





## Introduction

**T**he technologies behind blockchains such as Bitcoin or Ethereum suffer from many limitations. The lack of confidentiality and privacy guarantees in current blockchains is hindering their adoption, particularly in banks and big companies: in a recent survey to 134 global market participants working on blockchain technology[Ass16], 64% of banks and brokers said that transaction confidentiality was a significant concern with blockchain technology and 52% was worried about the security of private keys. And likewise, the lack of private smart contracts is a limiting factor to their universal adoption: only a very limited subset of all the possible smart contracts are being developed and executed, only those for which leaking all the input data, program execution and results is tolerable. Additionally, the concern of governments and regulators are not being met: there is no way to enforce regulations and no one can differentiate between criminal and law-abiding smart contracts. As a consequence of all the aforementioned problems, 10% of ICO funding gets stolen[Cha17] with the average financial loss incurred increasing by 20% annually and software bugs are being exploited with very high losses (\$150 MM, Parity wallet[Tec17]).

**A**lgorithmic/program trading keeps growing in other financial technologies not including blockchains: many trades on traditional exchanges are already done by computer programs[GK13], not human traders (more in equities, but also in FX/derivatives and catching up in bond markets). It's expected that a major part of this trading migrates to blockchains, but this transition will only occur after confidentiality and privacy issues are fully resolved.

Algorithmic Trading. Percentage of Market Volume



**R**aziel project uses cutting-edge cryptographic and verifiability technologies to solve all the above-mentioned problems, providing stronger property rights over intangible intellectual property in order to ease adoption of blockchains and increase their profitability.

# Market Need

The interests of all the involved stakeholders are being met:

**Regulation-aware:** in the crypto-currency space, the needs of governments and regulators are being overlooked much to the detriment of their widespread adoption in public and private settings. In order to further advance and promote these technologies to the grand public, it should be possible that laws and regulations could be coded on smart contracts in order to enhance public trust and commerce.

**Verifiable Smart Contracts:** executing smart contracts from unknown parties implies tacitly accepting considerable risks. By annotating the code of the smart contracts with proofs and providing said proofs before execution, said risks could be removed. Additionally, third parties (regulators, NGOs, private companies) could provide specifications against which said smart contracts must be proven secure.

For more detailed explanations, see sections 5 and 7.4 of the research paper[CS17c].

**Stronger property rights over intangible intellectual property.** The use of the latest secure computation techniques allows treating data confidentially while keeping the intellectual property rights of the owner/producer in multiple executions. In a financial context, this could be applied to financial series and investment strategies: the producer could rent access to private data to third parties without these parties learning anything about it. Ultimately, fully encrypted smart contracts could be exchanged without revealing anything about the data contained within them to third parties: *de facto*, new types of property rights are being created.



Different types of encrypted smart contracts will be considered:

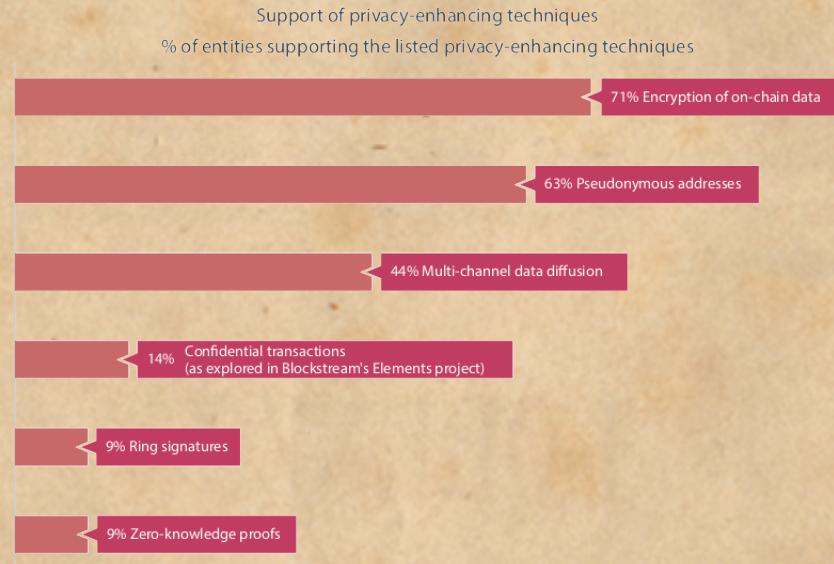
- protecting only the inputs of the different parties, but the program and the outputs being public
- additionally, only releasing the output to a subset of the parties, others being unable to learn the output
- additionally, protecting the code of the smart contract from malicious third parties
- smart contract securely stored on disk/cloud and transferable between different exchanges/blockchains: interoperability is a key feature to guarantee mass adoption between heterogeneous systems

