

ThreeFold

WHITEPAPER

http://whitepaper.threefold.me

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Abstract

The Internet is growing at an accelerated rate. To service this demand, a few large companies (Google, Amazon, Alibaba, Facebook, and more) have built and continue to grow supersized, power-hungry, and centralized data centers. These data centers make up the majority of all Internet capacity available today. However, the Internet is expanding much faster than data centers, and the planet can't cope with it. The solution is to have a more **distributed**, **cost-effective**, **neutral**, and **sustainable** Internet. ThreeFold (as an ecosystem) has developed this technology; creating the ThreeFold Grid (Grid) and a token, which enable this to happen.

- To build this Grid, the ThreeFold community has developed the ThreeFold Token (TFT), a decentralized token used to buy autonomous and decentralized Internet services (compute, storage, and application) on the ThreeFold Grid. TFTs represent units of reservation of autonomous Internet capacity on the ThreeFold Grid, together created to accommodate the growing demand of decentralized IT capacity for the Internet.
- The Internet capacity on the ThreeFold Grid is generated by independent ThreeFold 'farmers' (Farmers). They do this by connecting computers (IT Capacity) to the Internet. As a result, ThreeFold's minting code generates ThreeFold Tokens (TFT) validated by a Human Blockchain (group of people finding consensus over validation), the token represents Internet capacity (Compute/Storage Capacity).
- ThreeFold Tech is a technology company developing & commercializing "Self Driving IT" to power future innovation through decentralization. ThreeFold Tech has resolved some fundamental challenges in the IT world by simplifying the required architecture to three essential layers: a capacity layer, an autonomous layer, and a distributed application layer.
- ThreeFold Foundation is not ThreeFold — rather, it is a participant in the movement to bring the world a truly peer-to-peer internet. We acknowledge and support the many people and organizations around the world who bring crucial support to the growth and adoption of the ThreeFold Grid. A non for profit organization who contribute to the ThreeFold concept. The Foundation is a promotion and coordination organization executed by ThreeFold FZC in Dubai. *Work is ongoing to make the Foundation a global distributed concept with probably more than 1 legal entity.*
- On the capacity layer, Grid capacity is produced, purchased, and allocated locally, much like electricity. Service providers can then host their services and applications close to the end-user, leading to significantly higher performance, lower price points, and better margins. This creates built-in demand for ThreeFold Tokens, which are used to purchase these services and applications. ThreeFold's Operating System called Zero-OS allows Farmers to deliver Internet/IT capacity to the ThreeFold Grid with up to 90% energy savings compared to traditional data centers.
- Already today, the ThreeFold Grid has more capacity online compared to the sum of all blockchain players together. Check out the ThreeFold Cockpit to explore ThreeFold Grid capacity.
- The ThreeFold Grid is positioned as a complementary layer to enable blockchain and cloud projects to scale beyond current limitations to the edge of the network.
- The autonomous layer is where a large number of virtual administrators will perform the required Grid operational tasks to create autonomy for capacity operations and provide a foundation for building and running decentralized applications.
- The Experience layer is where decentralized and distributed apps will be built and run. There is an SDK available to build these applications.

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Mission Statement

The Internet is one of the most significant innovations of the last century, if not the biggest.

Today, the Internet's architecture is not distributed, not neutral, not environmentally friendly, nor is it cost-effective. We aim to change this. We have the technology and the will to do this today.

Yet, access to the Internet is a human right. It's a source of extensive information, education, and allows people to connect and communicate freely on a global scale.

Our mission is to expand the current Internet to all areas of the world and allow everyone to use it at a fraction of its current price. We want to make it easy for people to own their data and make it harder for companies to (ab)use it. We also want to help save the planet by ensuring that this new Internet capacity is much more energy-friendly than current alternatives.



Centralized Decentralized Distributed TF Grid

The ThreeFold Token is the result of independent people or companies expanding the new Internet in a process we call farming.

Together with our partners, we are creating an internet built for everyone, by everyone, everywhere.

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Background

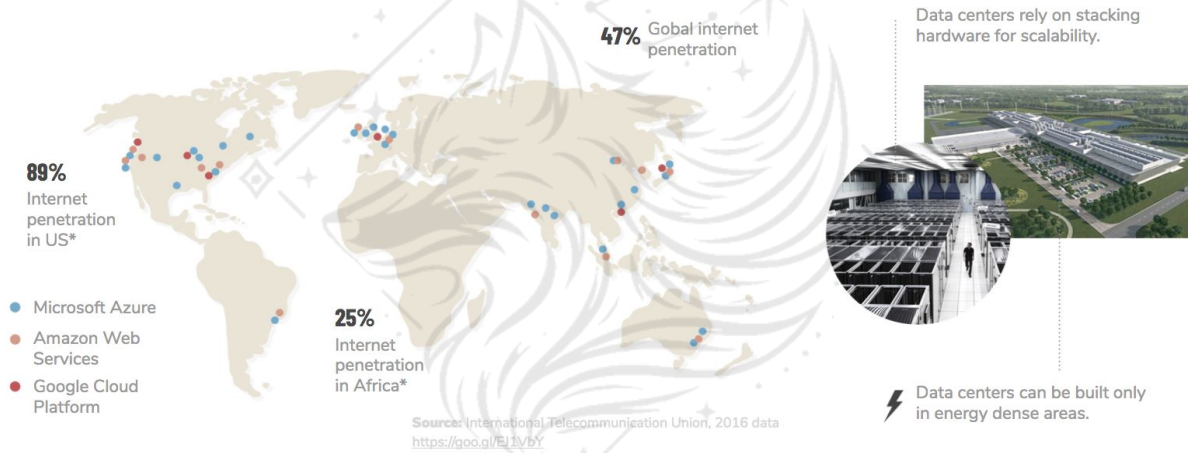
Without adequate Internet capacity, companies and societies are unable to develop and evolve – yet this is the future we face today.

Over the past decade, the spectacular advancement of Internet capacity has been due in large part to the hyper-scale efficiencies of multi-billion-dollar data centers. But this model is fast becoming obsolete. Short-term demand for Internet capacity is far outpacing available supply, thanks to power-intensive applications like Big Data, the Internet of Things (IoT), and Artificial Intelligence (AI).

Today's architecture will never be able to support future demand, for many reasons:

- In the centralized model, data must travel back and forth between users and data centers. These journeys, often thousands of miles, already slow computing speeds and undermine performance. This problem will only get worse.

- In many cases, these long journeys expose data to third-party intervention, raising government security concerns. Governments today prefer Internet infrastructure to be "in the country." ThreeFold prevents data from crossing borders without authorization.



- Explosive growth in processing and storage driven by the Internet of Things (IoT) pushes computing and storage closer to the Edge, as close to the sensors as possible; today's data centers are too remote.

- With demand for capacity set to grow exponentially in the next decade, the existing Internet "piping" will not be able to keep up.

