Project Catalyst Milestone Report

Cardano Native Token DEX Price Indexer in Kotlin

Project ID: 1200061
16 Sep 2024

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Version History

Version	Change
1.0	Milestone 1 (Proof of Concept) – 16 Sep 2024

1. Introduction

1.1. Identification

This report contains progressive milestone reporting for the Cardano Native Token (CNT) Decentralised Exchange (DEX) Price Indexer, project (Project ID: 1200061).

1.2. Objectives

This report aims to:

- Summarise Objective Quality Evidence (OQE) pertaining to the system's ability to address requirements, organised by agreed milestones.

1.3. System Description

Kotlin DEX Price Indexer (https://github.com/Edgxtech/prise) is a database indexer which tracks the Cardano blockchain in near real-time, detects any DEX trading events, computes and persists related prices including latest price and historical candles. The system currently uses;

- Bloxbean Yaci JVM based Cardano mini-protocols library
- Cardano Foundation Token Registry for CNT metadata (modular, can be swapped)
- Trades obtained from on-chain Cardano DEX data including Minswap V1/V2, Sundaeswap V1 and Wingriders (modular can be extended)
- dcSpark Carp general purpose indexer, only for txOutput resolution (modular option)
- Koios & Blockfrost general data APIs, only for txOutput resolution (modular option)
- Koin dependency injection

2. Project Milestones

Milestone 1 - Proof of Concept progress release, Sep 2024

Milestone Outputs	• Release of a system containing the foundational software architecture and providing the core requirement of generating and persisting price data • At least 1x (one) UTXO resolver external interface module • At least 1x (one) token metadata external interface module • At least 3x (three) DEX classifier(s)
Acceptance criteria	• 1.1 Can generate and persist latest price data from at least three (3) DEX's trading activity? • 1.2 Can generate and persist historical price candles data from at least three (3) DEX's trading activity?
Evidence of milestone completion	• Report section comparing a single DEX's latest prices for a sample of tokens (1.1) • Report section comparing a single DEX's historical price candles for a sample of tokens (1.2)
Method of Evidence Collection	• Software Testing (JUnit tests) covering DEX trading computations, price computations, historical candle computations and database interactions. Tests are included in the project software repository on Github under *indexer/src/test/kotlin*. • Manual Accuracy Comparisons of generated data compared to the popular Minswap DEX

Milestone 2 - Initial release, Nov 2024

Milestone Outputs	• Release of a system containing the foundational software architecture and providing the core requirements of generating and persisting price data and enabling query of data • At least 2x (two) UTXO resolver external interface modules • At least 1x (one) token metadata external interface module • At least 4x (four) DEX classifier(s)
Acceptance criteria	• 2.1 User can query latest price data? • 2.2 User can query historical price candles data?
Evidence of milestone completion	• Report section describing test serials and results for querying latest prices (2.1) • Report section describing test serials and results for querying historical prices (2.2)

Milestone 3 - Final Release, Dec 2024

Milestone Outputs	• Software capable of suitable performance for the intended operating environment • Final close-out report • Final closeout video
Acceptance criteria	• 3.1 User can install the software • 3.2 User can run the software • 3.3 User can maintain the software • Final closeout video is publicly available • Final closeout report is publicly available
Evidence of milestone completion	• Report section describing test serials and results for software installation (3.1) • Report section describing test serials and results for operating the software (3.2) • Report section describing test serials and results for maintaining the software (3.3) • Link to final closeout report • Link to final closeout video

3. Results – Milestone 1

3.1. Summary

Table 1: Summary of Milestone 1 Evidence

	Artefact	Location of Evidence
Milestone Outputs	• Release of a system containing the foundational software architecture and providing the core requirement of generating and persisting price data	• https://github.com/Edgxtech/prise
	• At least 1x (one) UTXO resolver external interface module	• https://github.com/Edgxtech/prise/blob/main/indexer/src/main/kotlin/tech/edgx/prise/indexer/service/dataprovider/module/carp/jdbc/CarpJdbcService.kt (implementation of a Carp based UTXO resolver)
	• At least 1x (one) token metadata external interface module	• https://github.com/Edgxtech/prise/blob/main/indexer/src/main/kotlin/tech/edgx/prise/indexer/service/dataprovider/module/tokenregistry/TokenRegistryService.kt (implementation of tokens.cardano.org metadata query)
	• At least 3x (three) DEX classifier(s)	• https://github.com/Edgxtech/prise/blob/main/indexer/src/main/kotlin/tech/edgx/prise/indexer/service/classifier/module/MinswapClassifier.kt -> /* Minswap V1 */ (Minswap V1) • https://github.com/Edgxtech/prise/blob/main/indexer/src/main/kotlin/tech/edgx/prise/indexer/service/classifier/module/MinswapV2Classifier.kt -> /* Minswap V2 */ (Minswap V2) • https://github.com/Edgxtech/prise/blob/main/indexer/src/main/kotlin/tech/edgx/prise/indexer/service/classifier/module/SundaeswapClassifier.kt (Sundaeswap V1) • https://github.com/Edgxtech/prise/blob/main/indexer/src/main/kotlin/tech/edgx/prise/indexer/service/classifier/module/WingridersClassifier.kt (Wingriders)

