

Titanium Blockchain

INFRASTRUCTURE SERVICES



TEIS

WHITE PAPER

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DOCUMENT REVISION HISTORY

Version	Modifications Made	Author(s)
v1.0	Initial Draft	Michael Stollaire/Jason Brink
v1.1	DEXchange Added to Titanium's List of Products and Services	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v1.2	Titanium BAR Token distribution percentages modified to leave more to reserve, Referral Bonus program added, Titanium Storage added as a potential strategic partner, ZCash added as an approved currency to purchase BAR with, Pre-Sale period extended, due to the rapid increase in Bitcoin's (BTC) price causing a subsequent dramatic decrease in Ethereum's (ETH) value and the minimum amount of BTC/ETH raised to consider the ICO a "success" decreased, because of BTC's rapid price increase (doubled in price since release of v1.0 of this White Paper). Also, added a new section: "The EHI Advantage."	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v1.3	Increased the bonus for using the BAR within The Titanium Ecosystem to 10% from 5%. Also added verbiage to "The EHI Advantage" Section of the White Paper. Added verbiage about a defined soft cap of money that the project must raise for the project to be viable.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v1.4	Added Table of Contents	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v1.5	Moved Content, Added New Citations, Client Logos, etc.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v1.6	Changed security cap to 350,000 ETH.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v1.7	Added a figure of \$35,000,000 for a hard cap.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)

v1.8	Added emphasis on Titanium being the first blockchain start-up ever, to obtain D&B and BBB accreditation.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v1.9	Replaced old roadmap Figure 1 image with new roadmap image.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v2.0	Based on audit results, added more corporate information, such as Federal Tax ID, California Corporation ID, etc. Also, added more Titanium Core Team information as well.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v2.1	Corrected DEXchange information, regarding the number of cryptocurrencies listed, the number of fiat currency pairs supported, and the guarantee that DEXchange will charge the lowest transaction fees in the world, guaranteed.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v2.2	Added Five-Year Financial Projections for the Titanium Project.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v2.3	Re-Corrected an Incorrect Statement about the BAR Token, as it will be the only currency that can be used in the Titanium Ecosystem.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v2.4	Added verbiage for Platform as a Service (PaaS), as an augmentation and synergistic element of IaaS.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)

v2.5	Added additional verbiage, regarding PaaS, more information about what cloud-based issues that Titanium would solve, greater detail as to how Titanium's deployment on blockchain functions and solves current problems, removed a subsection of EHI-based verbiage, pegging BAR to the USD vs ETH, Added "Why Titanium?" section, added verbiage about what happens in the case all BARs are not sold, the incentive for providing decentralized hardware, etc.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v2.6	Added Graphics for Payment Incentives for High-End Hardware in the Titanium IaaS/PaaS infrastructure and an overview graphic of IaaS/PaaS itself. Also, added graphics as to how decentralized resources, e.g., processor, memory and storage are delivered to the Titanium Infrastructure.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)
v3.0	Extensive technology deep-dive updates, explaining in detail, how the decentralized resources of Titanium IaaS/PaaS/SaaS operate.	Michael Stollaire/Artem Chupkhin (Legal)/Vincent Fullerton (Technical Advisor)

WHY TITANIUM?

- Titanium is first-to-market, regarding providing Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) on blockchain, our core competencies.
- Decentralized resources will allow Titanium to charge at least 50% less than our competitors.
- Because of its decentralized nature, Titanium will be able to promise customers uptimes of 99.99% for all services, applications, devices, etc.
- Cloud-based IaaS and PaaS are centralized, and therefore prone to [outages](#), performance degradation, and typical hacker attacks, such as Distributed Denial of Service (DDoS).
- Titanium is the sister company of EHI, the first technology company that our Founder and CEO started, which has been in business close to two decades and can give a warm handoff of Fortune 500, Education and Government clients to Titanium.
- The Titanium Core Team has over two-hundred (200) years of experience, and are considered to be in the top 1% of their respective technology fields.
- Titanium is the very first blockchain start-up to achieve both Dun and Bradstreet (D&B) and Better Business Bureau (BBB) accreditation.