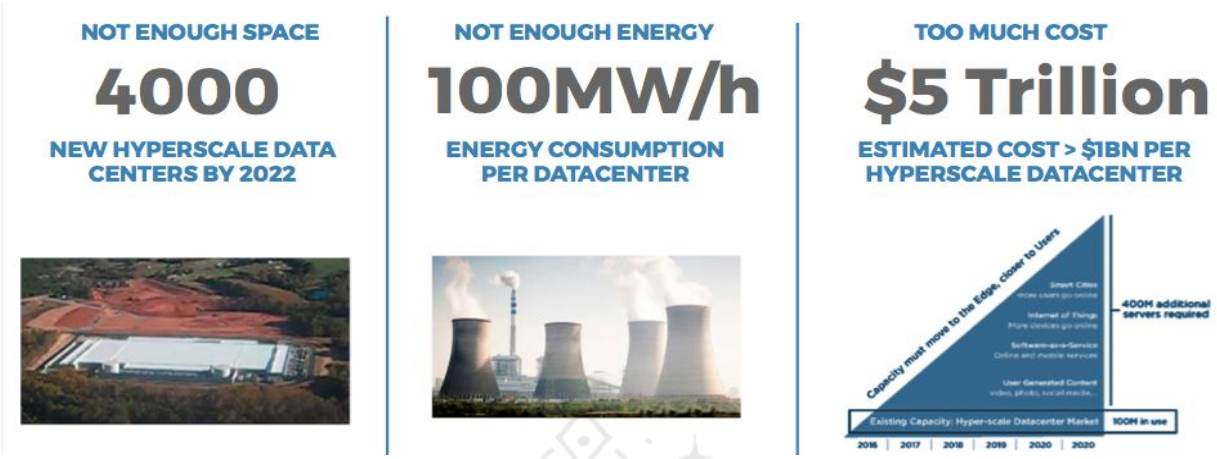
- The hyper-scale model places control of the world's data and Internet capacity in the hands of a few tech giants, raising neutrality and privacy concerns, going against the principles on which the Internet was founded.

- Persistent issues with security, outages, and lost data regularly underscore the weakness of the centralized model.

- Power-hungry data centers consume energy at unsustainable rates. Already, the collective energy consumption of the world's data centers exceeds annual power consumption in the UK by more than 30 percent. This energy usage results in about 2 percent of global greenhouse gas emissions – a carbon footprint comparable to that of the entire airline industry.

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- TTo meet the projected demand for 2022, more than 4,000 new data centers, costing an estimated $5 trillion, will be needed to build and consume an additional 400GW/h. This is roughly equivalent to Japan's energy consumption and would place an impossible strain on global electricity grids. Already, demand for data center storage is causing memory shortages and price hikes.



- New digital currencies are required to allow people to do business on this new Internet. Most of the current digital currencies (cryptocurrencies) are too speculative, power-hungry, and not scalable.

In 2016, the United Nations declared Internet access a basic human right. But we are far from equal global access to that commodity. Africa, for example, has an Internet penetration of just 25 percent. As underserved regions develop, affordable, neutral access will increasingly be expected, rather than the exception. To get there, we need to expand capacity to these regions vastly.

ThreeFold offers a sustainable, cost-effective solution, ideal for both developed and emerging economies. Just as the global financial model of a handful of powerful central banks and too-big-to-fail financial giants will likely switch to distributed networks of cryptocurrencies, a green, equitable, and scalable Internet is needed to accommodate the glbao capacity demand of the 21st century.

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Values

Respect The World

No matter economic status or geographic location, everyone is entitled to the Internet capacity that provides access to resources and education, enabling people to become an integral part of the digital economy.

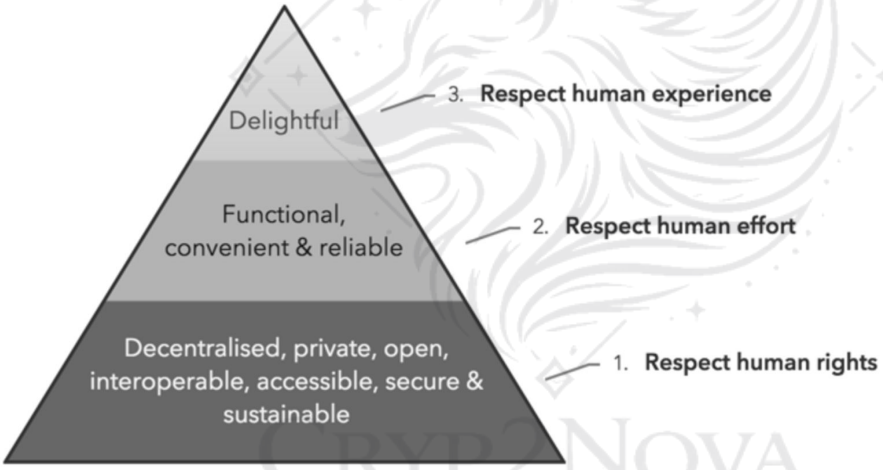
This new distributed economy will allow people to work together across borders, free from the control of large corporations just focused on the bottom line. We want 'love' and 'respect' to drive our world instead of 'ego' and 'greed'. The ThreeFold Foundation encourages and practices transparency and integrity in its operations and practices.

Respect Human Effort

Today's IT industry builds on complexity, with business models built around increasingly complex technologies. The result is a buggy and environmentally-unfriendly system that favors the elite.

We have created a user-friendly "IT as energy" solution, in which the Internet is affordable and available everywhere, just like electricity.

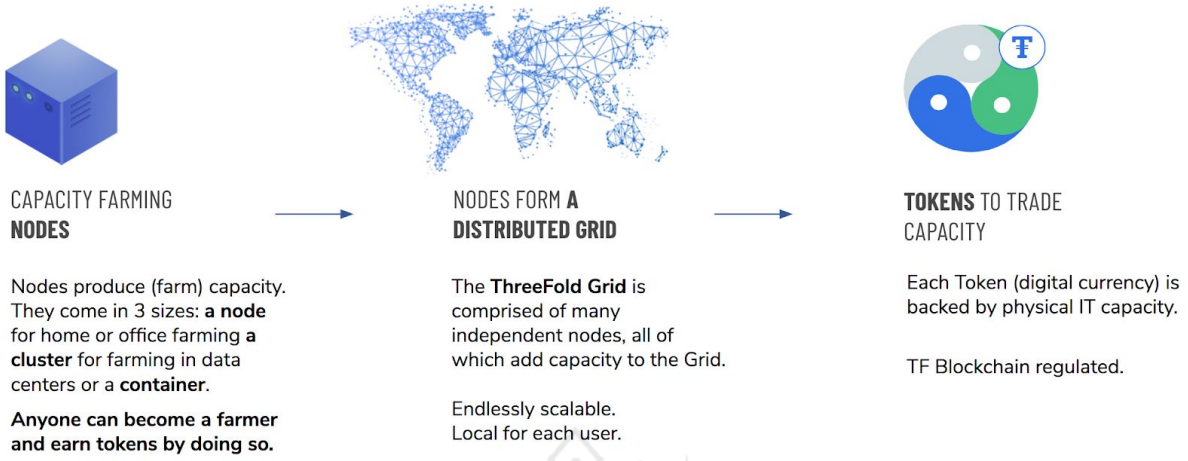
Respect Ethical Design



We expect the Foundation and its product to reflect these values. Thus, we have underwritten a concept called Ethical Design. To read more about this and other relevant topics, please visit our wiki-based extranet: http://tiny.cc/values_extranet.