Acceptance criteria	• 1.1 Can generate and persist latest price data from at least three (3) DEX's trading activity?	• Table 2: Software Verification Test Results
		  • `tech.edgx.prise.indexer.service.classifier.*`
		  • `AssetServiceIT`
		  • `AssetRepositoryIT`
		• Table 4: Latest Price Comparison

	• 1.2 Can generate and persist historical price candles data from at least three (3) DEX's trading activity?	• Table 2: Software Verification Test Results
		  • `tech.edgx.prise.indexer.service.classifier.*`
		  • `HistoricalPriceServiceIT`
		  • `HistoricalPriceHelpers`
		• Table 3: Historical Price Comparison

Evidence of milestone completion	• Report section comparing a single DEX's latest prices for a sample of tokens	• Latest Price Comparison
	• Report section comparing a single DEX's historical price candles for a sample of tokens	• Historical Price Comparison

3.2. Software Verification Testing

Procedure

Test was conducted with the following test environment, equipment and procedures:

(i) Test Environment:

- Installation instructions are contained at: https://github.com/Edgxtech/prise/blob/main/README.md
- Test location(s): https://github.com/Edgxtech/prise/tree/main/indexer/src/test/kotlin/tech/edgx/prise/indexer
- Note: Tests of type Integration Test (IT) require a **`src/test/kotlin/prise.properties`** file with the following configs:
  - `cnode.address/cnode.port` – Cardano Node (https://github.com/IntersectMBO/cardano-node) pointing to a live synced node
  - either;

    (preferred)

    - `carp.datasource.*` - Carp (https://github.com/dcSpark/carp) configs pointing to a live synced Carp service,

      Or,

      (least preferred, or for development and testing purposes)

    - `koios.datasource.*` - Koios (https://api.koios.rest/) configs with API Key and URL, and
    - `blockfrost.datasource.*` - Blockfrost (https://blockfrost.io) configs with API Key and URL

    - `app.datasource.*` - MySQL configs point to a local database
- Software:
    - Maven is required for project building/testing
    - Java, JRE: 11, JDK: Liberica 11
    - Kotlin: 231-1.9.21-release-633-IJ8109.175

(ii) Test Equipment Used:

- MacBook Pro, Processor: Apple M1 Max, Memory: 64 GB Ram

(iii) Procedure to run a single test:

- From project root (prise/indexer), run: `mvn test -Dtest="<TestClassName>"`
- e.g. `mvn test -Dtest="WingridersClassifierTest"`

(iv) Procedure to run Unit Tests:

- From project root (prise/indexer), run: `mvn clean test`

(v) Procedure to run Integration Tests:

- From project root (prise/indexer), run: `mvn clean verify -DskipUnitTests`

(vi) Procedure to run all tests:

- From project root (prise/indexer), run: `mvn clean verify`

Results

Software testing results are contained in Table 2

Table 2: Software Verification Test Results

Summary

Tests	Errors	Failures	Skipped	Success Rate	Time
100	0	0	0	100.0%	311.1 s

Package List

Package	Tests	Errors	Failures	Skipped	Success Rate	Time
tech.edgx.prise.indexer.util	6	0	0	0	100%	0.533 s
tech.edgx.prise.indexer.service.dataprovider	2	0	0	0	100%	6.901 s
tech.edgx.prise.indexer.config	4	0	0	0	100%	0.015 s
tech.edgx.prise.indexer.service.price	24	0	0	0	100%	8.110 s
tech.edgx.prise.indexer.repository	4	0	0	0	100%	0.921 s
tech.edgx.prise.indexer.service.chaindb	6	0	0	0	100%	7.902 s
tech.edgx.prise.indexer.service.chain	5	0	0	0	100%	13.13 s
tech.edgx.prise.indexer.service	6	0	0	0	100%	0.309 s
tech.edgx.prise.indexer.service.classifier	43	0	0	0	100%	273.3 s

tech.edgx.prise.indexer.util

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	HelpersTest	6	0	0	0	100%	0.533 s

tech.edgx.prise.indexer.service.dataprovider

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	TokenRegistryServiceIT	2	0	0	0	100%	6.901 s

tech.edgx.prise.indexer.config

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	ConfigTest	4	0	0	0	100%	0.015 s

tech.edgx.prise.indexer.service.price

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	HistoricalPriceHelpersTest	20	0	0	0	100%	4.751 s
passed	HistoricalPriceServiceIT	4	0	0	0	100%	3.359 s

tech.edgx.prise.indexer.repository

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	AssetRepositoryIT	4	0	0	0	100%	0.921 s

tech.edgx.prise.indexer.service.chaindb

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	CarpJdbcServiceIT	4	0	0	0	100.0%	6.007 s
passed	KoiosServiceIT	2	0	0	0	100%	1.895 s

tech.edgx.prise.indexer.service.chain

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	ChainServiceIT	5	0	0	0	100%	13.13 s