Figure 1: Titanium ~ Setting a New Precedent in Blockchain Technology

EXECUTIVE SUMMARY

Titanium Infrastructure Services: The Ultimate Strength of the Blockchain... Unleashed™.

- Titanium Blockchain Infrastructure Services (TBIS) finally answers the question: "What if an entire IT enterprise could be decentralized, including data centers, firewalls, load-balancers, routers, switches, network appliances and servers?"
- TBIS intends to disrupt the current market leaders in the provisioning and virtualization space.
- Services Will Include: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Company as a Service™ (CaaS), Bring Your Own Cloud™ (BYOC), DEXchange™, Monitoring as a Service (MaaS), Blockchain as a Service (BaaS), Mining as a Service™ (MlaaS), Instant ICO Incubator™ (III), etc.
- TBIS is developed on the blockchain platform, so all changes in the environment and assets will be recorded on an immutable ledger, to correlate with standard IT change management and ITIL methodologies.
- Follow-the-Sun enterprise management and monitoring services, autonomous healing, and optimized disaster recovery and redundancy mechanisms will allow TBIS to virtually guarantee close to 100% uptime of devices, applications and services, making them a market leader.
- Since TBIS would operate on the blockchain, the days of Distributed Denial of Service (DDoS) attacks and other black hat hacker exploits would effectively be over.
- Most, if not all, of the issues associated with similar cloud server products would be solved.
- The TBIS Administrative User Interface (UI) is intuitive and the simplest to use in the industry, and will be available as a thick client, web-based thin client, and mobility applications on both Apple's iOS and Android platforms.
- UI wizards will allow administrators to create any component of their infrastructure in mere minutes, designed in alignment with their growth factors, technical requirements and business drivers.
- A unique capability to create virtual cryptocurrency miners will be included in TBIS services, allowing customers to spin up emulated ASIC and/or GPU miners with a specified hash rate.
- Mean Time to Repair (MTTR) will be significantly hastened, minimizing the cost of outages.
- Cost of ownership (COO) will be reduced to minimal levels.
- Return on Investment (ROI) will be achieved far faster than with traditional cloud-based solutions.

TITANIUM: The first blockchain start-up ever to acquire both Better

Business Bureau (BBB) and Dun and Bradstreet (D&B) Accreditation



D&B Number: [080926636](#)

Better Business Bureau (BBB) - Business ID: [756765](#)

Federal Tax ID: 82-3126792

California Corporation Number: 4073241

TITANIUM: The EHI Advantage

What does EHI stand for? Excellence, Honesty and Integrity, because that is what we

stand for.

Unlike 99.99% of Blockchain start-ups and Initial Coin Offerings (ICOs), the Titanium Core Team is not composed of relative newcomers to technology. In stark contrast, the Titanium Core Team has over two-hundred (200) years of combined experience. This is also not the first technology company that Titanium's Founder and CEO, Michael Stollaire, has ever formed. In 1999, Mr. Stollaire founded EHI, a technology consultancy specializing in enterprise infrastructure management, which is still thriving and growing today with Michael at the helm.

Two decades of experience taught EHI's personnel the strengths of infrastructure-based enterprise management, but it also unveiled the weaknesses of several solutions and problems that had to be minimized at several past customers.

Taking these problems and weaknesses under consideration, The EHI Team formulated a new architectural design on an entirely new bleeding-edge platform, The Ethereum Blockchain, which mitigated all of these issues. It was called Titanium, because the objective was to make our clients' technology infrastructure stronger than steel.

Also, EHI and its consultants are known in the industry as top-tier, elite personnel, as shown by their impressive Client List and Testimonials.

Most Blockchain start-ups and ICOs face a very serious problem after they develop a viable product and or service: finding companies and people that will actually purchase them and use them.

Titanium will not have this problem. As EHI's sister company, Titanium will simply inherit EHI's clientele, and since EHI is considered a trusted source of excellent customer service and personnel, Titanium will also be held in high regard.

