Velocity: An Autonomous, Open Source Platform for Derivatives

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Abstract

Velocity is an automated system for hedging risk on asset prices. It allows anyone to establish and participate in a marketplace on publicly accessible price feeds. The platform enables hedgers and speculators to take part in a market that reduces the threat of systemic risk.

Introduction

This paper proposes a method for automating derivatives contracts.

Velocity is a distributed autonomous derivatives marketplace. It allows people to hedge or gain exposure to movements on an underlying asset. An underlying asset can be the price of a cryptocurrency such as bitcoin or any other cryptographically-backed asset. In Velocity, all derivatives contracts are cash settled. Velocity allows users to hold leveraged positions on any given price feed in the distributed finance world.

Margin trading has long been centralized due to the complexity in managing risks of positions. Clearinghouses, brokers and other third parties are required for holding derivatives positions. Velocity removes the need for these third parties. It uses smart contract technology to enable automated derivatives. The smart contract functions as escrow between buyers and sellers as an autonomous clearinghouse.

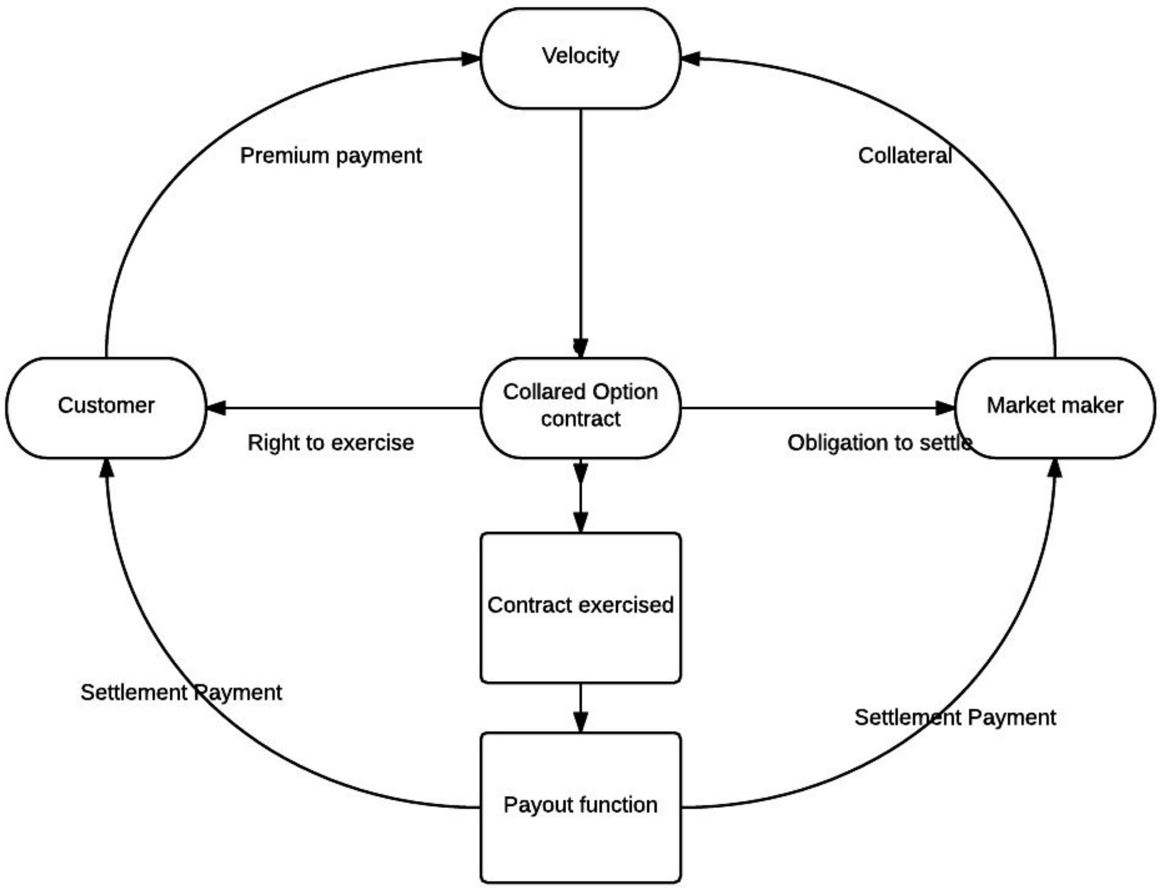
Concept

Velocity enables participants to hold leveraged positions on the movements of a price feed. Customers can buy and hold collar options contracts which are issued and settled autonomously. Collar options are an options contract with a cap on its maximum payout. Capping payouts allows the system to remain solvent and fully capitalized at all times.