tech.edgx.prise.indexer.service

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	CandleServiceIT	4	0	0	0	100%	0.246 s
passed	AssetServiceIT	2	0	0	0	100%	0.063 s

tech.edgx.prise.indexer.service.classifier

	Class	Tests	Errors	Failures	Skipped	Success Rate	Time
passed	WingridersClassifierTest	2	0	0	0	100%	0.185 s
passed	SundaeswapClassifierTest	2	0	0	0	100%	0.043 s
passed	MinswapClassifierTest	5	0	0	0	100%	0.018 s
passed	MinswapV2ClassifierTest	10	0	0	0	100%	0.338 s
passed	MinswapV2ClassifierIT	6	0	0	0	100%	68.34 s
passed	MinswapClassifierIT	6	0	0	0	100%	138.2 s
passed	SundaeswapClassifierIT	6	0	0	0	100%	38.12 s
passed	WingridersClassifierIT	6	0	0	0	100%	28.08 s

Test Cases

WingridersClassifierTest

passed	computeSwap_DuelSwapSingleTransaction	0.158 s

passed	computeSwap_SingleSwapSingleTransaction	0.026 s

SundaeswapClassifierTest

passed	computeSwap_TripleSwapSingleTransaction	0.037 s
passed	computeSwap_SingleSwapSingleTransaction	0.005 s

ConfigTest

passed	validateProperties_1	0.009 s
passed	validateProperties_2	0.002 s
passed	validateProperties_3	0.002 s
passed	validateProperties_4	0.001 s

MinswapClassifierTest

passed	computeSwap_NilSwap_3	0.004 s
passed	computeSwaps_SingleSwapSingleTransaction_5	0.003 s
passed	computeSwap_SingleSwapSingleTransaction_1	0.004 s
passed	computeSwap_SingleSwapSingleTransaction_2	0.003 s
passed	computeSwap_SingleSwapSingleTransaction_4	0.002 s

HistoricalPriceHelpersTest

passed	determineTriggers_FinaliseOnly	0.012 s
passed	makeKnownDailyCandle	0.216 s
passed	makeKnownWeeklyCandle	0.011 s
passed	determineClosePrice_NoSlotDuplicates	0.060 s
passed	determineOpenPrice	0.657 s
passed	determineTriggers_None	0.001 s
passed	determineTriggers_Update	0.001 s
passed	filterOutliers_GrubsTest	3.566 s
passed	filterOutliers_ExponentialMovingAverageTest_PrimitiveDT	0.019 s
passed	makeSuperCandles_HourlyFromFifteen	0.002 s
passed	makeKnownFifteenCandle	0.007 s

passed	determineTriggers_FinaliseAndInitialise_NewSwapsAcrossBoundary	0.001 s
passed	makeKnownHourlyCandleFromSubCandles	0.009 s
passed	determineTriggers_FinaliseAndInitialiseNext	0 s
passed	determineClosePrice_WithSlotDuplicates	0.045 s
passed	filterOutliers_ExponentialMovingAverageTest	0.004 s
passed	filterOutliersGrubbsTest	0.001 s
passed	transformTradesToPrices	0 s
passed	makeRandomCandles	0.129 s
passed	makeKnownHourlyCandle	0.004 s

MinswapV2ClassifierTest

passed	computeSwap_SingleTransaction_SingleSwap_1	0.010 s
passed	computeSwap_SingleTransaction_SingleSwap_2	0.004 s
passed	computeSwap_SingleTransaction_SingleSwap_3	0.025 s
passed	computeSwap_SingleTransaction_SingleSwap_4	0.006 s
passed	computeSwaps_QtyTransaction_QtySwaps_1	0.053 s
passed	computeSwaps_QtyTransaction_QtySwaps_2	0.144 s
passed	computeSwaps_QtyTransaction_QtySwaps_3	0.079 s
passed	computeSwap_SingleTransaction_SingleSwap_Type3_SwapExactOut	0.003 s
passed	computeSwaps_SingleTransaction_Type4_Deposit	0.004 s
passed	computeSwaps_SingleTransaction_QtySwaps_Type3_SwapExactOut	0.005 s

HelpersTest

passed	convertAddressToCredential	0.514 s
passed	getDexName	0.002 s
passed	calculatePriceInOtherAsset	0.001 s
passed	findEarliestDate	0.001 s
passed	regexpMatchPolicy	0.001 s
passed	decodeHexString	0.001 s

MinswapV2ClassifierIT

passed	computeSwaps_SingleTransaction_QtySwaps	2.424 s
passed	computeSwaps_QtyTransaction_QtySwaps_2	15.89 s
passed	computeSwaps_SingleTransaction_SingleSwap_1	1.301 s
passed	computeSwaps_SingleTransaction_SingleSwap_2	1.620 s
passed	computeSwaps_FromChainSync_TimePeriod	40.06 s
passed	computeSwaps_SingleTransaction_Type4_Deposit	3.681 s