For more detailed explanations, see sections 4, 7.1 and 7.5 of the research paper[CS17c].

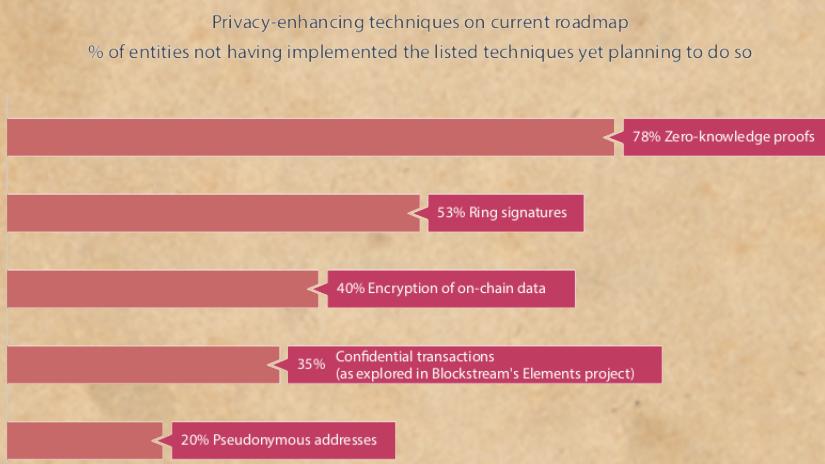


## Privacy-Enhancing Technologies

The following figure shows the current support of privacy-enhancing technologies[HR17] being adopted in blockchains:



And the next figure shows the future support of privacy-enhancing technologies[HR17]:



Note that secure computation techniques are yet to be developed and the zero-knowledge proofs only protect the privacy of the transactions, and not the code executed within smart contracts: actually, they are pre-requisites for all future decentralized software architectures.

Encrypted Algorithmic Trading

 Racing the execution of any smart contract, including public input and output parameters, is a well-known privacy leakage of current permissionless blockchains. Consider the following example:

**T**hese execution traces violate privacy regulations: the “Right to Be Forgotten”, the principles of “Privacy by Design” and “Privacy by Default” included on the new European General Data Protection Regulation[PC16]; and the “Financial Privacy Rule” of the Gramm-Leach-Bliley Act[Con99]. Even worse, only a tiny percentage of all the possible smart contracts are being deployed on permissionless blockchains because it’s economically irrational to expose so much confidential information; consequently, the crypto-currency space is being held back due to the lack of essential privacy protections. To reach the same level of algorithmic/program trading observed in public exchanges, it will be indispensable to adopt the most efficient secure computation techniques available.

# Market Opportunity

**T**HE financial model considers the Discounted Cash Flow of the fees obtained from the future trading volume of Private and Verifiable Smart Contracts (i.e., Cryptographically Secure Financial Instruments); it doesn't include other considerations like network effects and other externalities. The results of this model should not be used as if they were price targets extracted from the models of a stock analyst: the goal of this model is to provide a non-binding purview to assess the market opportunity of the project.