Market makers can create new markets on different price feeds or leverages and time to expiry for offering liquidity to the system. These market makers, also known as liquidity providers, earn a fee. They generate revenue helping the system function efficiently. They also absorb risk inverse to the payout quoted to buyers in the system.

System Design

Velocity consists of multiple smart contracts. An overview of the structure:

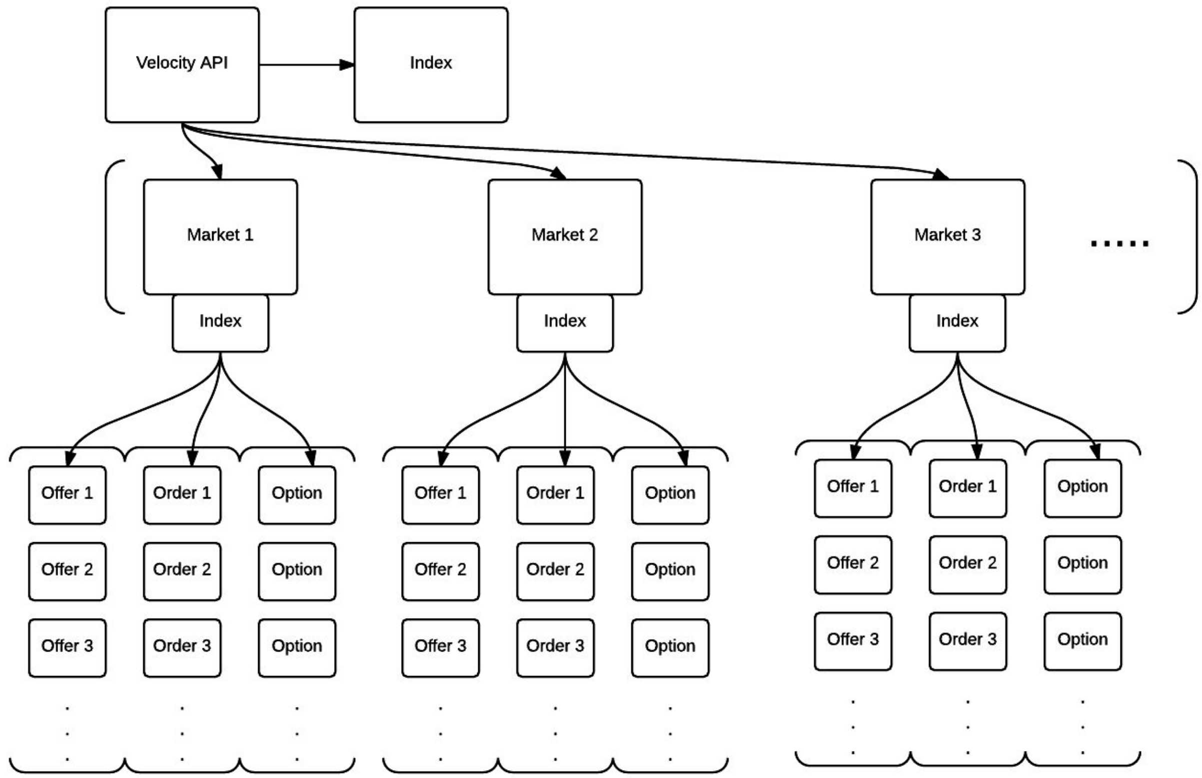


Smart Contracts

The purpose of a smart contract is to enforce performance of an agreed-upon set of negotiated standards. Smart contracts remove need for trusted intermediaries [1]. This paradigm replaces intermediaries with pre-defined logical parameters.

Life Cycle of an Option Contract

An option contract grants the owner of the contract the right but not the obligation to buy an asset at a price agreed price upon at an agreed future date. All options issued by Velocity are cash settled and capped to a maximum payout as agreed in the contract.



Note: Contracts like market, offer, order etc. are replicating contracts.

Participants

Option buyers

Buyers pay a fixed amount quoted as a premium to buy a contract in Velocity. The customer then holds the right to exercise the contract at any given point up until its expiration date. On that date, the option contract is automatically exercised. The amount according to the payout function defined in the contract is paid to the buyer.

Market makers

Market makers help keep Velocity risk neutral and provide system liquidity. Entrance to market making is as frictionless as possible. Options sold to buyers are provided by a market maker. In order to furnish liquidity, market makers hold assets that are collateralized equal to option contracts sold.

Developers

Developers utilize the Velocity API in order to facilitate transactions. They also could deploy unused capital towards market making incentivization. This may be to assist either buyers or market makers. By programmatically issuing API calls, stakeholders in Velocity have an opportunity to build more complex products that utilize option puts or calls.

Units of Account and Payment Currencies

Units of Account

Any price feed in Velocity is structured as A versus B. An example could be BTC versus USD. In this case, the price quoted is in USD and the market creator should use USD as the unit of account.