TokenRegistryServiceIT

passed	bulkGetDecimalsAllTokens	5.641 s
passed	bulkGetDecimals	1.207 s

MinswapClassifierIT

passed	computeSwaps_FromChainSync_TimePeriod	126.1 s
passed	computeSwaps_SingleTransaction_1	1.632 s
passed	computeSwaps_SingleTransaction_2	2.155 s
passed	computeSwaps_SingleTransaction_3	2.135 s
passed	computeSwaps_SingleTransaction_4	1.825 s
passed	computeSwaps_SingleTransaction_5	1.935 s

CandleServiceIT

passed	crudTest	0.135 s
passed	checkAndMakeIndexes	0.007 s
passed	getCandlesBetweenTimes	0.037 s
passed	clearAllCandles	0.020 s

CarpJdbcServiceIT

passed	getInputUtxos_2	0.329 s
passed	getBlockNearestToSlot	1.108 s

passed	Expected value to be true.	-
passed	getBlockNearestToSlot_Specific	1.446 s
passed	getInputUtxos	0.639 s

HistoricalPriceServiceIT

passed	makeCandlesFromSwaps_10tx	0.141 s
passed	testMakeKnownFifteenCandle	0.073 s
passed	batchProcessHistoricalPrices_TriggersFinaliseAndInitialise	2.918 s
passed	batchProcessHistoricalPrices_TriggerUpdate	0.141 s

AssetServiceIT

passed	crudTest	0.033 s
passed	isDatabaseUptoDate	0.005 s

SundaeswapClassifierIT

passed	computeSwaps_FromChainSync_TimePeriod	26.55 s
passed	computeSwaps_SingleTransaction_1_Reactive	1.735 s
passed	computeSwaps_SingleTransaction_1	1.743 s
passed	computeSwaps_SingleTransaction_2	1.419 s
passed	computeSwaps_SingleTransaction_3	1.816 s
passed	computeSwaps_SingleTransaction_4	2.217 s

KoiosServiceIT

passed	getBlockNearestToSlot	0.001 s
passed	getInputUtxos	1.852 s

WingridersClassifierIT

passed	computeSwaps_FromChainSync_TimePeriod	16.03 s
passed	computeSwaps_SingleTransaction_1	1.514 s

passed	computeSwaps_SingleTransaction_2	2.771 s
passed	computeSwaps_SingleTransaction_3	1.765 s
passed	computeSwaps_SingleTransaction_4	1.828 s
passed	computeSwaps_SingleTransaction_5	1.729 s

AssetRepositoryIT

passed	batchUpdateMissingOriginal	0.344 s
passed	batchUpdateSomeOnly	0.021 s
passed	batchInsert	0.013 s
passed	batchUpdate	0.019 s

ChainServiceIT

passed	autoSelectPoint_ProvidedInConfig	1.393 s
passed	autoSelectPoint_NoPriorCandles	2.000 s
passed	qualifyTransactions	2.627 s
passed	autoSelectPoint_PriorCandles_1	1.529 s
passed	autoSelectPoint_PriorCandles_2	2.809 s

3.3. Accuracy Validation

Procedure

Test was conducted with the following test environment, equipment and procedures:

(i) Test Environment:

- Software:
  - 'Prise' version: `commit 5a9414809cd8f9c2d6e9f68752cb3315b9dd1379`
    - Synced to local DB for ~1week of blockchain time, from 01 Aug 24 0000 UTC *(`start.point.time=1722470400`)*
    - Configured with 4x DEX Classifiers; `Sundaeswap V1, Wingriders V1, Minswap V1, Minswap V2`

- Custom Flutter charting application using lightweight Trading View charts for demonstrating historical data

(ii) Procedure:

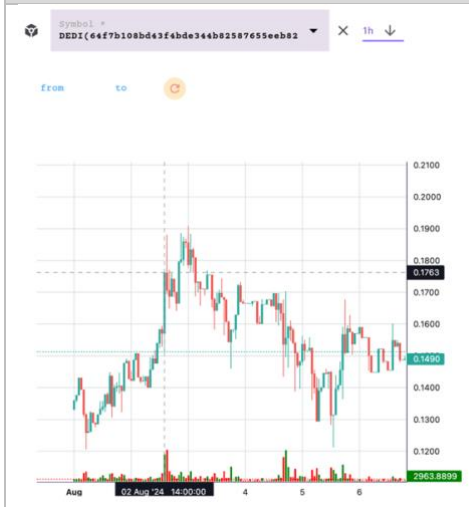
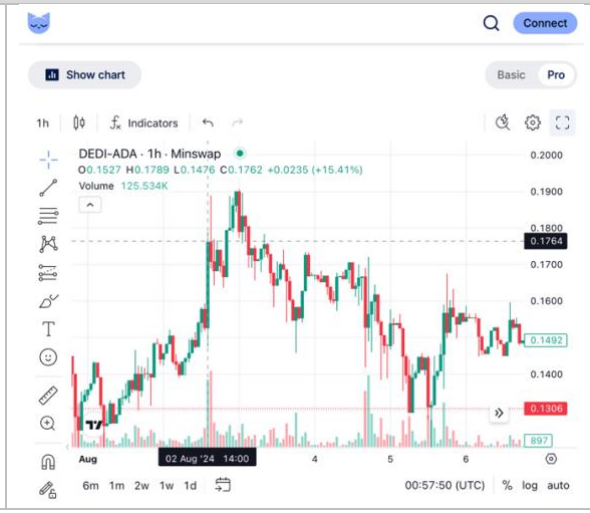
- For a sample of Cardano Native Tokens (CNT):
  - chart historical data, screenshot the charts focussing on daily, hourly and 15min charts
  - screenshot the same time range from Minswap (well-known DEX) charts
  - visually compare historical charts, expecting the ‘big hands’ view to be correct; price/volume magnitudes and shape.
  - retrieve latest prices from a backend database query of the ‘asset’ table for a given token, compare against Minswap V1/V2 trade at the same time