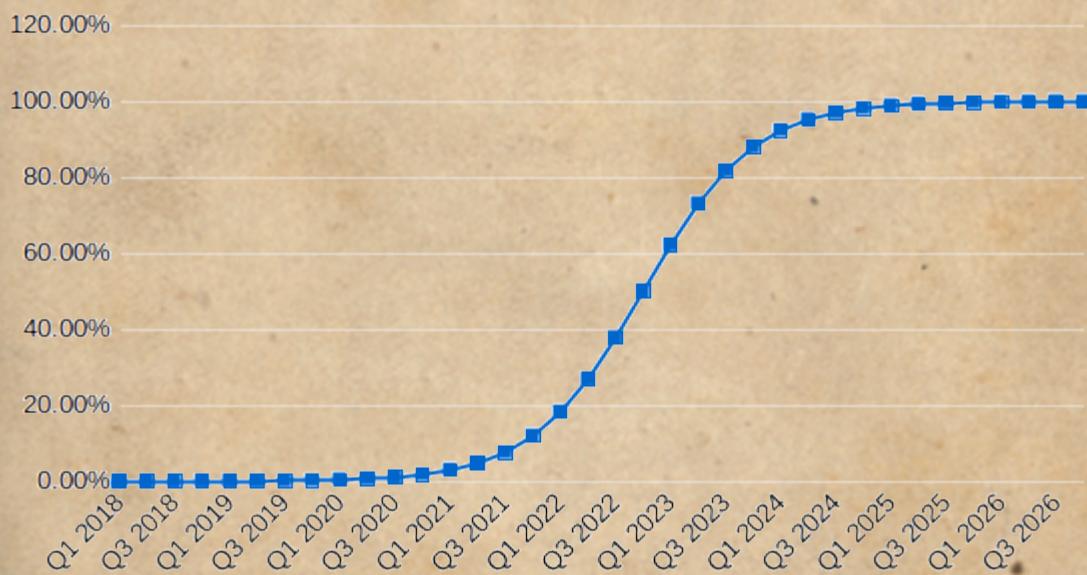
	RAZ Token Supply	1,000,000,000 tokens
Steepness of S-curve Inflection point	k x0	0.5 20 in quarters
Financial Instruments Turnover (QTRLY)	20,099,916,950,000,000	
% Final Penetration	1%	
% Fees (Trading Volume)	0.1%	
Discount Rate (Annual)	80%	
Discount Rate (Quarterly)	16%	
<b>PESSIMISTIC PROJECTIONS.</b> To prevent false promises, this estimation is based on a very pessimistic scenario: (1) Only technologically advanced and/or first-world markets considered; (2) 1% penetration in 10 years; (3) fees of 0,1% traded volume; (4) high and constant discount rate, 80%		
More optimistic projections could consider: higher penetration ratios, higher fees and a lower discount rate		
		1      2
% Penetration	0.01%	0.01%
CF to Token Holders (USD)	\$ 15,044,030	\$ 24,802,207
PV of CF + Terminal Value	\$83,280,611,208	
Price per Token	\$83.280611	
Market Cap	\$83,280,611,208	

**T**HE projections of the model use pessimistic parameters:

1. We include only a subset of the whole worldwide market of traded financial instruments:
  - Worldwide markets mainly traded on the most important exchanges: stocks, OTC Foreign Exchange, interest rates derivatives, credit derivatives, and FX derivatives.
  - First world markets: the US, Japan and EU Bonds; US Futures.
2. Low penetration after 10 years: only 1% of the turnover will be using Private and Verifiable Smart Contracts (i.e., Cryptographically Secure Financial Instruments) following a S-Curve adoption model. As previously noted, the current trading volume of algorithmic/program trading is >50% in many markets.

3. Low fees: only 10 basis points of the traded volume. Note that expense ratio for USA equity funds has ranged from 66bp in 1980 to 69.2bp in 2010[Mal13]; the average fees paid to active domestic equity managers for institutional investors have ranged from 46.8bp in 1996 to 55bp in 2011[Mal13]; the average fees paid to active fixed-income managers for institutional investors have ranged from 29bp in 1996 to 30bp in 2011[Mal13]; and the equity trading costs in Europe went from 42bp in 1997 to 33bp in 2004[Mun05].
4. High and constant discount rate: a very high annual discount rate of 80% (8 times the discount rate for risky stocks with high WACCs) has been chosen. Conversely, this also implies that investors holding RAZ tokens for 10 years could get an 80% annual return (i.e., the discount rate is interpreted as the expected rate of return at the same time, but in no way this can be understood as a promise of future returns).