In the eyes and opinion of Mr. Stollaire, in fact, Titanium is an organic evolution of EHI, and should effectively be considered "EHI v2.0."

What follows is a short excerpt of some of EHI's customers, which Titanium will leverage immediately.

CLIENTS INCLUDE

accenture



Cargill™



Honeywell



PayPal



Figure 2: The EHI ⇔ Titanium Connection

THE TITANIUM TEAM

TWO CENTURIES OF COMBINED EXPERIENCE

Titanium has many excellent assets and advantages, but nothing stands out more than The Titanium Core Team. Combined, The Titanium Core Team holds over two-hundred (200) years of combined experience in global infrastructure enterprise environments. Throughout seventeen years of experience in the technology sector, specializing in enterprise infrastructure management, Founder and CEO of Titanium, Michael Stollaire, made it a habit of identifying the most elite talent in technology, and made sure he kept in close contact with these individuals throughout the years. Over the course of time, Mr. Stollaire called in a favor or two to a handful on the list, to assist him with projects at Accenture, Boeing, Devon Energy, etc. However, with the advent of The Titanium Project, every resource that was accumulated over two decades was brought into the fold, forming an “A-Team” of the finest technology talent in the world.

**MICHAEL STOLLAIRE**

President & CEO

**RICHARD SILVER**

COO/Director of
Marketing

**CHRISTOPHER SNOOK**

CTO

**VINCENT FULLERTON**

Technical Advisor (Pura
Core Team & NEM
Developer)

