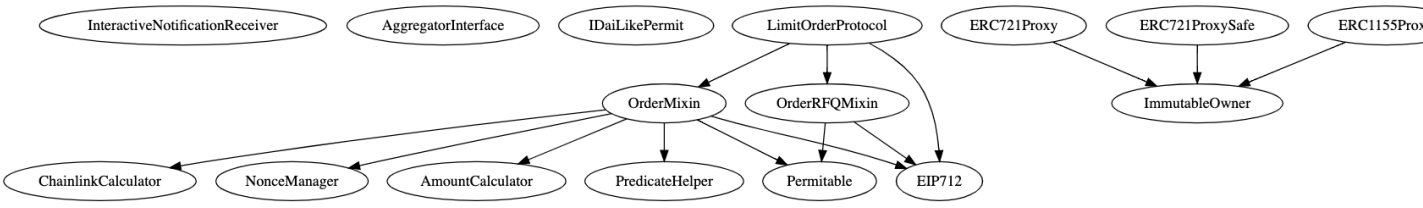
5. Scope of Work

The 1inch Team provided us with the files that needs to be tested. The scope of the audit is the limit o
9d11830) contracts.

The team put forward the following assumptions regarding the security, usage of the contracts:

- The smart contract is coded according to the newest standards and in a secure way
- The changes since the last audit didn't effected the codebase https://github.com/chainsulting/S
  Audits/blob/master/1inch_Exchange/02_Smart%20Contract%20Audit_1inch_limit_order_protoc

The main goal of this audit was to verify these claims. The auditors can provide additional feedback or
request.



5.1 Manual and Automated Vulnerability Test

CRITICAL ISSUES
During the audit, Chainsulting‘s experts found **no Critical issues** in the code of the smart contract.

HIGH ISSUES
During the audit, Chainsulting’s experts found **no High issues** in the code of the smart contract.

MEDIUM ISSUES
During the audit, Chainsulting’s experts found **no Medium issues** in the code of the smart contract

LOW ISSUES
During the audit, Chainsulting’s experts found **no Low issues** in the code of the smart contract

INFORMATIONAL ISSUES
During the audit, Chainsulting’s experts found **no Informational issues** in the code of the smart contr

5.2. SWC Attacks

ID	Title	Relationships
SWC-131	Presence of unused variables	CWE-1164: Irrelevant Code
SWC-130	Right-To-Left-Override control character (U+202E)	CWE-451: User Interface (UI) Misrepresentation of
SWC-129	Typographical Error	CWE-480: Use of Incorrect Operator
SWC-128	DoS With Block Gas Limit	CWE-400: Uncontrolled Resource Consumption
SWC-127	Arbitrary Jump with Function Type Variable	CWE-695: Use of Low-Level Functionality
SWC-125	Incorrect Inheritance Order	CWE-696: Incorrect Behavior Order
SWC-124	Write to Arbitrary Storage Location	CWE-123: Write-what-where Condition
SWC-123	Requirement Violation	CWE-573: Improper Following of Specification by C

ID	Title	Relationships
SWC-122	Lack of Proper Signature Verification	CWE-345: Insufficient Verification of Data Authentic
SWC-121	Missing Protection against Signature Replay Attacks	CWE-347: Improper Verification of Cryptographic S
SWC-120	Weak Sources of Randomness from Chain Attributes	CWE-330: Use of Insufficiently Random Values
SWC-119	Shadowing State Variables	CWE-710: Improper Adherence to Coding Standards
SWC-118	Incorrect Constructor Name	CWE-665: Improper Initialization
SWC-117	Signature Malleability	CWE-347: Improper Verification of Cryptographic S
SWC-116	Timestamp Dependence	CWE-829: Inclusion of Functionality from Untruste
SWC-115	Authorization through tx.origin	CWE-477: Use of Obsolete Function
SWC-114	Transaction Order Dependence	CWE-362: Concurrent Execution using Shared Reso Synchronization ('Race Condition')

ID	Title	Relationships
SWC-113	DoS with Failed Call	CWE-703: Improper Check or Handling of Exceptio
SWC-112	Delegatecall to Untrusted Callee	CWE-829: Inclusion of Functionality from Untruste
SWC-111	Use of Deprecated Solidity Functions	CWE-477: Use of Obsolete Function
SWC-110	Assert Violation	CWE-670: Always-Incorrect Control Flow Implemer
SWC-109	Uninitialized Storage Pointer	CWE-824: Access of Uninitialized Pointer
SWC-108	State Variable Default Visibility	CWE-710: Improper Adherence to Coding Standard
SWC-107	Reentrancy	CWE-841: Improper Enforcement of Behavioral Wo
SWC-106	Unprotected SELFDESTRUCT Instruction	CWE-284: Improper Access Control
SWC-105	Unprotected Ether Withdrawal	CWE-284: Improper Access Control
SWC-104	Unchecked Call Return Value	CWE-252: Unchecked Return Value

ID	Title	Relationships
SWC-103	Floating Pragma	CWE-664: Improper Control of a Resource Through
SWC-102	Outdated Compiler Version	CWE-937: Using Components with Known Vulnerab
SWC-101	Integer Overflow and Underflow	CWE-682: Incorrect Calculation
SWC-100	Function Default Visibility	CWE-710: Improper Adherence to Coding Standards

5.3. Verify Claims

5.3.1 The smart contract is coded according to the newest standards and in a secure way
Status: tested and verified ✅

5.3.2 The changes since the last audit didn’t affected the codebase
Status: tested and verified ✅

6. Executive Summary

Two (2) independent Chainsulting experts performed an unbiased and isolated audit of the smart cont
took place on the October 16, 2021. The main goal of the audit was to verify the claims regarding the
and regards the changes that has been made since the last audit.

During the audit, no critical issues were found after the manual and automated security testing and the
verified.