 The rationale of the model is explained in a long post[Jon17] and its simplified explanation is as follows: only a fraction (1%) of all the turnover from financial trading would end up using Private and Verifiable Financial Instruments (\$20.000TT per quarter) charging a very low execution fee (10bp). Considering a S-Curve adoption model (steepness 0.5 and inflection point in 5 years) for the diffusion of this technology (10 years), the present value of discounted cash flow is calculated using a very high discount rate (80%) and then divided to obtain the price per token. Note that the S-Curve as pictured below features a very slow uptake: a less steeped S-Curve (e.g.,  $k=0.2$ ) would result in a much higher market capitalization.



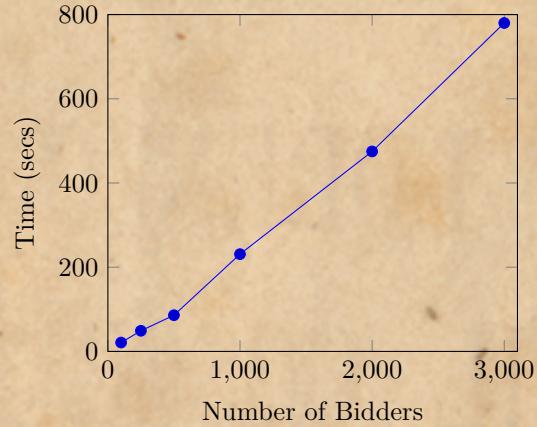
 Obtaining better projections is very easy: change the input parameters of the spreadsheet[CS17b] and check the growth of the market capitalization using higher penetration ratios, higher fees and a adequate discount rate.

## Publications and Patents

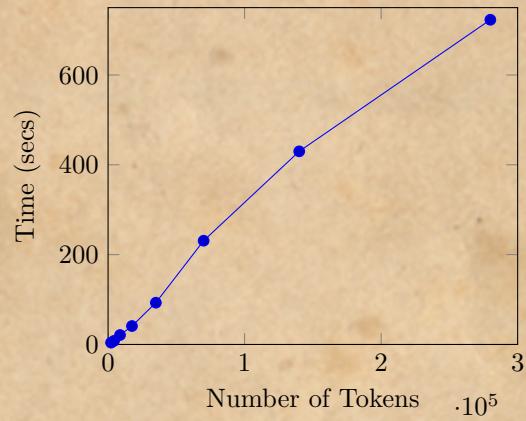
**T**HE contents of the following publications and patents are incorporated herein by way of reference.

**T**wo research publications have been published:

**"An Optimal ICO Mechanism"**[CS17a]: Initial Coin Offerings are raising billions in funding using multiple strategies, none justified from the point of view of mechanism design, resulting in severe underpricing and high volatility. In the present paper, an optimal ICO mechanism is proposed for the first time: a truthful multi-unit Vickrey-Dutch auction of callable tokens (i.e., a new hybrid security of tokens packaged with callable warrants). Truthful bidding is an ex-post Nash equilibrium strategy and the auction terminates with an ex-post efficient allocation; additionally, the callability of the warrants eliminates the winners curse of the auction and its underpricing. An implementation demonstrates its practical viability.

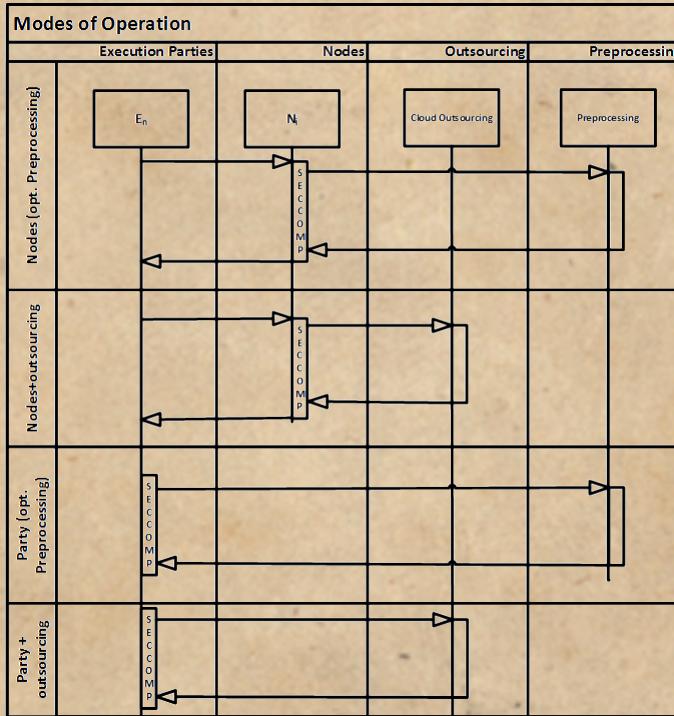
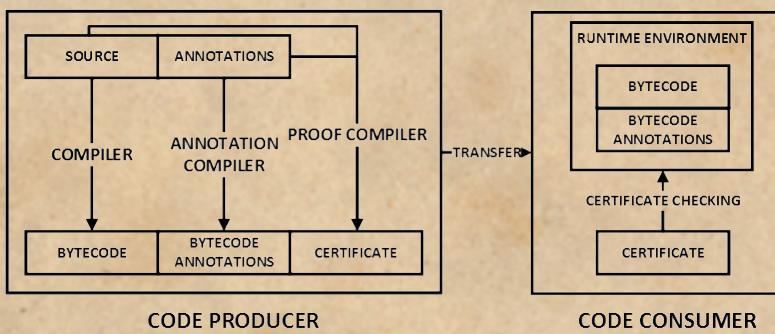