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ThreeFold Grid



To build this Grid, ThreeFold Foundation has created the ThreeFold Token (TFT). TFTs are generated only when Internet capacity is added to the ThreeFold Grid (*), a TFT represents Internet (Storage, Compete, Network) capacity on the Threefold Grid. A maximum of 4 Billion TFT can be minted by the ThreeFold minting software.

The only way new Tokens can be created (minted) is as a result of independent “farmers” connecting servers (storage and compute) to the existing Internet (*).

ThreeFold Farmers are independent parties who invest in computers (storage and computing servers) and connect it to the Grid to create new IT capacity. Every Farmer’s capacity, called a Farming Pool, is registered on the Zero-Chain by running Zero OS, the ThreeFold Operating System, which makes it available to users worldwide. TFTs are used for selling and buying IT capacity and potentially services on the TFgrid.

Thanks to ThreeFold’s open source software, the Farming Pools use considerably less power than traditional data centers. Internet capacity is produced and allocated locally, similar to how electricity and other utilities are purchased and used today. This allows any digital service or application provider anywhere in the world to host their applications nearer to the end-user, boosting performance and efficiency.

We believe the TF Token value estimation should be free from speculation and velocity changes (as a result of activity on public exchanges). The TFTs are not an investment instrument and are meant to be a method of exchange on the TF Grid; TFTs are used to buy and sell IT capacity.

More details can be found on the ThreeFold Website.

(*) after creation and launch of the TFChain and TFGrid (means starting block 1)

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ThreeFold Objectives

Neutral: The ThreeFold Foundation empowers a digitally responsible world by connecting humanity to a decentralized, distributed, neutral, and green Internet owned by all of us. All technology used by ThreeFold is open-source. All users and ThreeFold Nodes are registered on the TFExplorer. Each TFNode and User has a unique private key and signs every piece of information stored which allows everyone to validate authenticity.

Utility-Driven: The TFT has a specific commercial utility, being the currency for buying and selling IT Capacity on the TF Grid.

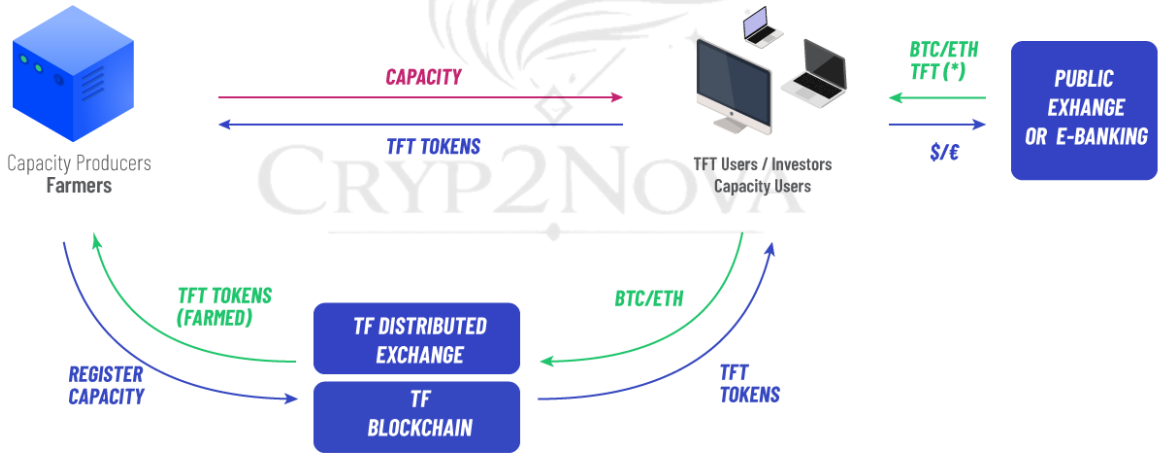
Green: The ThreeFold Chain's Operating System (Zero OS) runs on a decentralized and distributed network of dedicated efficient Zero Node (Node) infrastructure, which enables the delivery of unlimited scalability with an extremely low carbon footprint.

ThreeFold Tokens

To uphold its decentralization principles, the Foundation contributors have created several ways in and out of the ThreeFold Token ecosystem, which include but are not limited to: crypto exchanges, (atomic) swaps, OTC (over the counter) desks, and Farming by TF Farmers. The ThreeFold Token and the ThreeFold blockchain are live as of the end of March 2018.

More details on tokenomics can be found in ThreeFold Wiki.

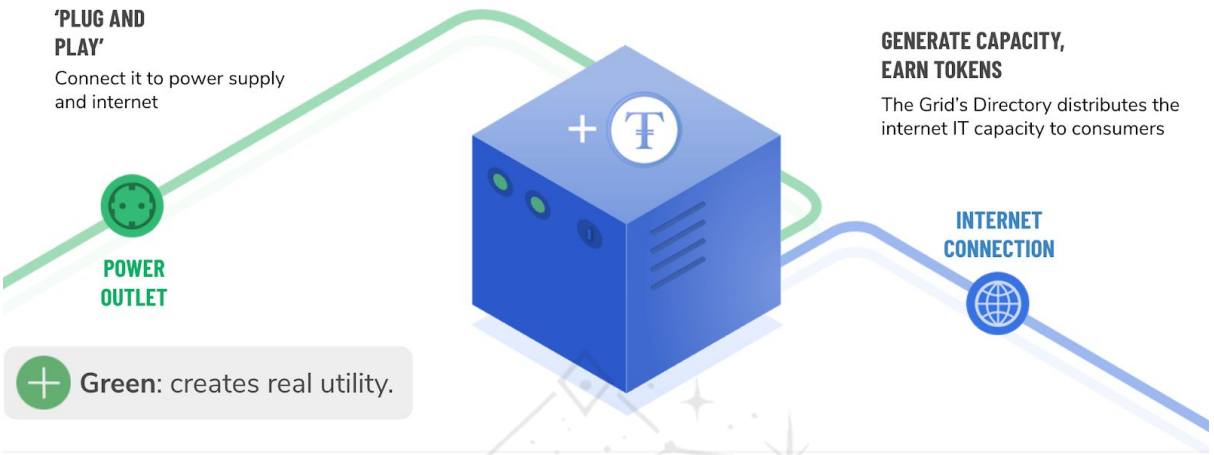
ThreeFold Tokens can be bought from ThreeFold Farmers or by means of decentralized and/or Public Exchanges. The TF Distributed exchange is since March 2020 based on Stellar integrated distributed exchange and before this could be done using Atomic Swaps as integrated in Rivine, our previous blockchain.