Velocity also provides data oracles [2] to quote prices in a different unit of account. For example, for a BTC vs. USD price feed, ETH can be used as the unit of account for this oracle. The price of USD vs. ETH is required, which can be provided by Velocity.

Payment Currency

A payment currency can be any token issued on the Ethereum [3] blockchain that Velocity can receive and hold in its smart contracts. Using the same unit of account and payment currency enables buyers and sellers to easily understand the payoff functions and also reduces accounting complications.

This payment currency must be one that can be held inside an Ethereum smart contract. Market creators decide to choose an appropriate payment currency when a market gets created. The simplest payment currency that can be used is ETH (ether).

Any token issued on Ethereum can be used as a payment currency. However, Velocity has no control over the solvency and stability of external tokens. Market creators and participants must understand risks of such tokens before using them in Velocity.

An options contract is an agreement between the buyer of the contract and the seller of the contract. The seller of the contract contributes half of the collateral to the contract. The buyer contributes the other half of the collateral plus a small additional premium for the opportunity to buy the contract. The contract redistributes one unit of collateral for one unit of movement in the underlying asset. The buyer can choose to execute the payout function anytime between creation and expiry of the contract.

Revenues

Fees

Velocity charges a fee once every transaction. This helps cover operational and liquidity costs. As a decentralized autonomous organization, Velocity will profit from these fees. This will then be passed on to stakeholders.

Operational costs of Velocity include:

1. Cost of gas paid to the ethereum network
2. Cost to obtain real-time data

Velocity earns a trade fee on every option contract sold and earns a part of the fee charged by the liquidity provider.

Revenue sharing with liquidity providers

Liquidity providers help make Velocity efficient. For this, liquidity providers earn 70% of revenues that they help create.

1. Trade fee - 70% liquidity provider, 30% Velocity
2. Premium - 70% liquidity provider, 30% Velocity

Market Forces

Market creators using Velocity can decide to create a market with unique price feeds and time ranges. These market creators can create a market with low friction.

The difficult part is liquidity. Participation in markets are usually judged by maximum benefit. This kind of market-based selection enables competition and appropriate market discovery. Participants will be encouraged to take part in highly liquid markets because they are already efficient.

Governance

There are components of Velocity that require governance. This governance includes continuous development, setting decision variables and methods for handling collateral. As stakeholders increase, decisions will need to be made. For these decisions, a consensus mechanism will be necessary.

Velocity intends to create an entity that takes on the decision making process for protocol specification. Voting will be given to active critical stakeholders.

Timeline

The rollout of Velocity would be phased:

Phase 1 Starting Q3 2016 Alpha: Whitepaper and proof of concept release
Phase 2 Starting Q4 2016 Beta: Token presale and beta launch
Phase 3 Starting Q2 2017 Production: Formal release

Velocity API

The system will incorporate an application programming interface. This will enable market makers, buyers and third parties enhanced access to Velocity. It will enable participants the ability to gain exposure and hedge risk in a variety of ways.

Naming conventions
Currency
Asset
Market

Example API calls

Adding or removing a market:

-ADDMARKET (price feed, name, time to expiry, price range, unit of account, payment currency) - < Has a cost, say 10 VMS>
-REMOVEMARKET(marketID)
Each Market

Offering liquidity:

-OFFERLIQUIDITY (type, premium, quantity, ITNURL)

Withdrawing liquidity:

-WITHDRAWLIQUIDITY (offerID)

Order an options contract:

-GETOPTIONQUOTE(type)
-BUYOPTION (type)

Exercising an options contract:

-EXERCISEOPTION(optionID)
Meta Market
-SELLOPTION(type, strike, price equation)
-BUYOPTION(offerID)

Real time data

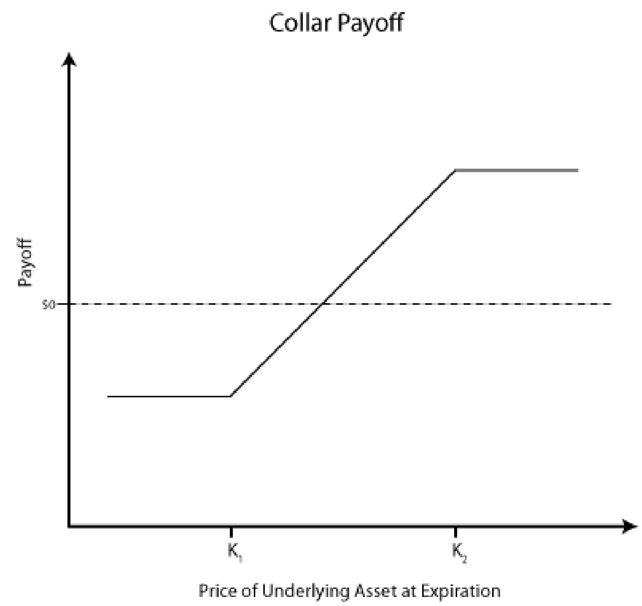
Price feed-based markets rely on the authenticity of data available in real-time. Price feed manipulation could cause huge financial losses and could lead to loss in confidence of the system. Technology like oracles provide a way to receive provably honest data inside a smart contract. The integrity of receiving real-time data is incredibly important within Velocity.