**A**dditionally, the next figure shows another timing experiment, this time varying the number of tokens to be auctioned while maintaining fixed the number of bidders (1000) and the final price (2).



- **Raziel: Private and Verifiable Smart Contracts on Blockchains:**

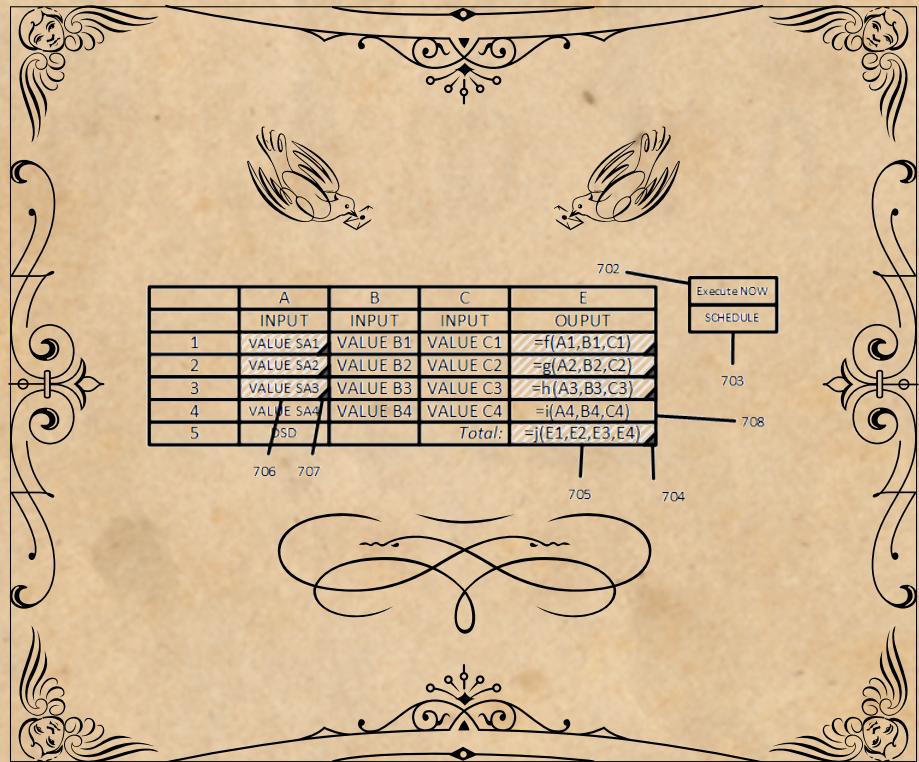
Raziel[CS17c] combines secure multi-party computation and proof-carrying code to provide privacy, correctness and verifiability guarantees for smart contracts on blockchains. Effectively solving DAO and Gyges attacks, this paper describes an implementation and presents examples to demonstrate its practical viability (e.g., private and verifiable crowdfundings and investment funds). Additionally, we show how to use Zero-Knowledge Proofs of Proofs (i.e., Proof-Carrying Code certificates) to prove the validity of smart contracts to third parties before their execution without revealing anything else. Finally, we show how miners could get rewarded for generating pre-processing data for secure multi-party computation.