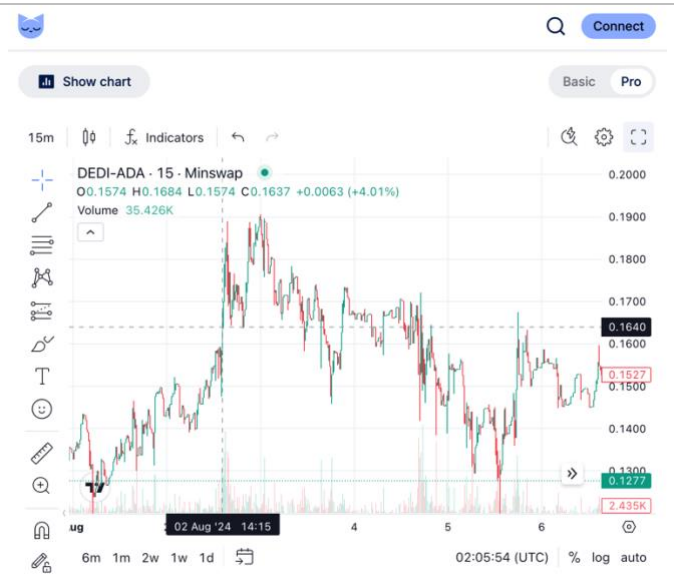
Historical Price Comparison

Considerations and Exceptions:

- Expect the magnitudes to be equivalent, not necessarily perfect number matching since:
  - ‘Prise’ is using data from multiple DEX’s
  - Minswap are counting additional ‘Zaps’ and other non-SWAP_EXACT_IN type activities trade data (which only make up a small % of activity)
  - It is unknown what specific outlier filtering (if any) is being used in the comparison data
- At this milestone, only a ~1 week slice of data is compared for validation since it takes time to sync data, hence the focus of validation is on historical data for that slice of time

Table 3: Historical Price Comparison

Prise Chart	MinswapV2 Chart	Notes
TOKEN: DEDI (64f7b108bd43f4bde344b82587655eeb821256c0c8e79ad48db15d1844454449)		
		**Candle Resolution:** 1 hour **Pointer location:** 02 Aug 24 1400 UTC (1722607200) **Volume (not shown at pointer):** Prise: 115.877k Minswap: 125.534k Ok *** Difference due to not extracting non-SWAP_EXACT_IN trading activity (e.g. Zaps), to be investigated in future milestones* **Shape:** Ok **Time alignment:** Ok **Price Magnitude:** Ok (0.19 ADA)



Candle Resolution: 15 Minutes

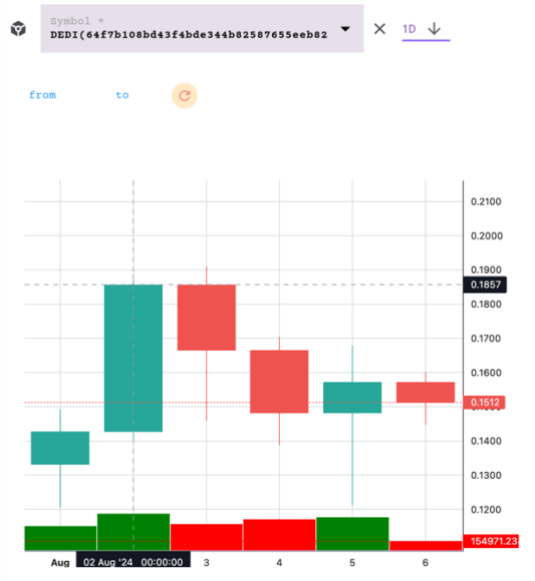
Pointer location: 02 Aug 24 1415 UTC (1722608100)

