

Smartlink
Vortex Protocol V1

Decentralized AMM
built on the Tezos Blockchain

Whitepaper

September 2021

1 - Introduction

Vortex is an automated market maker (AMM) liquidity protocol. Instead of a classic order book, a factory smart contract creates liquidity pool smart contracts for each pair.

This means the first person that adds liquidity to a pair also creates the unique pool for that particular pair.

The pools keep track of the liquidity added and removed at all times.

For a given liquidity pool, each pool uses the function $x * y = k$ to maintain a curve along which trades can happen, with x and y indicating the quantity of the tokens, and k a scalar (invariant).

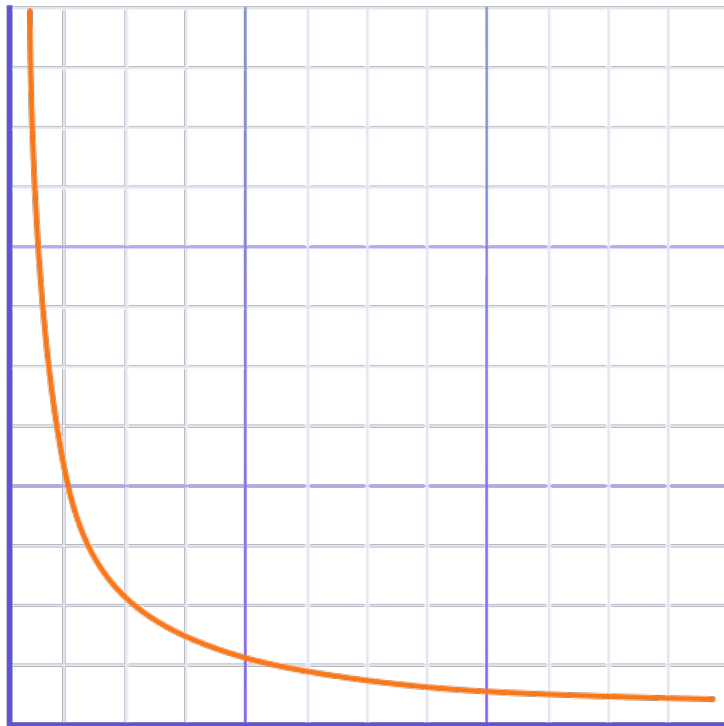


Fig.1: The function $x * y = k$

When someone trades, it is equivalent to moving on the curve and the prices adjust accordingly to maintain the value of 'k.'

When you swap a token, you're trading against the pool and it doesn't require a matching order from another user.

For example, if there are 1000 A tokens and 1000 XTZ in the pool,

$$k = 1000 * 1000 = 1000000.$$

If a trader wants to trade 20 A tokens against some XTZ, without fees he would receive x XTZ such that:

$$(1000 + 20) * (1000 - x) = k = 1000000$$

This leads to:

$$x = \frac{20000}{1020} \approx 19.608$$

But since there are fees (see Price and Fees), the trader will actually receive:

$$\bar{x} = \frac{9972 * 1000 * 20}{10000 * 1020} = \frac{9972}{10000} x \approx 19.553$$

Since the fees remain in the pool as long as liquidity providers do not withdraw liquidity besides the fees to the Smartlink Treasury and towards \$SMAK token buy back and burn which together are worth:

$$f = \frac{3x}{10000} = 0.006,$$

k slightly increases to:

$$(1000 + 20) * (1000 - \bar{x} - f) = 1000050$$

However, still with 1000 A tokens and 1000 XTZ in the reserve, if a trader wants to trade 20 XTZ against some A tokens, he would receive y A tokens such that:

$$(1000 + 0.9972 * 20) * (1000 - y) = k .$$

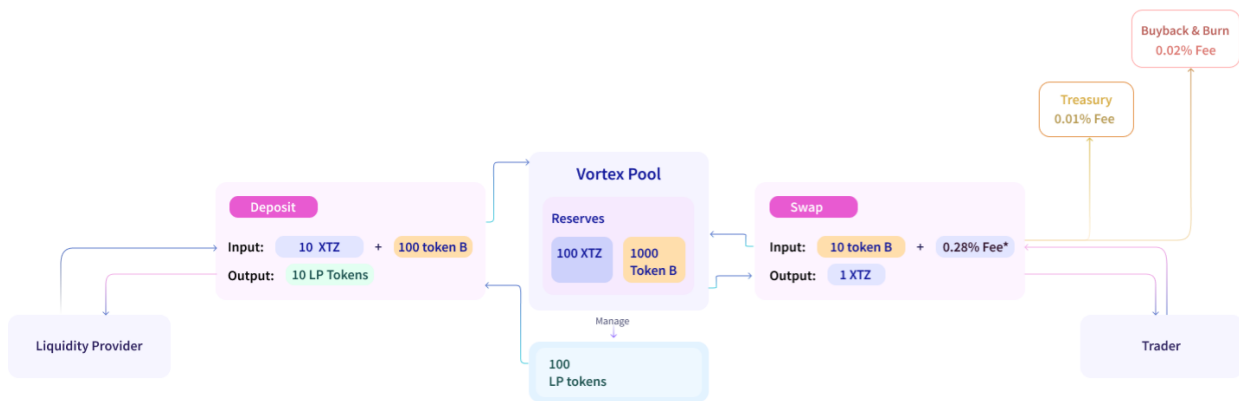
This leads to:

$$y = \frac{0,9972 * 20 * 1000}{1000 + 0,9972 * 20} \approx 19.554$$

k slightly increases to:

$$(1000 + 0.9997 * 20) * (1000 - y) \approx 1000049$$

Click on the picture to zoom in:



*For each trade 0.28% fee is paid, 0.01% goes to the Smartlink Treasury and 0.02% to Buyback and Burn.

Each pool is decentralized and includes functionalities to swap tokens and manage liquidity, including adding and removing liquidity.

2 - Composability

Smartink's decentralized exchange follows the following rules, with 0.28% overall fees, when the initial reserves are x of token XTZ and y of tokens and the user sells a of XTZ to receive b , the following can be observed with k being invariant:

$$(x + 0.9972 * a) * (y - b) = x * y = k$$

By symmetry, the following formula holds with a sale of b tokens to receive a :

$$(x - a) * (y + 0.9972 * b) = x * y = k$$

Definition

Composability of such a decentralized exchange means that a trader gets the same price from participating all at once as in a set of small trades. Therefore, traders do not need to strategize how they make trades, which can be complex to achieve in a public blockchain context. They are therefore financially incentivized to quickly perform the largest possible trades, which has a positive impact on the gains of liquidity providers.

Proof

Let $a_1, a_2 > 0$ and b_1, b_2 such that, with $a = a_1 + a_2$ and $b = b_1 + b_2$:

$$(x + 0.9972 * a_1) * (y - b_1) = k = \left(x + 0.9972 * (a_1 + a_2) \right) * (y - (b_1 + b_2)) = (x + 0.9972 * a) * (y - b)$$

That means that with initial reserves of x of token XTZ and y of tokens a user may sell a_1 of XTZ to receive b_1 of tokens and then a_2 of XTZ to receive b_2 of tokens.

Or a user may “directly” sell $a = a_1 + a_2$ of XTZ to receive $b = b_1 + b_2$ of tokens.

Let b_2 such that:

$$(x + 0.9972 * a_2) * (y - \tilde{b}_2) = k$$

Note that \tilde{b}_2 is not necessarily equal to b_2 .

Recall that b is the only real such that:

$$(x + 0.9972 * a) * (y - b) = k$$

Hence, with initial reserves x of token XTZ and y of tokens a user may sell a_2 of XTZ to receive b_2 of tokens and then a_1 of XTZ to receive $b - b_2$ of tokens.

Or a user may "directly" sell $a = a_1 + a_2$ of XTZ to receive $b = b_1 + b_2$ of tokens.

As a consequence, a trader who sells a of XTZ receives the same amount b he would have received if he had either first sold a_1 and then a_2 or first a_2 and then a_1 . This is composability.

3 - Prices and fees

Prices

Prices are determined by the amount of each token in a pool. For a given liquidity pair, the smart contract maintains the above equation $x * y = k$.

For example, if you bring Δx tokens in order to swap for Δy XTZ then the following formula will be used

$$x * y = k = (x + \Delta x) * (y - \Delta y)$$

Since the product must still be equal to k . It is equivalent to :

$$\Delta y = y * \Delta x / (x + \Delta x)$$

Finally, we need to operate with integers only (Tezos doesn't manage floating numbers) and take a 0.28% fee, which means at the end of every transaction, the user receives $97.2\% = 9972 / 10000$:

$$\Delta y = 9972 * y * \Delta x / 10000 * (x + \Delta x) \Delta y = 9972 * y * \Delta x / 10000 * (x + \Delta x) \Delta y = 9972 * y * \Delta x / 10000 * (x + \Delta x)$$

If you bring Δx XTZ in order to swap for Δy tokens then the following formula will be used :

$$k = x * y = (x + 0.9972 * \Delta x) * (y - \Delta y)$$

Hence

$$\Delta y = \left(\frac{0.9972 * \Delta x * y}{x + 0.9972 * \Delta x} \right)$$

4 - Fees

The 0.28% fee taken against each swap is allocated as per the following ratio:

0.25% will be given to the liquidity providers

0.01% will be sent to Smartlink Treasury

0.02% will be used to buy back and burn \$SMAK tokens.