**STUART SIEGLER**

Ethereum Developer and
Enterprise Automation
Expert

**JAMES CONNOLLY**

Ethereum Developer

**JESSE URE**

Ethereum Developer

**RITCHEY MULHOLLEM**

Ethereum Developer

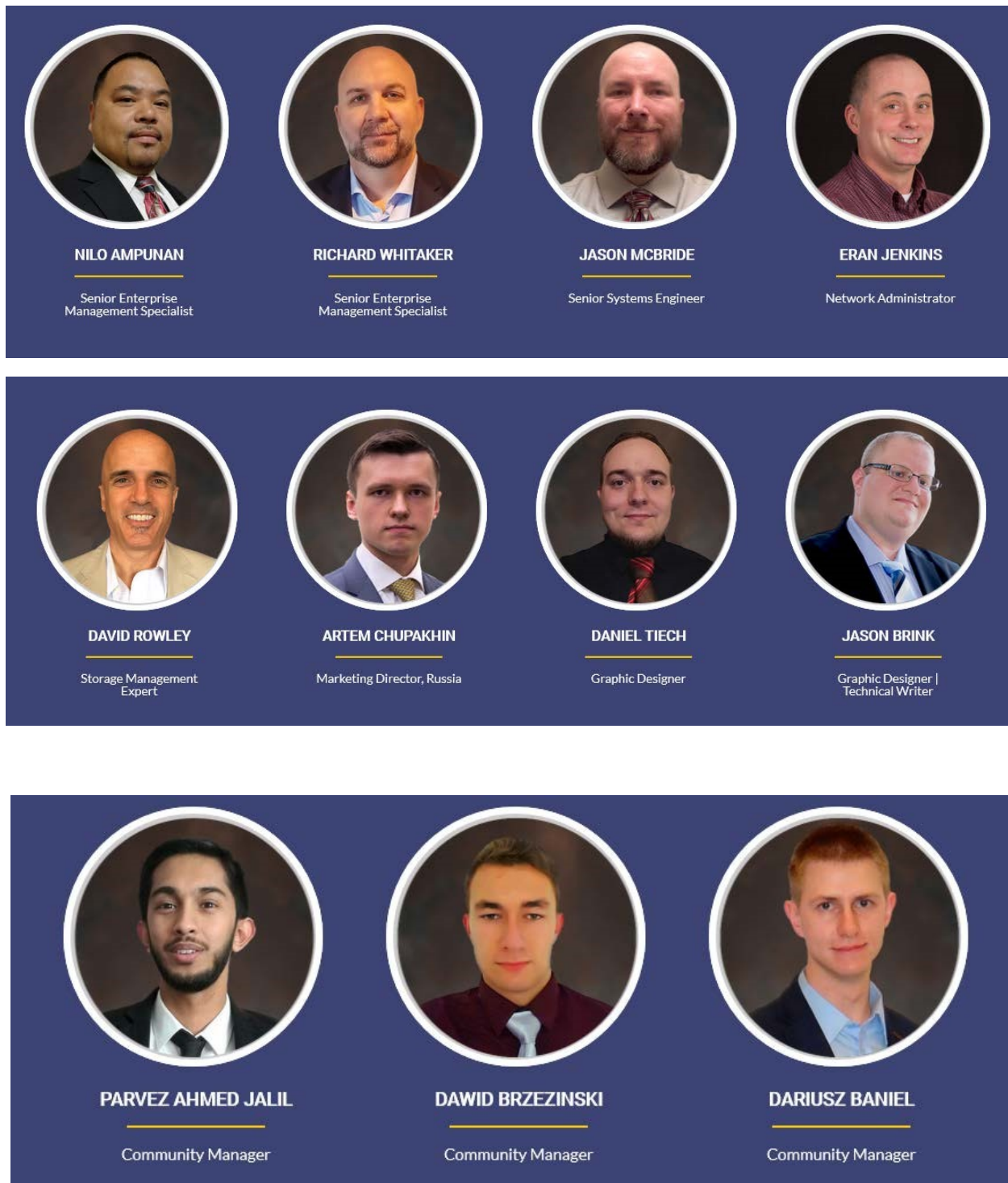


Figure 3: Team Titanium

BACKGROUND

Since the advent of the idea of an interconnected network in the 1960s, very little has changed regarding internet infrastructure. While today's internet has infinitely more interconnected servers, home computers, and most importantly, users, the functional technological framework has not changed since the first envisioned by the computing pioneers of the '60s and '70s. Of course, server technology has improved since the first network arrays such as ARPANET, but the fundamental infrastructure hasn't changed – it is still based on large data centers and is centrally controlled by large companies who have their own interests at heart; these interests are not necessarily yours.

In 1999, the invention of virtualization software allowed for the creation of virtual machines (VMs) on high capacity servers. This saved companies around the world billions of dollars and allowed for the rapid growth of the consumer webhosting industry as hundreds of low traffic websites could be hosted in a very small amount of rack space as “servers” could be brought into being with the touch of a button. However, even in this situation, a disproportionate amount of power was placed in the hands of relatively few companies. Even today, up to 70% of internet traffic passes through server farms concentrated in Northern Virginia and operated by a single company.¹ While the status quo *works*, it is far from the ideal decentralized and democratized internet envisioned by our technological progenitors and which is only now becoming a possibility.

Welcome to the new world brought to you by Titanium Infrastructure Services (TBIS); We Are the Revolution.

A NEW ERA

Today, the largest transportation company in the world owns no cars (Uber), the largest hospitality company on the face of the planet owns no hotels (AirBnB), the largest retailer carries no stock (Alibaba), and the world's most popular media network creates no content (Facebook). Clearly, we are living in a time of radical change. Why should internet infrastructure be any different?

TBIS is proud to introduce decentralized/distributed Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) on the Ethereum blockchain platform. Today the internet, considered collectively, represents an estimated 11.5 million petabytes of data. As enormous as this it, it is dwarfed by the potential of a fully integrated and interconnected global network scattered throughout the billions of desktops,

¹ As of the time of writing, roughly 70% of all internet traffic passes through Amazon Web Services (AWS) server farms scattered throughout Northern Virginia. This centralization introduces a fundamental weakness to the entire infrastructure of the Internet; TBIS was designed to solve this problem.

Source: <https://www.washingtonian.com/2016/09/14/70-percent-worlds-web-traffic-flows-loudoun-county>

servers, and networked devices. It is the leveraging of this system to which TBIS is dedicated. With completed proof-of-concept models created and functioning infrastructure forged by the greatest minds in the distributed computing industry, TBIS will completely revolutionize internet infrastructure.