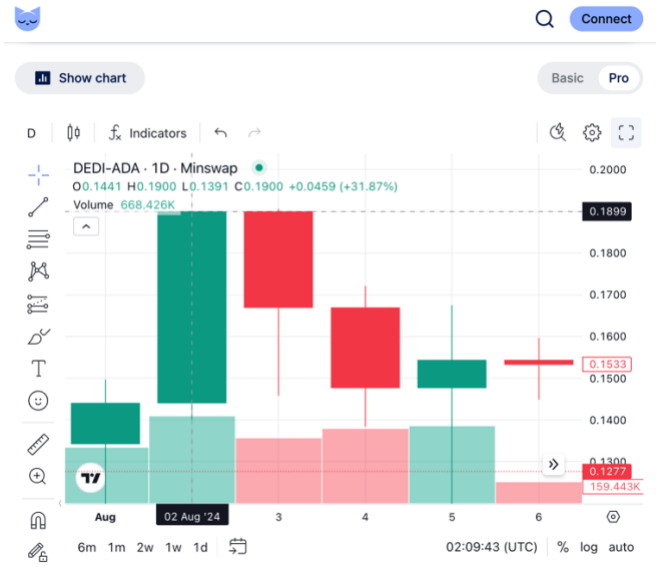
Volume (not shown at pointer):
Prise: 35.4257k
Minswap: 35.426k
Ok

Shape: Ok

Time alignment: Ok

Price Magnitude: Ok (0.19 ADA)





Candle Resolution: 1 Day

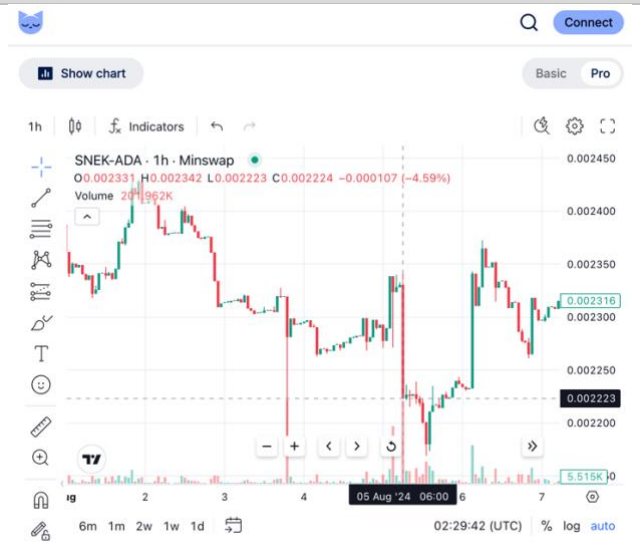
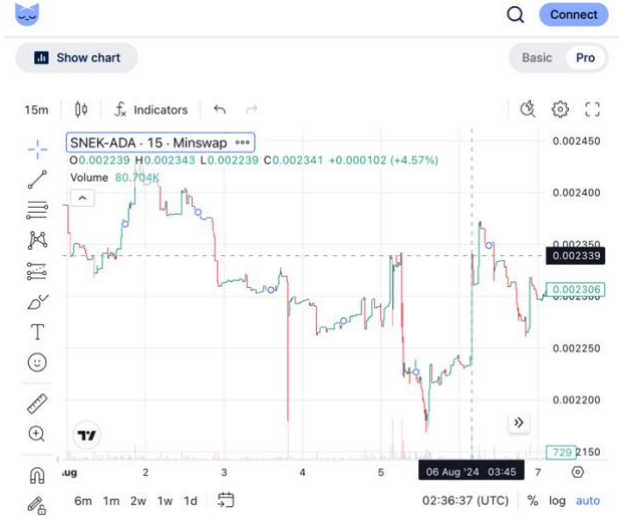
Pointer location: 02 Aug 24 0000 UTC (1722556800)

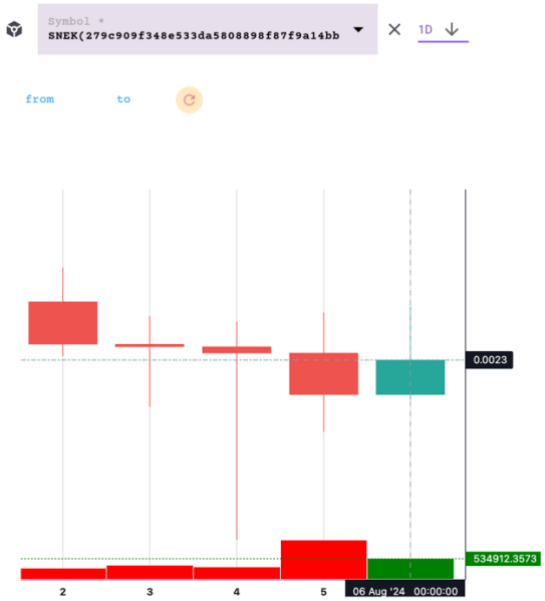
Volume (not shown at pointer):
Prise: 631.891k
Minswap: 668.426k
Ok
** Difference due to not extracting non-SWAP_EXACT_IN trading activity (e.g. Zaps), to be investigated in future milestones