1. Manipulation of data
2. Unreachable price feed

Capping Payouts With Collar Options

Derivative markets offer multiple options with varying expiration times and strikes. The first type of option available on Velocity are *collar options*.

The philosophy behind deep in the money options is to reduce exposure to volatility. Deep in the money is an option with an exercise price, or strike price, significantly below or above the market price of the underlying asset. Options deep in the money tend to have delta near 1. This lend themselves to less complex hedge strategies.



Collared payout functions execute when the maximum payout is capped to a pre-agreed value. This means the holder of the option cannot be exposed to risk of catastrophic losses.

Function	Traditional derivative markets	Velocity, Decentralized market
Trade execution	Exchange, Broker	Smart contract
Margin maintenance	Broker, Clearinghouse	Smart contract
Trade Settlement	Clearinghouse	Smart contract

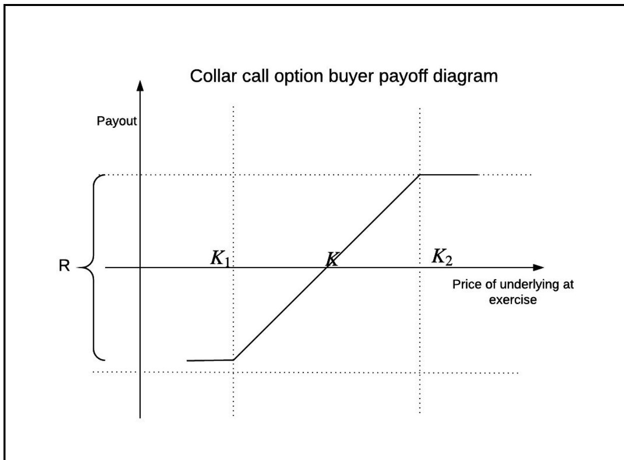
Derivative contracts are a special type of financial instrument. Price is derived from the performance of an underlying asset. Derivatives include futures contracts, options contracts, swaps, insurance and more. Velocity allows users to work with a type of options contract called American style collar options.

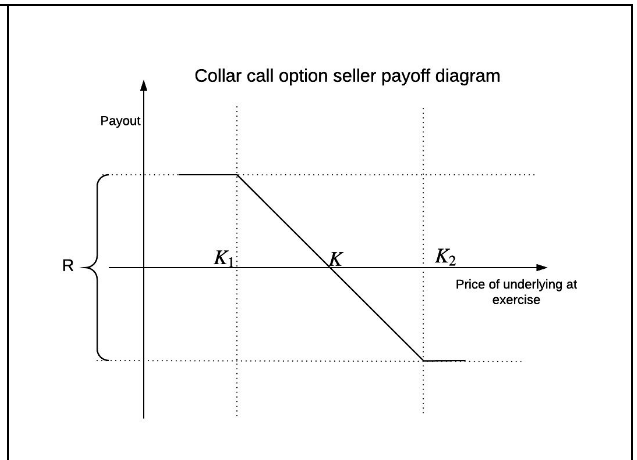
American style collar options

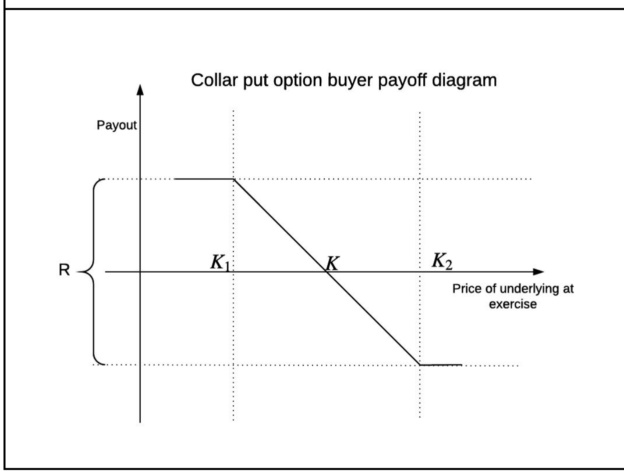
A collar call option pays out $1 for every $1 increase in the underlying asset. This is up to a pre-agreed cap. The payout stays constant above or below the price threshold.