Just as steel changed the building industry forever, Titanium will usher in a new era of network construction. With TBIS' proprietary IaaS, every device, from enterprise level on down, can be virtualized; routers, firewalls, and specialized equipment such as cryptocurrency miners, can exist in an entirely cloud-based environment. With Titanium Hydra Fault Tolerance, if a device falters, TBIS will have already shifted load away and onto another network of redundant nodes. If a potential security problem arises, the TBIS system will work automatically to limit the potential impact of attacks such as DDOS or other address-specific attacks; it is impossible to overwhelm a piece of equipment that exists only on the ether.

The backbone of the TBIS system is the Service Level Agreement (SLA) which can be constructed to virtually guarantee 100% uptime of all devices, applications, and mission-critical services. The Titanium Control Panel will make it possible for even an inexperienced user to create SLAs that will be able to support enterprise-level support and network infrastructure for any person or company that has decided to be a part of the coming Titanium Revolution.

In short, TBIS IaaS will render current infrastructure services, from web hosting to any network support device, archaic, obsolete and utterly useless. Just as iron supplanted bronze, Titanium is elemental to the future of the internet.

MISSION STATEMENT

Our Mission:

"Our mission is to leverage the power of the immutable blockchain to provide virtual infrastructure services for businesses and individuals, creating a Titanium clad guarantee of reliability which had previously been wholly impossible."

Our team firmly believes in the disruptive power of the blockchain. Already, global business and finance are being transformed and disrupted by blockchain technologies. TBIS has already completed trials that demonstrate that it is possible to create entire infrastructure systems on distributed and redundant systems. Imagine a world in which businesses no longer need to have a networking closet full of expensive and temperamental equipment that rapidly becomes obsolete, requires tender care and reduces productivity through down time or general digital surliness. All of the decaying equipment with yellowing casings can be replaced with digital

titanium for a fraction of the cost of acquisition and maintenance of hardware infrastructure, all while increasing uptime and reliability and completely eliminating maintenance.

TBIS's Infrastructure as a Service (IaaS) is a powerful and timely platform which is needed to usher in a new era of productivity for companies and individuals around the world by providing end-to-end internet infrastructure.