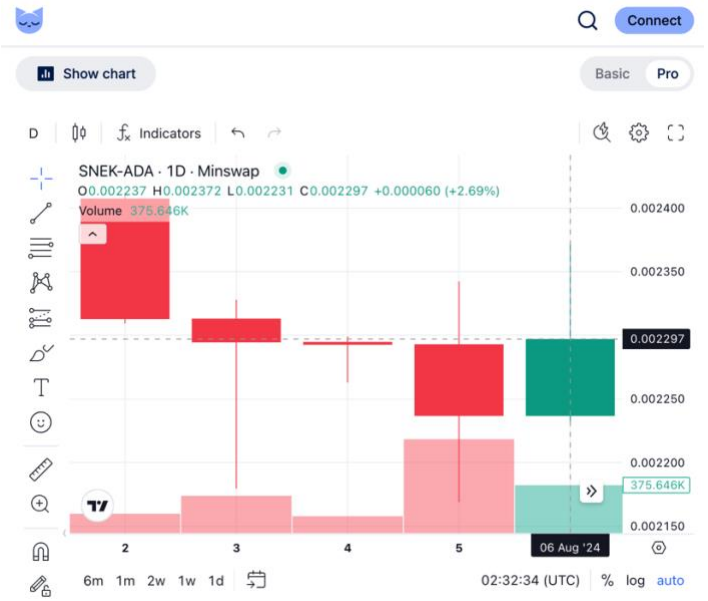
Shape: Ok

Time alignment: Ok

Price Magnitude: Ok (~0.19 ADA)

TOKEN: SNEK (279c909f348e533da5808898f87f9a14bb2c3dfbbacccd631d927a3f534e454b)		
		**Candle Resolution:** 1 hour **Pointer location:** 05 Aug 24 0600 UTC (1722837600) **Volume (not shown at pointer):** Prise: 283.329k Minswap: 201.962k Ok ** Difference due to SNEK trading on multiple DEXs and significant volume on other DEXs for this candle period. Also Prise is not extracting non-SWAP_EXACT_IN trading activity (e.g. Zaps), to be investigated in future milestones **Shape:** Ok **Time alignment:** Ok **Price Magnitude:** Ok (~0.002 ADA) **Comment:** Prise data appears choppier since SNEK is traded on more DEXs and there is more discrepancy between DEXs, as opposed to previous example (DEDI) which is mostly traded on MinswapV2
		**Candle Resolution:** 15 minutes **Pointer location:** 06 Aug 24 0345 UTC (1722915900) **Volume (not shown at pointer):** Prise: 103.905k Minswap: 80.704k Ok ** Difference due to SNEK trading on multiple DEXs and significant volume on other DEXs for this candle period. Also Prise is not extracting non-SWAP_EXACT_IN trading activity (e.g. Zaps), to be investigated in future milestones **Shape:** Ok **Time alignment:** Ok **Price Magnitude:** Ok (~0.002 ADA) **Comment:** Prise data appears choppier since SNEK is traded on more DEXs and there is more discrepancy between DEXs, as opposed to previous example (DEDI) which is mostly traded on MinswapV2





Candle Resolution: 1 Day

Pointer location: 06 Aug 24 0000 UTC (1722902400)

Volume (not shown at pointer):
Prise: 331.9k
Minswap: 375.646k
Ok
** Difference due to not extracting non-SWAP_EXACT_IN trading activity (e.g. Zaps), to be investigated in future milestones

Shape: Ok

Time alignment: Ok

Price Magnitude: Ok (~0.002 ADA)

Latest Price Comparison

Considerations and Exceptions:

- The indexer was stopped at an arbitrary point ~1 week in blockchain time from 01 Aug 24, which is reflected in the date this comparison is made
- Comparing at an arbitrary point in time is merely to avoid needing to synch the entire blockchain history for this testing
- The primary comparison DEX is Minswap v1/v2 since the data is available publicly using date/time filters
- The comparison price was taken from the DEX web application trading history page, e.g. *https://minswap.org/swap?cA=da8c30857834c6ae7203935b89278c532b3995245295456f993e1d24&tA=4c51&cB=&tB=*

Overview of Results:

- For the indexer running over the time 01 Aug - ~07 Aug 24:
  - Total entries persisted in database: 661
  - Unique DEX's: 4x DEX smart contracts
- A comparison of prices at the point the indexer was stopped, for a sample of tokens is provide in Table 4.

Table 4: Latest Price Comparison

Token	Policy	Price [ADA]	DEX	Last Update [UTC+8]	Comparison	Result
CHARLI3	8e5139890…b9490e15a	0.22241981	minswap	7/8/2024 4:11	0.222 @ 0411 Tx	Ok (exact)
CHARLI3	8e5139890…b9490e15a	0.22179735	sundaeswap	6/8/2024 15:10	-	Ok (equivalent)
CHARLI3	8e5139890…b9490e15a	0.22753845	wingriders	7/8/2024 5:38	-	Ok (equivalent)
DEDI	64f7b108b…48db15d18	0.15565952	minswapv2	7/8/2024 7:42	0.155 @ 0742 Tx	Ok (exact)
HOSKY	a0028f350…7d481c235	2.57E-08	minswap	7/8/2024 7:00	0.0_7257 @ 0700	Ok (exact)
HOSKY	a0028f350…7d481c235	2.56E-08	minswapv2	7/8/2024 7:23	0.0_7256 @ 0723	Ok (exact)
HOSKY	a0028f350…7d481c235	2.57E-08	sundaeswap	5/8/2024 23:10	-	Ok (equivalent)
HOSKY	a0028f350…7d481c235	2.6834E-08	wingriders	7/8/2024 4:56	-	Ok (equivalent)
LQ	da8c30857…f993e1d24	2.1393E-06	minswap	6/8/2024 23:08	2.139 @ 06Aug 2308	Ok (exact)