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ThreeFold IT Capacity Farming

ThreeFold Farmers (or "TF Farmers" or "Farmers") are independent individuals or entities who invest in and connect storage and compute (or "Farming pools") to the TF Grid with ThreeFold Nodes (or "TF Nodes" or "3Nodes"). Their contribution to the TF Grid is recorded on the TF Chain.



Each TF Node runs the ThreeFold software, which is the TF operating system = Zero OS, and TF Chain software.

The Zero OS software allows anyone in the world to use the IT capacity generated on Nodes to host their Internet workloads – storage apps, archive capacity, web applications, artificial intelligence, IoT, docker containers, and more.

People need TF Tokens to access capacity on the TF Nodes – as these are the only means of purchasing capacity on the TF Grid. As such, the TF Tokens are supported by a real marketplace, the supply and demand of Internet capacity.

By doing so, Internet capacity is produced on the TF Grid and is sold via the TF Directory. The TF Directory is a "marketplace" for selling TF node generated IT capacity.

Note that people need to own TF Tokens to use IT capacity through the TF Grid, as they are the only mechanism to purchase this capacity on the TF Grid. As such, TF Tokens represent a real utility.

The amount of TFT that Farmers receive for farming depends on the amount of TFT already in circulation. The more TFT already exists, the lower the rewards. This follows the principle of diminishing returns. We call this farming limitation Difficulty Level.

When the amount of existing TFT nears 4 billion, the amount of TFT received by farmers will decrease. Once the maximum of 4 billion TFT has been reached, there won't be any rewards for farming anymore.

TFTs are only created (minted) when new capacity (storage & compute) is added to the ThreeFold Grid by Farmers in the form of hardware. ThreeFold Farmers are the sustainable equivalent of cryptocurrency miners . Farming is calculated once a month, on the first day of the next month. Farmers need to keep their capacity connected for a minimum term in order to farm tokens?

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Types of Farming

Farmers will have the freedom and flexibility to choose the type of farming they would like to adopt as their own mode of capacity farming operation as explained below:

DIY Capacity

Unmanaged IT Capacity can exist everywhere; in people's homes, in mobile telephone masts, in utility cabinets, next to railways or motorways, anywhere where internet lines meet electrical outlets, any IT Hosting or Datacenter Facility. This capacity is deployed to the TF Grid and has no people involved to manage its operations (apart from the physical and network aspects).

There is no shell or server interface available on the 3Nodes. If a Farmer wants to use capacity from its own hosted TFNodes, he needs to follow the exact same way as any other user, i.e. through the TFExplorer and using Smart Contract For IT Layer.

Unmanaged capacity provides the amongst others following basic services:

- Storage Capacity = backend storage services which can be used as backend for more high level storage services like S3
- Compute Capacity = backend compute capacity which can be used as a backend for more high level compute services like Kubernetes.
- Network Gateway Services: integration with ZeroTier network, HTTP(s) reverse proxy, DNS services, TCP Port Forwarding.

These basic services are ordered through the TF Chain only. SLA's (service level agreements) cannot be guaranteed on Unmanaged Capacity and as such not registered in the TF Chain.

Certified Capacity

Threefold aims to provide a farming certification program by the end of 2020. Through a certain onboarding procedure, farmers would eventually be able to obtain their certification that allows them to gain benefits such as setting up their own pricing and getting a bespoke maintenance service from the support team.

Managed Capacity

Managed capacity is capacity that sits in a data center or other controlled environment where people operate and maintain supervision of the capacity connected to the TF Grid and published in the TF Directory. SLA (Service Level Agreements) are provided on this capacity like uptime, guaranteed bandwidth, response times.

Resource Units

Provided IT Capacity on the TF Grid is delivered by hardware capability and is measured by means of resource units.

description	code
1 logical core (hyperthreaded core) = cpu capacity	1 CRU
1 GB (memory capacity)	1 MRU
1 GB (harddisk storage capacity)	1 HRU

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1 GB (ssd storage capacity, fast storage)	1 SRU
1 GB of bandwidth transmitted in/out	1 NRU

Cloud Units

Cloud units are calculated from resource units, Cloud units are the way to account for farmed and used capacity. Cloud units are the compute, storage, and network equivalent to kWh - kilowatt-hour.

When a solution gets requested on the TFGrid, it always gets converted to the required amount of CU,NU,SU.

There are 3 categories of cloud units:

- Compute Unit (CU): The amount of data processing power, specified as the number of virtual CPU cores (logical CPUs) and RAM (Random Access Memory)
- Storage Unit (SU): The size of data storage capacity
- Network Unit (NU): The amount of data that travels in and out of the acquired storage units or data travelling to/from compute capacity expressed in GB.

It's a very easy way to express capacity.

Only TF Certified Farmers can define the price per CU,SU,NU. Otherwise it is defined by the gridcouncil in the ThreeFold foundation.

CU (Compute Unit)				
GB Memory	4	8	2	= MRU
nr vCPU	2	1	4	= CRU
Passmark Minimum	500	250	1000	is performance cpu

Passmark is not measured in the grid, we only use resource units to calculate the SU & CU. Passmark is a CPU benchmark. Passmark used in simulators and as a checking mechanism to make sure we have enough performance per CU.

SU (Storage Unit)	**HD (HRU)**	**SSD (SRU)**
GB Storage Capacity	1000	40

NU (Network Unit = per GB) = NRU per month	**GB (NRU)**
GB transferred OUT or IN	1

These are raw capacities, as measured by our ThreeFold Software on Zero-OS.

The Transformation between resource units (CRU, MRU, HRU, SRU) and cloud units (CU, SU); basically, how does the software translate measured capacity to capacity which gets sold/bought.

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1 SU is 1 TB of HD capacity and 50 GB of SSD capacity with a buffer of 20%

```
su = (hru / 1000 + sru / 100 / 2) / 1.2
```

i.e. 1 CU is 2 virtual CPU with max oversubscription on the CPU core of 4, and the minimum required memory is 4GB. Oversubscription of 4 is still gentle, we know that many other providers use more.

```
cu = min((mru - 1) / 4, cru * 2)
```

We subtract 1 GB of memory for the operating system to function.

Some Examples of CU and SU in Detail

Compute Unit (CU):

- 4 GB memory & 2 virtual CPU
- Recommended price on TF Grid = 10 USD
- Market price = between 40 USD and 180 USD

Storage Unit (SU):

- 1TB of net usable storage (1000 HRU)
- Recommended price on TF Grid = 10 USD
- Market price = between 20 USD and 200 USD

Cloud Production Rate

The Cloud Production Rate (CPR) indicates how 'productive' a compute or server hardware platform is. The higher the CPR, the more capacity in the form of compute and storage is added. This makes it simple for a non-tech farmer to select the best farming hardware for the budget available. It is similar to the hash rate of a Bitcoin miner, for example.