CORE OBJECTIVES, PRODUCTS AND SERVICES

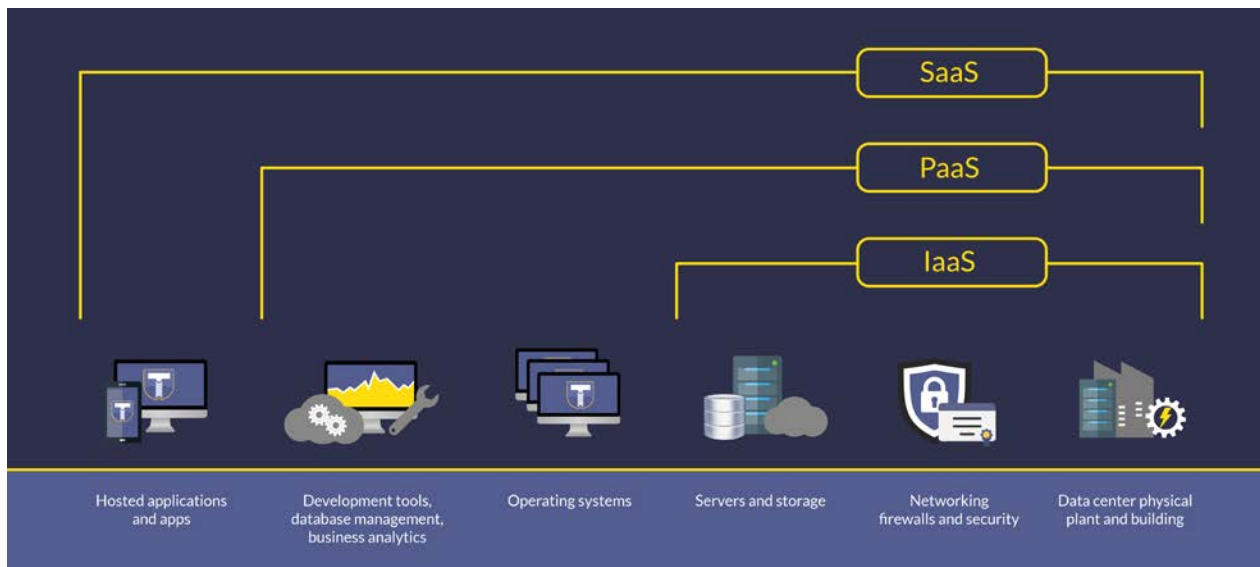


Figure 4: Decentralizing the Entire Technology Infrastructure

Titanium Infrastructure Services (TBIS) has the following core components:

Infrastructure as a Service (IaaS)

The core competency objective and primary goal of TBIS is the creation and propagation of a shockproof distributed network infrastructure capable of replacing the bloated and inefficient hardware foundation upon which the internet of today is based. *In essence: to build a better internet that cannot be controlled or destroyed by anyone and is open for all.*

This will include but is not limited to:

- a) Maintaining and Enhancing TBIS' existing enterprise virtualization software package which enables the creation of network components such as servers,

- routers, switches, etc., in a distributed environment
- b) Building and remaining as the *de facto* platform for creating, maintaining, patching and upgrading distributed enterprise IT environments
- c) Making it quick and simple to virtualize entire enterprise-level infrastructure environments while simultaneously decreasing the cost-to-consumer and downtime while increasing network reliability, security, and convenience
- d) Website hosting through the Titanium Virtual Server System will be more reliable than existing shared hosting because unlike a traditional server, which can go down, the TBIS servers will guarantee constant uptime and dramatically increased security
- e) Implement the cutting-edge TBIS Enterprise Management Software with autonomous healing and security functions include in the Titanium Hydra Fault Tolerance Suite for all monitored elements and network components
- f) Platform as a Service (PaaS) or application platform as a Service (aPaaS) is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app. PaaS can be delivered in two ways: as a public cloud service from a provider, where the consumer controls software deployment with minimal configuration options, and the provider provides the networks, servers, storage, operating system (OS), middleware (e.g. Java runtime, .NET runtime, integration, etc.), database and other services to host the consumer's application; or as a private service (software or appliance) inside the firewall, or as software deployed on a public infrastructure as a service.

Economic Incentives and Repurposing Legacy Hardware

First and foremost, we must point out that only enterprise-class resources will become part of the Titanium infrastructure. This can and should include legacy equipment such as older versions of servers, storage arrays, etc.

Legacy Mining Equipment

A significant advantage of IaaS and the decentralized resources that it will be composed of, is that it will allow for repurposing of legacy hardware, including older versions of cryptocurrency mining equipment. Instead of them essentially being "expensive paperweights," when they become part of the Titanium infrastructure, these pieces of hardware will be able to do exactly what they were made for: making money.

Initially, the owners of decentralized processor, memory and disk storage that are renting their equipment as part of the Titanium infrastructure will receive 5% of all revenue accrued as part of the contracts that Titanium will sign with future clients.