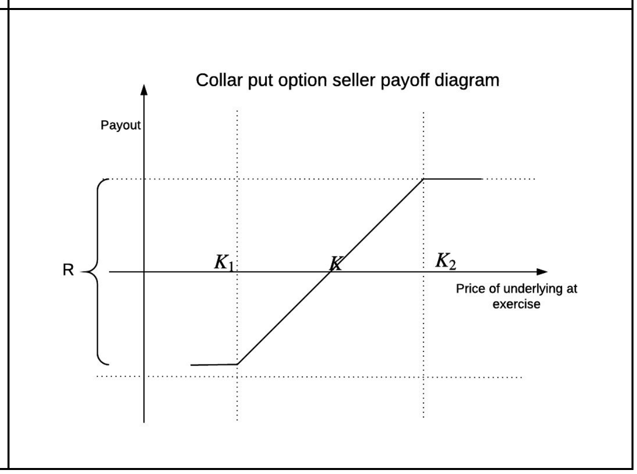
This kind of payout capping helps Velocity stay immune to systemic risks and black swan events [4]. Every option smart contract created in Velocity holds 100% of funds required to settle according to the pre-agreed payoff function.

In the same way, a collar put option pays out $1 for every $1 decrease in the underlying asset up to a pre-agreed cap. The payout stays constant above or below the price threshold.









Participants who want to hold a long position on an underlying asset can buy a collar call option or sell a collared put option. The participants who want to hold a short position on the underlying asset can buy a collared put option or sell a collared call option.

Participant's position

	Buyer	Seller
Call	Long on the underlying	Short on the underlying
Put	Short on the underlying	Long on the underlying

Every options contract brings together two parties. The buyer of the options contract and the seller of the options contract. These two parties hold opposite opinions about the future performance of the underlying asset.

Exercising an option

Exercising an option executes the payout function. The purchaser of an option has the right to exercise any time between its creation and before its expiration. At expiry, the option will be automatically exercised. The seller of the option on does not hold the right to exercise the option. The seller puts up collateral for the contract and his collateral is held by the contract until the option is exercised.

Terms

t0 - Time when the option contract is created.

t - Any time between the creation of the option contract the time when the option contract is exercised.

T - Time when the option contract is exercised.

Creating a market

A market needs to exist before option contracts can be sold or bought. Velocity is not a single market, but a platform encompassing several markets. A market can be created by any user of Velocity by defining initial parameters. These initial parameters define pay out functions for buyers and sellers. It also defines underlying assets to track.

Different types of variables

Type of variable	Defined by	Description
Initial market parameters	Creator of the market	It remains constant for the lifetime of the market.
Contract variables	Contract	Defined at the time when the contract is created. The formula for variable is defined when the market gets created.
External variables	Market forces	Variables over which Velocity has no control.

Variable	Abbreviation	Type	Description	Example
Pricefeed URL	-	Initial market parameter	Publicly accessible HTTP JSON API + JSON Function to get a discrete value.	json('https://www.bitstamp.net/api/ticker/').last
Time to expiry	T	Initial market parameter	Time until when the contract is automatically exercised.	7 days
Payoff range	R	Initial market parameter	Value range to play with.	100 USD.
Initial underlying price	K, S_{t0}	Contract variable	Price of the underlying asset when the option contract was created.	418 USD
Lower payout cutoff price	K_1	Contract variable	$K_1 = K - (R/2)$ Price of underlying below which the payout is flat.	368 USD
Upper payout cutoff price	K_2	Contract variable	$K_2 = K + (R/2)$ Price of underlying above which the payout is flat.	468 USD
Collateral	C	Initial market parameter	$C = R/2$ The collateral that the seller of the contract is required to hold.	50 USD
Contract price	P	External variable	Price paid by the taker to get into the contract.	51.5 USD

Effective premium	E	External variable	E = P - (R/2) The premium paid by the taker.	1.5 USD
Underlying price at exercise	S_T	External variable	Price of the underlying asset when the option contract is exercised.	440 USD

The K (midpoint of the payoff range K_1 and K_2) for an option contract is always set to the current price of the underlying asset obtained from the price feed at the time of the creation of the contract. The seller puts up one half of the price range and the buyer puts up one half of the price range. The amounts are then redistributed to the buyer and seller when the option is exercised according to the payout function.

Payoff matrix

	Scenario	Buyer receives	Seller receives	Maker receives	Velocity receives
Collar Call	$S_T < K_2 > K_1$	$(S_T - K)$	$K - S_T$	E * 0.7	E * 0.3
	$S_T <= K_1$	0	R	E * 0.7	E * 0.3
	$S_T >= K_2$	R	0	E * 0.7	E * 0.3
Collar put	$S_T < K_2 > K_1$	$K - S_T$	$S_T - K$	E * 0.7	E * 0.3
	$S_T <= K_1$	0	R	E * 0.7	E * 0.3
	$S_T >= K_2$	R	0	E * 0.7	E * 0.3

Market dynamics

The success of a market depends on its ability to attract sellers and buyers to take part. Market forces would decide which parameters make the most sense. The most efficient markets would be the most liquid markets. As a consequence, they would also be the cheapest for takers to participate.