To calculate the CPR are very simple and straightforward formula is used:

CPR = 1.5 * the amount of Compute Units (CU) of the hardware + the number of Storage Units (SU) of the hardware

Difficulty Level

The amount of TFT that Farmers receive for farming depends on the amount of TFT that are already in circulation. The more TFT already exist, the lower the rewards. This follows the principle of diminishing returns. The Difficulty Level defines this relationship.

When the amount of existing TFT nears 4 billion, the amount of TFT received by farmers will be less. Once the maximum of 4 billion TFT has been reached, there won´t be any rewards for farming anymore.

Pseudo code to show how difficulty level is being calculated:

```
def difficulty_get():
    nr_of_tft_ever_farmed = hreefold_explorer.nr_tft_total_get()
    p = nr_of_tft_ever_farmed / 4000000000
    if p > 0.999:
        return 0
    else:
        diff_level = 1 - p
```


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```
    return diff_level
```

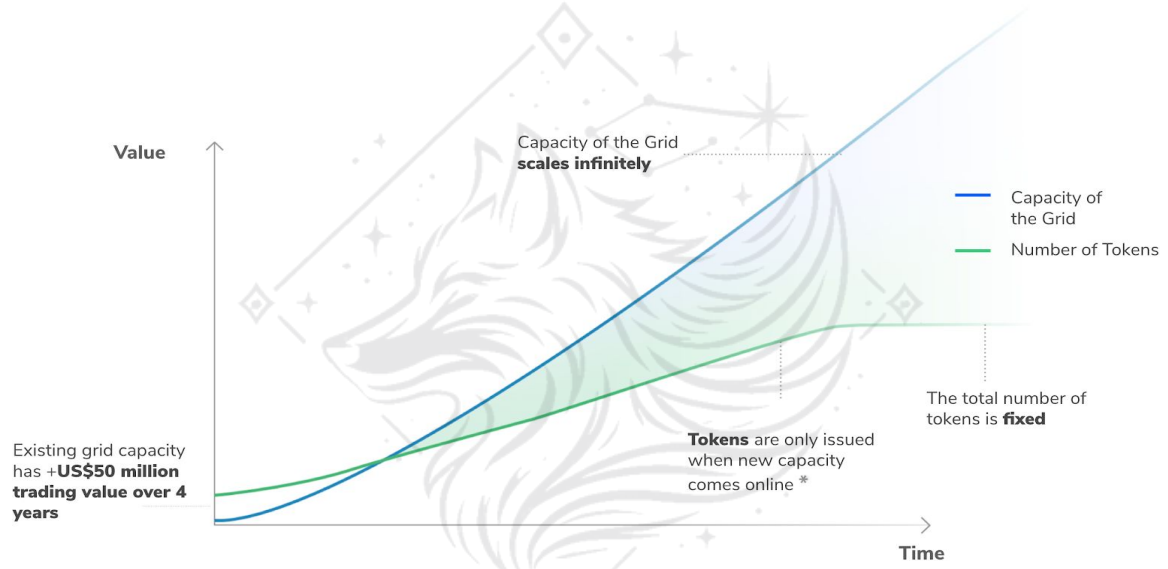
Calculation of TFT minted per Node per Period = Farming Calculation

The minting rules are the rules as implemented in

Amount of TFT = Amount of CRP * CPR Price USD / TFT Price USD / Difficulty Level

- CPR Price USD = USD 40 as of Q1 2020
- TFT Price USD = Until end of year 2020 the following USD TFA price is used for minting: USD 0.15 plus 2% monthly starting May 2020, Jan 1 2021, pricing comes from a mix of exchanges.
- Difficulty Level = see above (makes sure there can never be more than 4billion tokens)

Growth Curve



ThreeFold Grid has infinite potential to scale. With it, the number of ThreeFold Tokens that could ever be minted is limited to 4 billion TFT. At the initial stage, when farming difficulty is low, more tokens were minted compared to the amount of connected hardware capacity. Over time, with the growth of the grid more farmers will join and the difficulty factor will increase, thus increasing the ratio of connected capacity per existing token. At some point in time, when the amount of minted tokens will approach the 4 billion limit, minitin of new tokens will essentially stop, however, it will not limit further growth of the grid. Thus, ThreeFold Token to capacity ratio will continue increasing with the growth of the grid.

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Farmers Business Model

Farmers: Purchase or manufacture ThreeFold Nodes and connect them to the TF Grid to produce IT Capacity. Once this capacity has been validated by the TF Chain, the Farmer is awarded Tokens every 30 days. The Farmer also gets Tokens for selling this capacity via the TF Directory.

An example of possible costs and revenue associated with operating an environment is laid out below:

Token Simulation (basic params of the simulator)	**AMD Starter Node (DIY)**		
Tokenprice after 5 years	$0.3	$0.6	$2.0
Number of Nodes on the TF Grid after 60 month	600,000	600,000	600,000
Investment			
Hardware cost	$1,480	$1,480	$1,480
Investment Costs	$1,480	$1,480	$1,480
Operational Cost over 60 month			
Power/Rackspace	$2,089	$2,089	$2,089
Management/Hands On	$148	$148	$148
Network Cost	$241	$241	$241
Maintenance on software & upgrades	$0	$0	$0
Opex Costs over 60 month*	$2,477	$2,477	$2,477
Income from Farming			
Token Price at start of simulation	$0.15	$0.15	$0.15
Capacity in Compute Units	7.8	7.8	7.8
Capacity in Storage Units	8.8	8.8	8.8
Sold in Network Units (per month)	427	427	427
Cloud Production Rate (CPR)	20	20	20
CPR Price	$40.00	$40.00	$40.00
Avg Price Compute Units	$15.00	$15.00	$15.00
Avg Price Storage Units	$10.00	$10.00	$10.00
Avg Price Network Units (1GB in/out)	$0.05	$0.05	$0.05
Tokens Mined total (60 month)	24,122	17,903	9,165
Income Capacity Sales (Cultivation)			
Capacity sold sold by month 20 / sold by month 40	80% / 90%	80% / 90%	80% / 90%
% price erosion on CPR Price over 5 years	40%	40%	40%
% transfer to ThreeFold Foundation*	10%	10%	10%
Income from IT Capacity over 60 month	$6,788	$6,784	$6,760

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Income			
Token price after 5 years	$0.3	$0.6	$2.0
Proceeds from initial Farmed Tokens [$]	$7,236.6	$10,741.8	$17,871.8
Proceeds from initial Farmed Tokens [%]	52%	61%	73%
Proceeds from selling IT capacity [$]	$6,788	$6,784	$6,760
Proceeds from selling IT capacity [%]	48%	39%	27%
Total income over 60 month	$14,024	$17,526	$24,632
ROI after 60 month (SIMULATION ONLY!!!)	**8.60**	**11.80**	**17.10**

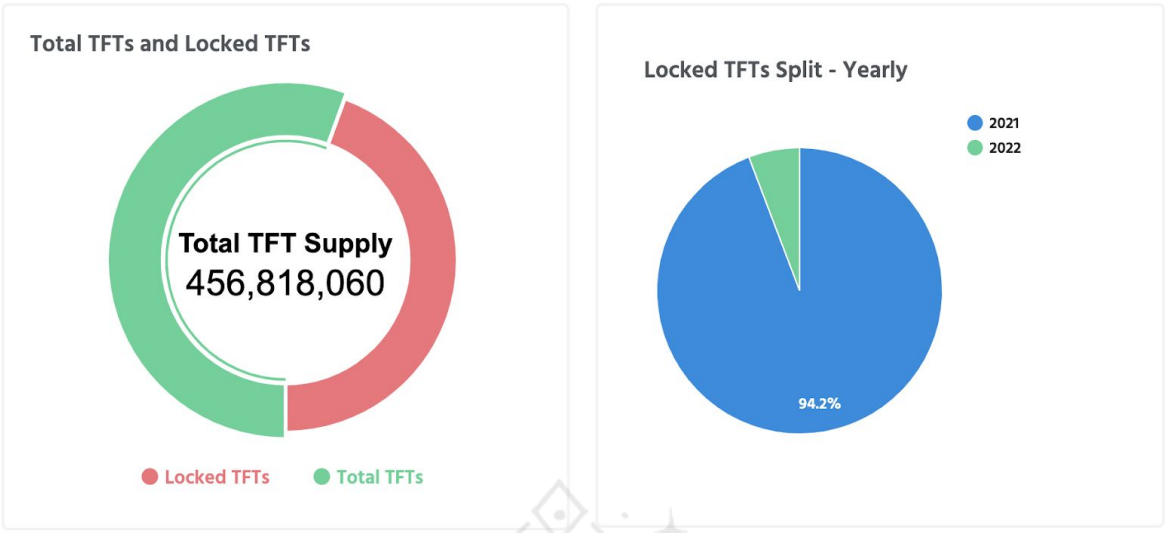
* covered by selling cultivation income tokens

Please note, the above model uses estimates for the cost of the hardware and installation as well as for the utilization and potential price of the Token. Your individual results may materially differ from the above.

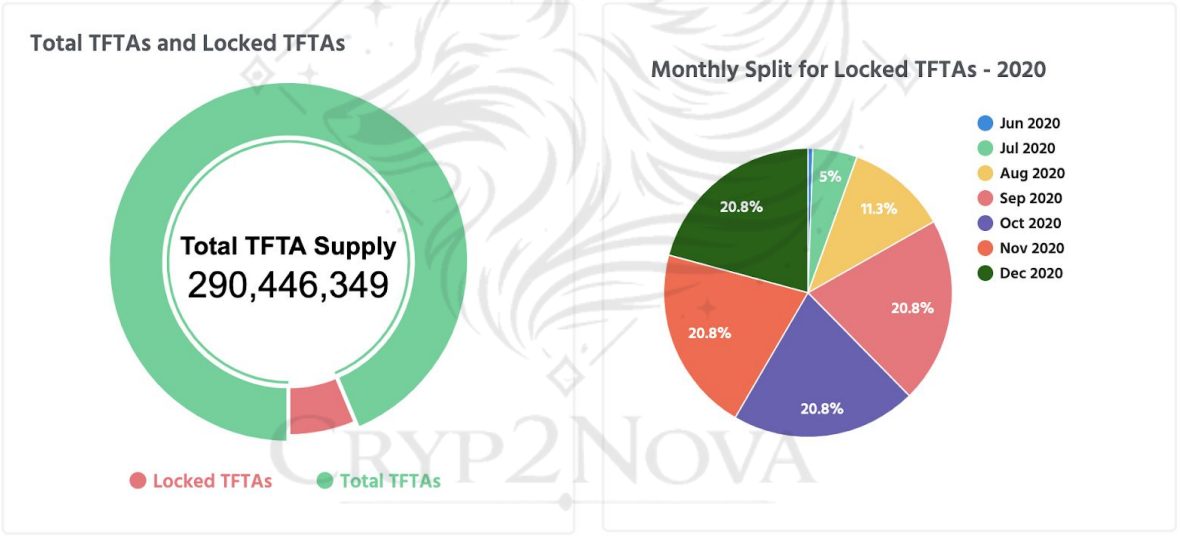
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TFT Statistics



TFTA - Staking Pool



Updated version see: https://tokenstats.threefoldtoken.com/ (above info comes from there)

Situation Aug 2020. The TFTA is a voluntary staking pool. Only TFT's can be sold/bought on the public exchanges.

Originally there was a max 0f 100.000.000.000 TFT and the genesis block was 695.000.000 TFT. After version 2 of our TFGrid/Token, there is a maximum of **4.000.000.000 TFT**. More info see on https://wiki.threefold.io/#/genesis_block_pool_details