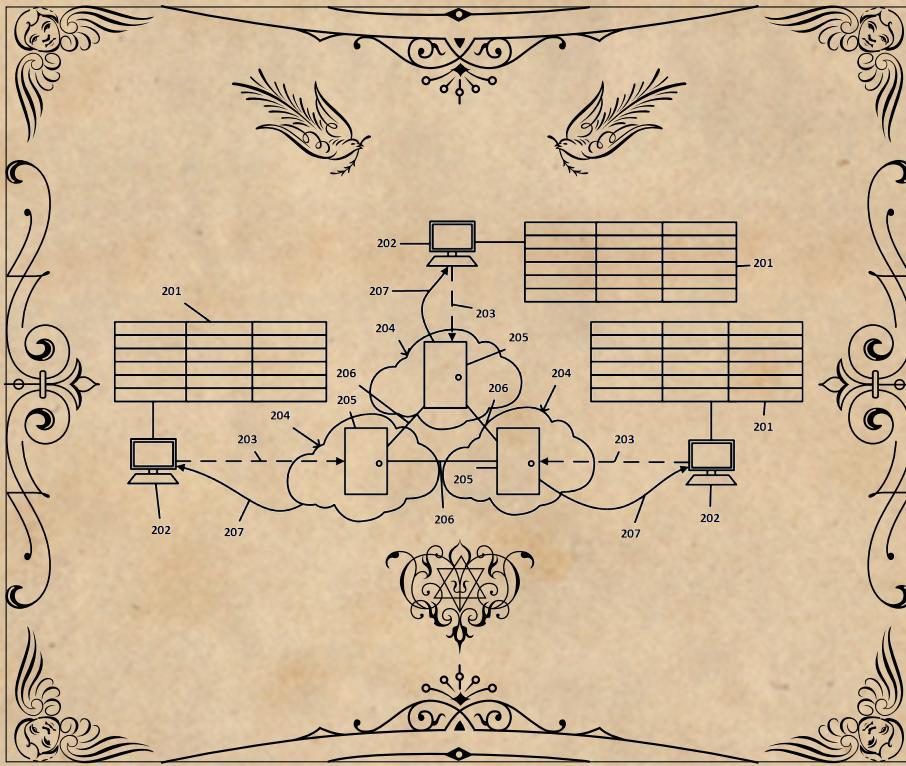


**T**wo patents have been filed:

“Secure Computation on Spreadsheets”[CS14]: Systems, computer-readable media and methods for enabling secure computation on spreadsheet software. A secure spreadsheet is implemented as an add-in to an existing spreadsheet program, or as a new spreadsheet program/web application, to allow secure computations on private input data (and also optionally with private functions) without the parties learning anything about them, via the familiar spreadsheet interface and its formula language. Automatic conversion of previous spreadsheet data and formulas is provided whenever possible, or assisted via a helper. The secure computation can be executed between the computers of the involved parties, or outsourced to a third-parties, or outsourced to a third-party -cloud-computing system-: the secure cryptographic calculation module automatically optimizes for the best performing technique of secure computation (for example, homomorphic encryption, garbled circuits, oblivious transfers, secret sharing, oblivious random machines and/or a combination of the previous crypto-primitives).

The Secure Spreadsheet is the first program to offer provably-secure state-of-the-art cryptographically secure secure computation to the general public: for the first time, joint secure calculations between potentially distrusting parties can now be used for very profitable purposes in accounting/finance/banking while maintaining the privacy of the input data. The Secure Spreadsheet is fully functional and already available on the webpage: its strongest points are the easiness of use and retro-compatibility with previously available spreadsheet files. Future developments will integrate it with Private and Verifiable Smart Contracts.





- **Cryptographically Secure Financial Instruments[CS15]:** Systems, methods and financial instruments enhanced with secure computation. A financial instrument management system is implemented with secure computation capabilities, respecting the privacy and secrecy rights during computation of the information contained within financial instruments, external datasets and/or secure computation programs. Automatic conversion and aggregation of conventional financial instruments is also disclosed. Furthermore, secure computation programs can be certified with mathematical proofs about very advantageous and valuable properties such as their correct termination, conformance to a specification, or any other pre-conditions, post-conditions and invariants on their inputs and outputs, encrypted or in plaintext form.