The tighter the payoff range is the more the difficulty hedging becomes for makers. Market creators have to keep in mind that the makers need a easy way to hedge away their risks. A tight payoff range means the probability of prices moving out of the payoff range are high.

If the payoff range is high, the initial capital required to get into positions will be higher. This will lead to a lowering of the leverage of positions. This may discourage users looking for higher leverages. An optimum payoff range for a given time is one where price movements stay within payoff boundaries. It is also important to offer attractive leverage for the buyer.

Market makers in Velocity must to lock in capital with the order book and wait for a buyer. This is performed via a smart contract. Once they have sold a contract, the maker should hedge risk by holding a position in the underlying asset outside Velocity. For this reason the market maker gets a percentage share of the premium generated from the sale of the contract. The premium of the contract would reflect market uncertainty as the cost of the hedge and cost of holding capital.

Leverage:

$$Leverage = \frac{S_{t_0}}{(\frac{R}{2})}$$

$$Max. profit = \frac{R}{2}$$

In Velocity all contracts are 100% backed. The total funds required to payout a contract is held in a smart contract. The design of the market comes with two parameters time to expiry and payoff range. Here are some example parameters for a market.

Feed	BTC vs. USD
Time to expiry	7 days
Payoff range	$100

In this case the buyer of the contract has to hold $50 in order to gain 1:1 exposure to the price of BTC vs. USD. If the price of BTC grows more than $50 in the given 7 day period, the buyer does not realize profits above $50. If the payoff range is within the range BTC could move in a given 7 day period, the buyer gains 8X leverage on the trade.

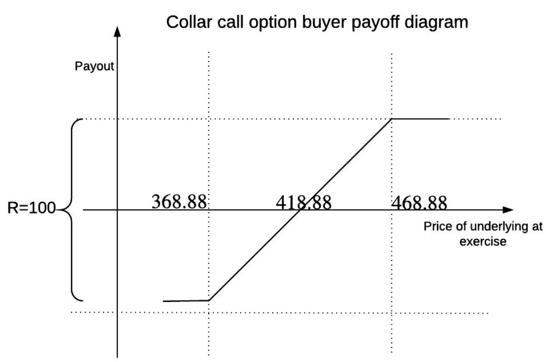
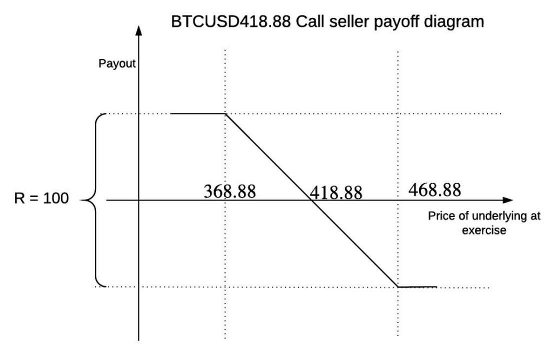
Examples of market that can be created:

Price feed URL: json('https://www.bitstamp.net/api/ticker/').last
Description: Last traded BTC vs. USD price on bitstamp.
Payoff range (R): 100 USD
Time to expiry(T): 7 days

An example call option contract sold in the above defined market:

Current price of underlying from price feed K = 418.88 (The K for the option contract is decided when the contract is created.) Lower payoff cutoff price K_1 = 418.88 - (100/2) = 368.88 USD Upper payoff cutoff price K_2 = 418.88 + (100/2) = 468.88 USD	**Amounts held in the contract** Price paid by the buyer of the contract P = 51.18 USD (market based pricing). Collateral placed by seller C = 50 USD Effective premium E = 51.18 - 50 = 1.18 USD

Payoff diagrams

Call Buyer	**Call seller**
	

Payout scenarios:

BTC vs USD on Exercise	Buyer receives	Seller receives	Maker additionally receives	Velocity receives
200	0	100	0.826	0.354
368.88	0	100	0.826	0.354
390	28.88	71.12	0.826	0.354

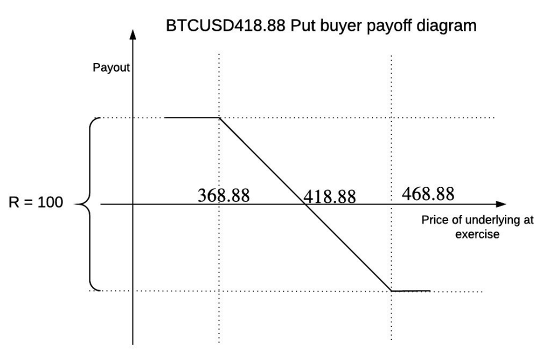
418.88	50	50	0.826	0.354
440	71.12	28.88	0.826	0.354
468.88	100	0	0.826	0.354
600	100	0	0.826	0.354