Tokens are currently available on BTCAlpa, Liquid and Stellar Distributed Exchange, also many TF farmers sell/buy TFT directly.

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How Can You Help?

The ThreeFold community is promoting this new Internet, and we need a lot of people who would like to expand the network. Our ambitious aim is to have more than USD $1 Billion invested in Farming capacity activities within a few years by independent farmers from all over the world.

Farmers

We are looking for people who want to Farm IT Capacity for this new Internet.

Today we have around 60+ famers and around 600+ nodes in the global grid. These farmers range in size from people that have in a small, single CPU, single disk box that they host in their study to farmers that have built business models around finding investors and deploying datacenter racks full of equipment in. Here's an overview of the current locations:



Farmers can choose to do all the work themselves ("Do It Yourself") or they can use a Farming Cooperative. With the Cooperative option, you would purchase IT Capacity producing hardware that is operated and monitored by a Farming Cooperative. The advantage of Farming through a Cooperative is that it gives you peace of mind that your hardware is being attended to at all times; in the most effective and efficient manner. With a Cooperative there is an initial one-time hardware acquisition and setup cost as well as a monthly hosting and management fee. It's up to each Cooperative to define their own pricing structures.

There are multiple Farming Cooperatives and others are in the process of being created, two examples are Mazraa and BetterToken.

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ThreeFold Tech Investors

The open source software which makes the ThreeFold Grid possible has mainly been developed by ThreeFold Tech, which is a Belgium software tech company. ThreeFold Tech is a spinoff from Incubaid, an incubator who accomplished already 6 exits with a very good return for its investors.

ThreeFold Tech has nothing to do with the tokens or even the TF Grid. ThreeFold Tech makes money by delivering its software in a supported/certified way, which makes certified farming possible, as well as providing other value-added services to end-users on the TF Grid.

Ambassadors

We need people to help us promote the ThreeFold message, through their network, who share our values and who want to make the world a better place.

We ask that each Ambassadors spend at minimum a few hours of time per month to help us with this project. Each Ambassador can additionally earn ThreeFold Tokens for their contribution. We have currently an active ambassador community of over 100 who meet on a biweekly basis online (status summer 2020).

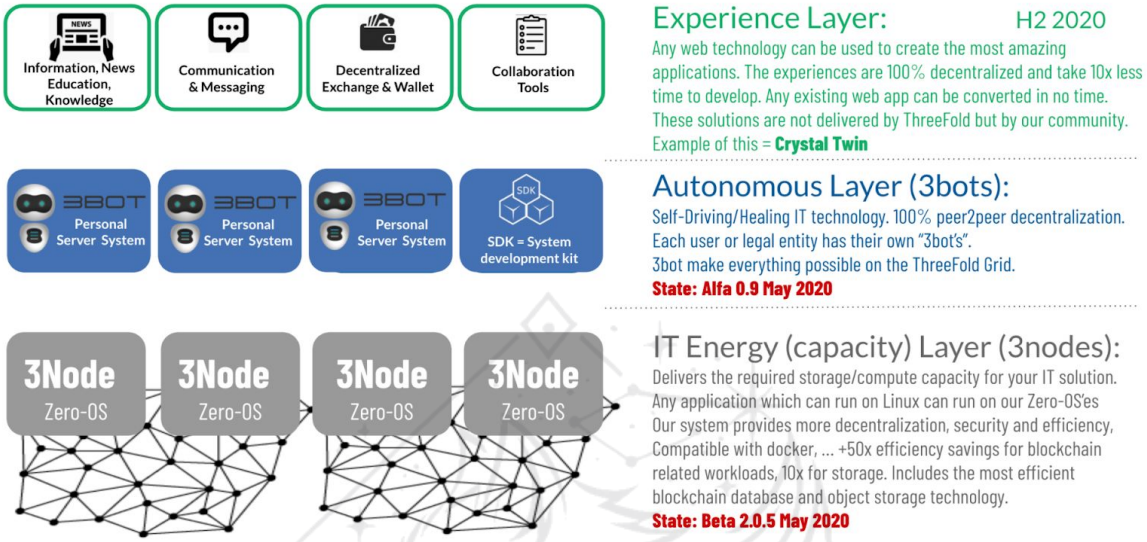
Ambassadors actively engage in bringing forward their networks and they are regularly asked for their opinion if TF Foundation or TF Tech needs to make an impactful decision. They also share a Telegram channel, please let us know if you are interested to join them.

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ThreeFold Tech has developed, promotes & uses open-source technology. This technology has been actively developing components of the core technology of the ThreeFold Grid for the past 10 years which are all open-source.

Layers



Capacity Layer

Delivers the required capacity for your IT solution.

Any application which can run on Linux can run on our Zero-OS'es.

Our system provides more decentralization, security, and efficiency.

The capacity layer is the layer where CPU and Storage resources are delivered. It consists of hardware (storage/compute servers) and the TFTech operating system called Zero-OS.

Zero-OS nodes are installed wherever capacity is required (e.g. at a base station for 5G applications, etc). Zero-OS has been designed from the bottom up. TFTech started from a Linux kernel and secure boot BIOS – everything else in the operating system has been created from scratch. It delivers 3 primitive functions: storage capacity, compute capacity in the form of highly-optimized containers, and network capacity for running the network services.

This layer has no self-driving or self-healing capabilities – it is a layer of smart, efficient, and secure algorithms created with as little code as possible. The fewer lines of code the more security.

This layer is in production today and can be used to run any linux based app on the TFGrid.

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Autonomous Layer (3bots)

- Self-Driving and Self-Healing IT technology allows 100% decentralization.
- Includes the most efficient blockchain database and object storage technology.
- +50x efficiency savings for blockchain-related workloads, 10x for storage.

TFTech's solution allows for self-driving and self-healing workloads. This is possible because of an innovative decentralization technique. Each user or organization (e.g. company or department of the company) gets a digital avatar which we call a 3Bot. Example: each user in the 5G network will have his or her own 3Bot in complete safety and data privacy. The 3Bots are all registered on a modern type of phone book implemented using blockchain technology.