LQ	da8c30857…f993e1d24	2.10727201	minswapv2	7/8/2024 6:18	2.107 @ 0618	Ok (exact)
LQ	da8c30857…f993e1d24	2.09253137	sundaeswap	7/8/2024 0:58	-	Ok (equivalent)
LQ	da8c30857…f993e1d24	2.13325889	wingriders	7/8/2024 6:44	-	Ok (equivalent)
MIN	29d222ce7…d267170c6	0.04265584	minswap	7/8/2024 6:15	0.0426 @ 0615 Tx	Ok (exact)
MIN	29d222ce7…d267170c6	0.04240157	minswapv2	7/8/2024 7:04	0.0424 @ 0704	Ok (exact)
MIN	29d222ce7…d267170c6	0.05022207	sundaeswap	7/8/2024 4:07	-	Ok (equivalent)
MIN	29d222ce7…d267170c6	0.04505389	wingriders	7/8/2024 1:38	-	Ok (equivalent)
orcfaxtoken	a3931691f…32a6c1e51	0.02571787	minswap	4/8/2024 8:37	0.0257 @ 04Aug 0837 Tx	Ok (exact)
orcfaxtoken	a3931691f…32a6c1e51	0.02567866	minswapv2	7/8/2024 3:58	0.0256 @ 07Aug 0358	Ok (exact)
orcfaxtoken	a3931691f…32a6c1e51	0.0261956	sundaeswap	5/8/2024 9:34	-	Ok (equivalent)
orcfaxtoken	a3931691f…32a6c1e51	0.02574555	wingriders	6/8/2024 23:08	-	Ok (equivalent)
PAVIA	884892bcd…0e7a903ae	0.00289664	minswap	7/8/2024 7:42	0.00289 @ 0742	Ok (exact)
PAVIA	884892bcd…0e7a903ae	0.0029369	minswapv2	7/8/2024 7:02	0.00293 @ 0702 Tx	Ok (exact)
PAVIA	884892bcd…0e7a903ae	0.00295873	sundaeswap	7/8/2024 6:31	-	Ok (equivalent)
PAVIA	884892bcd…0e7a903ae	0.00292703	wingriders	7/8/2024 7:37	-	Ok (equivalent)
REVU	94cbb4fcb…c4c135864	0.03326211	minswap	6/8/2024 2:08	0.0332 @ 0208 Tx	Ok (exact)
REVU	94cbb4fcb…c4c135864	0.03679635	sundaeswap	6/8/2024 9:32	-	Ok (equivalent)
REVU	94cbb4fcb…c4c135864	0.03736526	wingriders	6/8/2024 5:09	0.03671652 @ 0509 Tx	Ok (equivalent)
ShenMicroUSD	8db269c3e…879a1cd61	1.02518536	minswap	7/8/2024 3:16	1.0251 @ 0316 Tx	Ok (exact)
ShenMicroUSD	8db269c3e…879a1cd61	1.02483286	minswapv2	7/8/2024 6:44	1.0248 @ 0644	Ok (exact)
ShenMicroUSD	8db269c3e…879a1cd61	1.11243162	sundaeswap	1/8/2024 22:40	-	Ok (equivalent)
ShenMicroUSD	8db269c3e…879a1cd61	1.02686275	wingriders	7/8/2024 3:16	-	Ok (equivalent)
SUNDAE	9a9693a9a…4aa144d77	0.01584183	minswap	6/8/2024 22:42	0.0158 @ 2242 Tx	Ok (exact)
SUNDAE	9a9693a9a…4aa144d77	0.01644704	sundaeswap	7/8/2024 0:06	-	Ok (equivalent)

SUNDAE	9a9693a9a…4aa144d77	0.01669488	wingriders	6/8/2024 13:34	0.01647 @ 1204 Tx	Ok (equivalent)
worldmobiletoken	1d7f33bd2…2a0f34e1e	0.54209603	minswap	7/8/2024 6:07	0.542 @ 0607 Tx	Ok (exact)
worldmobiletoken	1d7f33bd2…2a0f34e1e	0.5413276	minswapv2	7/8/2024 7:13	0.541 @ 0713 Tx	Ok (exact)
worldmobiletoken	1d7f33bd2…2a0f34e1e	0.54099246	sundaeswap	7/8/2024 7:24	-	Ok (equivalent)
worldmobiletoken	1d7f33bd2…2a0f34e1e	0.54199875	wingriders	7/8/2024 6:41	-	Ok (equivalent)

3.4. Discussion

The software meets the requirements for Milestone 1 – Proof of Concept progress release. The software can effectively generate and persist latest price and historical candle data for a range of Decentralised Exchanges (DEX). The accuracy of generated data matches other publicly available trading data.

4. Results – Milestone 2

TBI

5. Results – Milestone 3

TBI

6. Conclusion

TBI