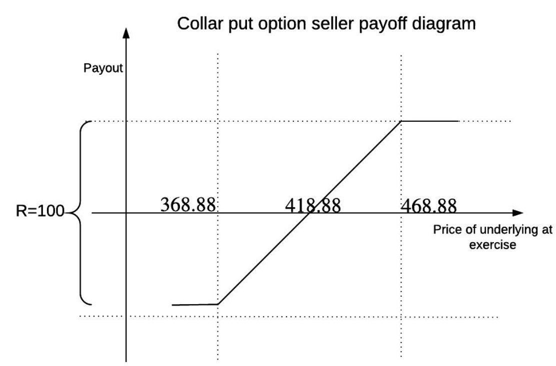
An example put option contract sold in the above defined market:

Current price of underlying from price feed K = 418.88 (The K for the option contract is decided when the contract is created.) Lower payoff cutoff price K_1 = 418.88 - (100/2) = 368.88 USD Upper payoff cutoff price K_2 = 418.88 + (100/2) = 468.88 USD	**Amounts held in the contract** Price paid by the buyer of the contract P = 51.18 USD (market based pricing). Collateral placed by seller C = 50 USD Effective premium E = 51.18 - 50 = 1.18 USD

Payoff diagrams

Put Buyer	**Put seller**





Payout scenarios:

BTC vs USD on	Put Buyer	Put Seller	Maker	Velocity receives

Exercise	receives	receives	additionally receives	
200	100	0	0.826	0.354
368.88	100	0	0.826	0.354
390	71.12	28.88	0.826	0.354
418.88	50	50	0.826	0.354
440	28.88	71.12	0.826	0.354
468.88	0	100	0.826	0.354
600	0	100	0.826	0.354

Advantages of capping payouts - Reduction of systemic risks

Capping payouts allows the system to remain solvent and fully backed at all times. Any significant movement in the underlying asset does not negatively impact the system. Systemic risks are removed and the makes the system immune to “black swan events”.

Disadvantages of capping payouts - Increased competition

Traditional markets allow uncapped options. Velocity lacks competitive edge over systems which let participants earn multiples of initial capital. In Velocity the maximum payout would be 100% of the capital deployed at a given time.

Additional Information About Derivatives and Options

Fractionally backed derivatives

In traditional markets, sellers of derivative contracts hold a margin which is marked to market every day and overseen by brokers. In Velocity, fractional margin contracts would introduce risks. Due to lack of tools to enforce these contracts, margin based contracts are implausible.

Risk and the transfer of risk

Risk is a consequence of action taken in spite of uncertainty. The consequence could be favourable or unfavourable. Holding on to risk means possible exposure to consequences, be it favorable or unfavorable. However, transferring risk reduces exposure to consequences. It means another party takes on risk for a fee.

Packaging risk - derivatives

Derivative contracts are a way to package risk. They can transferred to another party according to the expected risk profile. Insurance contracts are the most common form of derivative contracts. Financial outcomes need to be independent of external events. This is why transferring risk to another entity is important.

Anatomy of a derivatives contract

Type of derivatives contract

There are several types of derivatives contracts; these include futures, swaps and options. Velocity concentrates on two of these futures and options. For all derivatives contracts, one common element is the underlying asset. The performance of the derivative contracts depends on the performance of the underlying asset.

The underlying asset

The price feed or performance data feed of the underlying asset is the central aspect of the contract.

Example price feed: BitStamp-BTCUSD - https://www.bitstamp.net/api/ticker/
The above URL tracks the most recent traded price of BTC in USD on bitstamp.

Options contract

The contract offers the buyer the right, but not the obligation, to buy (call) or sell (put) a security or other financial asset. This is at an agreed-upon price (the strike price) during a certain period of time or on a specific date (exercise date).

Decentralizing derivatives contracts

A derivative contract payout is a function of performance of the underlying asset and a function of time. The settlement of these contracts are well-suited to be distributed and autonomously enforced.

Decentralizing the role of the counterparty

Traditionally the function of a derivatives clearinghouse is to act as the central counterparty. Each party sells or buys a derivative contract from the clearing house. Therefore, the clearinghouse guarantees to settle according to the payout function. This is true even in the case of one of parties failure to oblige to the agreements of the contract. Velocity will function in a similar fashion by design. Each derivative contract Velocity creates is fully backed by the buyer and the seller.