This phone book allows all 3Bots to talk to each other (find each other) while securing communication (verify incoming traffic on authenticity and correctness).

All these 3Bots run autonomously in the network created around them and in the base stations. There are no people involved to run this network and keep it operational. This is a very different way of thinking – it leads to much more security, efficiency, and higher performance. More specifically, this will lead to huge network savings and makes building large scale datacenters obsolete.

The 3Bots know how to deploy IT and network capacity as required by the user or the company (self-driving) and they can also be programmed to auto repair issues (self-healing). As an example, this technology can be used to implement any network service as required by a 5G operator.

ThreeFold uses this layer today to deliver you the 3bot as a virtual system administrator.

Experience Layer (decentralized apps)

Autonomous Decentralized Experience Layer.

Any web technology can be used to create the most amazing experiences.

The result is 100% decentralized and any experienced developer will need 10x less time to develop.

The grid of 3Bots allows any experience to be developed with much more efficiency. This is not something ThreeFold Tech does, its up to anyone to build apps/experiences on top.

Some advantages

- With only two numbers, all information in the world can be addressed.
- The security is higher because everyone has their own 3bot.
- More performance, because your 3bot is close to you.
- Up to 50 times more network and storage efficiency can be achieved (if compared to blockchain).
- The 3Bot API allows any chosen web technology (JavaScript frameworks) to easily connect to the 3Bot for all backend services.

This enables easy creation of experiences (apps) for end-users.

This experience layer is delivered in the form of an SDK (System Development Kit) and has a lot of components pre-made like decentralized authentication, identity management, identity verification, video and audio conferencing, object storage, browser security (secure audited browser in browser technology), email services, and more.

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Which apps can be built using the 3bot technology?
any web app you experience today in your digital life

There are multiple companies building experiences on top of the TFGrid right now. Probably before the end of 2020 there should be end user apps running on top of 3bot. This layer is only available to experienced developers, please reach out to us and together we can create the most amazing experiences for mankind.

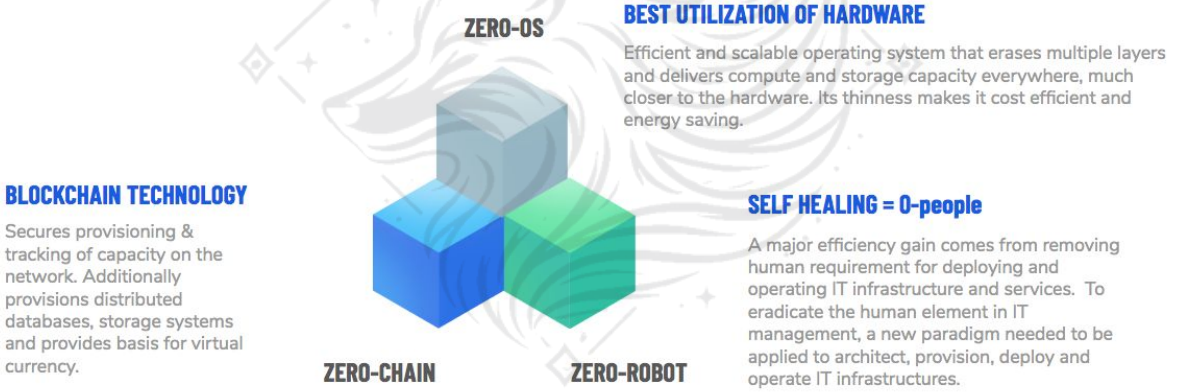
Components

This technology consists of three major building blocks:

Zero-OS is a stateless operating system which enables distributed hardware to form the TF Grid which generates both IT storage and compute capacity.

Zero Robot is a self-healing Intelligence system which controls and operates the TF Grid without the help of people and reserves, procures and executes workloads on the grid using our Jumpscale and At Your Service automation platform.

Zero Chain is the blockchain framework: store of tokens, management of 3bots (our digital users), verification of communication (key management), ledger for digital notary services, ...



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Zero-OS = Stateless Operating System

The global TF Grid is composed of thousands (eventually millions) of nodes (called Zero Nodes) distributed geographically around the world and running our operating system called Zero OS.

To manage this complexity a stateless operating system is a must; such a system avoids upgrades, has no local filesystem or many of the other complex layers you would find in standard operating systems like linux. Zero-OS has no human user interface components like UI or Shell Console, only API's which are used by the Zero Robots.

Benefits:

- **Performance:**
  Lightweight Operating System ("OS") without overhead for running bare-metal machines. This means there are no complex install procedures required, just a thin efficient software layer on top of hardware.
- **Private:**

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"No data left behind" when workloads move from one node to another.

- **Distributed:**
  Capacity is generated without the need for data centers at The Edge (which means as close as possible to where end users uses the Internet capacity)
- **Highly-available:**
  Any of the Zero Nodes running the Zero-OS can go down without impact of the applications running on top of the TF Grid.
- **Portability:**
  Moving applications and data from one node to another within the Grid is easy.
- **Secure:**
  Much less layers & open-source software deliver better security.
- **Green:**
  Advanced algorithms within Zero-OS optimize hardware performance and efficiency which results in minimal node power consumption (upto 10x benefit).
- **Integrated storage system:**
  Block & Object based storage systems which self-heal, autoscale - fast enough for any scale out workload.

This technology is available today and can be found on our open-source repositories on github.

Zero Robot = Self-Healing Technology

Zero Robots are intelligent virtual (no humans involved) system administrators which guarantee the uptime, security and performance of the TF-Grid.