Note that these Cryptographically Secure Financial Instruments are a specific case of the Private and Verifiable Smart Contracts, in the sense that smart contracts can be of a more general class than the more specific financial instruments. Additional features not discussed on the Raziel paper[CS17c] but available on the patent[CS15] include: storage of the encrypted smart contracts in standard formats; conversion of insecure financial instruments to private financial instruments; packaging financial instruments and interoperability between exchanges.

### *Cætera desunt*

All the technologies hereby mentioned are results of very recent research: future developments are expected and we'll collaborate to be part of their development.

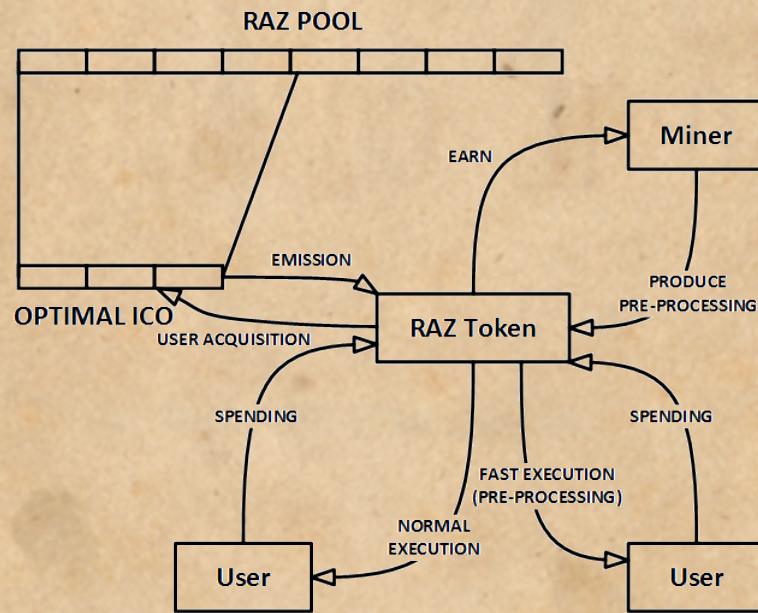
# ICO

## Details

Role of Token	Utility token for Raziel Smart Contracts
Token Name	RAZ
Maximum supply	1 billion of RAZ Tokens
Offered on ICO	5% (50 million)
Accepted Currencies	ETH
ICO Mechanism	Described in An Optimal ICO Mechanism
If minimum not met	Funds not called/refunded

## Token Lifecycle

The ultimate objective for the creation of the RAZ token is to bootstrap a market for the execution rights of private and verifiable smart contracts, including the production and sale of pre-processing data for secure multi-party computation (up to 100x execution speed-up).



Note that the utility of this token intentionally resembles the legally authorised ETH[SC17] (i.e., qualifies as virtual currency), plus the option to speed-up secure computations using acquired pre-processing.

## ⌚ Unoffered Tokens ⌚

**T**okens that have not been offered in the ICO will become reserved and could be offered later in a controlled way (i.e., preventing dumping the price of quoted tokens).

## ⌚ Minimum Contribution Goal ⌚

**A** minimum contribution goal has been set: if it's not achieved, the individual contributions will not be called and/or refunded.

## ⌚ Use of Funds ⌚

Research & Development	80%
Legal	10%
Marketing	10%

## ⌚ Exchanges ⌚

**A**fter the finalization of the ICO, tokens will be listed on at least one major exchange.

## ⌚ Agreement ⌚

**N**ote that before contributing to the ICO, you must read, understand and agree to the crowdsale agreement.

## ⌚ Current Status ⌚

1. The Secure Spreadsheet is perfectly functional and available on the web.
2. “An Optimal ICO Mechanism” will be open-sourced after the ICO.
3. Raziel is being developed: the purpose of the ICO is to solve the chicken-and-egg problem by jump-starting a market for its smart-contracts and their pre-processing, and to finance its development to completion.



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