Risk exposure

Velocity's aim is to offer a market where risk transfers from one party to another. The Velocity DAO itself remains risk neutral during operations. Derivatives contracts created by Velocity follow a predefined payout function fully backed by buyers and sellers. The contract holds enough funds to pay out the party in any given situation. This is how Velocity remains immune to black swan events.

Velocity defines payout functions which it can payout in all situations by:

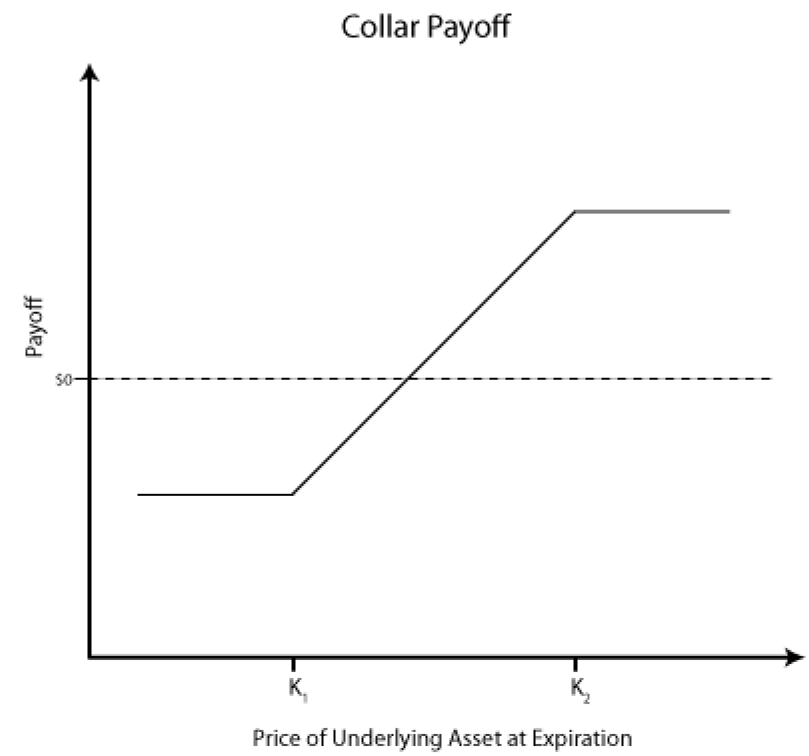
1. Keeping the time to expiry low so it lets traders settle and re-establish positions frequently.
2. Keeping maximum payouts from contracts well defined. In the case of an unexpected price rise, a contract payout function will only pay a maximum cut-off amount agreed when the contract sold. This is called a collar option.

Simple deep in the money options

The philosophy behind deep in the money options is to reduce exposure to volatility. The options deep in the money tend to have delta near 1 and thus lend themselves to simpler hedge strategies.

Choosing a price range and time to settlement

Derivatives markets offer many options with varying times to expiration and strikes. The first type of options that can sold on Velocity are collar options.



Collared pay out functions are where the maximum payouts are capped to a pre-agreed value. This way option holders lack exposure to risk of losses greater than the initial stake.

Black swan events

There are events that have a low probability of occurring. For example, if tossing a fair coin 100 times, the probability of it turning up heads each time is 50%. The probability of getting 100 heads is unlikely, but it can occur.

These low probability occurrences are called black swan events. By definition, these events are rare. However, there is always a possibility they can happen. Derivative clearing houses mark to market every day. They make sure contracts can remain solvent, enforced through brokers. Even though synthesizing a call option is the goal, it might not always be practical in this case.

Velocity's contracts might not be attractive to those seeking payouts that are not capped. However, this system places solvency as paramount. Capping payouts is the method by which Velocity intends to maintain solvency. Collared options allow the system to remain prudent. At the same time, this prudency creates a safer market for both hedgers and speculators.

Deep in the money options

An example of a deep in the money option::

Underlying asset: BTC

Current market price (CMP): 410 USD

Today: 1st of April 2016

Expiry: 15th April 2016 (15 days to expiry).

Strike price: 310 USD.

Market price on expiry: X USD

Payout function:

0 -> if X < 310

X - 310 -> if X > 310 < 510

100 if X > 510

Introduction of new underlying assets

Velocity’s objective is to allow derivative markets on any underlying asset’s performance. The only thing required is a price feed for the asset. The payout agreement and a corresponding hedge ensures risk is transferred from Velocity. However, it is important to understand the implications. The collar option approach means Velocity is blind to historic performance of an asset.

Conclusion

Markets need four mechanisms: (1) an issuer, (2) a clearinghouse, (3) an auctioneer, and (4) a market maker. Velocity automates the first two of these components. For transparency, it aims to execute all four mechanisms on-blockchain. The goal: Enable a transparent marketplaces for any digital asset with a price while maintaining system stability.

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