These are called 3bot's. Go to http://marketplace.grid.tf/ to provision your own 3bot.

The purpose of the Zero Robots:

- **Self-Healing:** Zero Robots are smart enough to deal with all kinds of expected issues like broken hardware, sites being disconnected from the internet, resource overload situations (e.g. overload of CPU or hard disks almost full), and will rebalance the workloads without causing downtime.
- **Lifecycle Management**: Each application running on the grid can be managed through it's full lifecycle by the Zero Robots.
- **Autoscaling:** The platform automatically scales to meet application and infrastructure performance requirements.

Today our Zero Robot technology can cover the large majority of issues, but need to be programmed by smart IT experts, it's our job to deliver the framework and capability, we rely on the ecosystem to insert the rules & knowledge.

This technology is available today and can be found on our open-source repositories on github. Jumpscale is a framework we have been working on for more than 10 years.

Zero Chain = Our Blockchain Framework

The Zero Chain is a set of blockchain technologies which are currently used inside the TF Grid and invisible for the user today. The Main one is BCDB (A Beyond Blockchain Database). BCDB is a highly-capable database (scalable, secure, etc.) incorporating all the features of modern blockchain technology.

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The blockchain database (BCDB) is a super-efficient database that uses blockchain technology to securely store and retrieve data. Blockchain principles like “always append” and “store data in an immutable manner” are key aspects of this database technology.

The blockchain database is used in the autonomous layer for storing information of users, farmers, the digital representatives (3Bots), IT Architecture descriptions, and the state information of these running applications. This database technology provides distributed storage of key information of the autonomous layer.

For a 100 node deployment, our BCDB will be 50x more efficient compared to other blockchain technologies for storing data from a storage and network perspective.

The BCDB is used in the 3Bot which means every user has his or her own Blockchain DataBase. A BCDB can also be used as a shared ledger between multiple people.

This technology component alone is significant enough to grow a big startup business on its own.

All these technologies are open-source and can be found on github.

Team, Disclaimer, Remarks

None of the participants to the ThreeFold movement are registered, licensed, or supervised as a broker dealer or investment adviser by the European Securities and Markets Authority, the Securities and Exchange Commission (SEC), the Financial Industry Regulatory Authority (FINRA), or any other financial regulatory authority, nor licensed to provide any financial advice or services.

To learn more about our team see our team on our website: https://threefold.io/public/#/team

Definitions used in this whitepaper see: https://wiki.threefold.io/#/definitions

Version 2.2 was a major upgrade compared to our original version which is years old now, for history see https://wiki.threefold.io/#/whitepaper_original

In order to start using the TFGrid or TFT you must agree with our Disclaimer as mentioned on https://wiki.threefold.io/#/disclaimer and terms and conditions on the same wiki.

This document contains forward-looking statements that are based on our beliefs and assumptions and on information currently available to us. In some cases, you can identify forward-looking statements by the following words: “will,” “expect,” “would,” “intend,” “believe,” or other comparable terminology. These statements involve risks, uncertainties, assumptions, and other factors that may cause actual results or performance to be materially different. We cannot assure you that the forward-looking statements will prove to be accurate. These forward-looking statements speak only as of the date hereof. We disclaim any obligation to update these forward-looking statements.

We are only human, we are sure mistakes are part of this whitepaper and we would love to get your feedback and remarks so we can improve.

This whitepaper has been written with all best intentions in mind and does not imply any promise or liability, see our disclaimer: https://wiki.threefold.io/#/disclaimer

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Thank You

Thank you for reading our white paper.

We hope that we were able to give you a sense of how we intend to realize our mission of a better, safer and greener world for all. Please join us in this opportunity to change the world. Together, we can make a huge difference for ourselves and billions of others and help save the planet in doing so. It is all about optimally enabling easy access to technology for all citizens of the world. We believe the time for change is now!t

Feel free to contact us through chat on our website which is available at https://threefold.io.

Please do not forget we are a decentralized environment, what is happening on the ThreeFold Grid and with The ThreeFold token is the result of many independent people and companies working together.

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