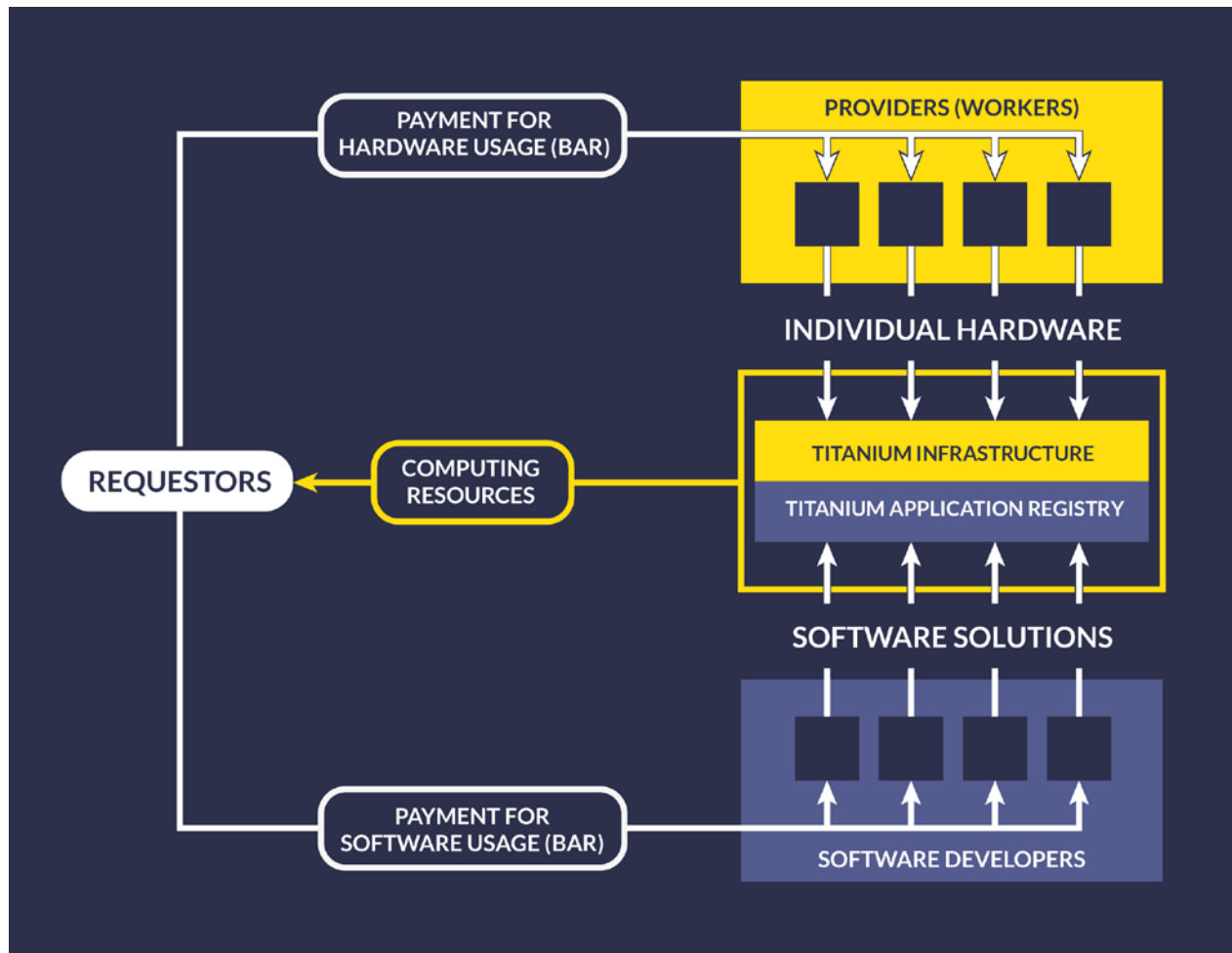


Figure 5: Monetizing SaaS/IaaS/PaaS

Platform as a Service (PaaS)

With Titanium's Platform as a Service (PaaS) you have access to a world of decentralized enterprise applications, distributed applications (dApps) and more, all available on an as-needed basis. You pay only for the resources you require and of course they are delivered via your secure internet connection in a thoroughly decentralized development/deployment environment.

PaaS adds an assortment of infrastructure assets on top of the storage, servers and networking hardware that IaaS offers. Middleware, database management systems, business intelligence (BI) services, comprehensive development tools and more are added as part of PaaS. The entire application lifecycle from coding and testing to deployment and management are supported and of course you'll be working with the latest versions as everything is updated on a regular basis.

The beauty of Titanium's PaaS is that you can focus on just managing the apps and services that are your core focus and leave everything else to us. No longer will you have to worry about purchasing or managing software licenses, middleware, development tools or app infrastructure.

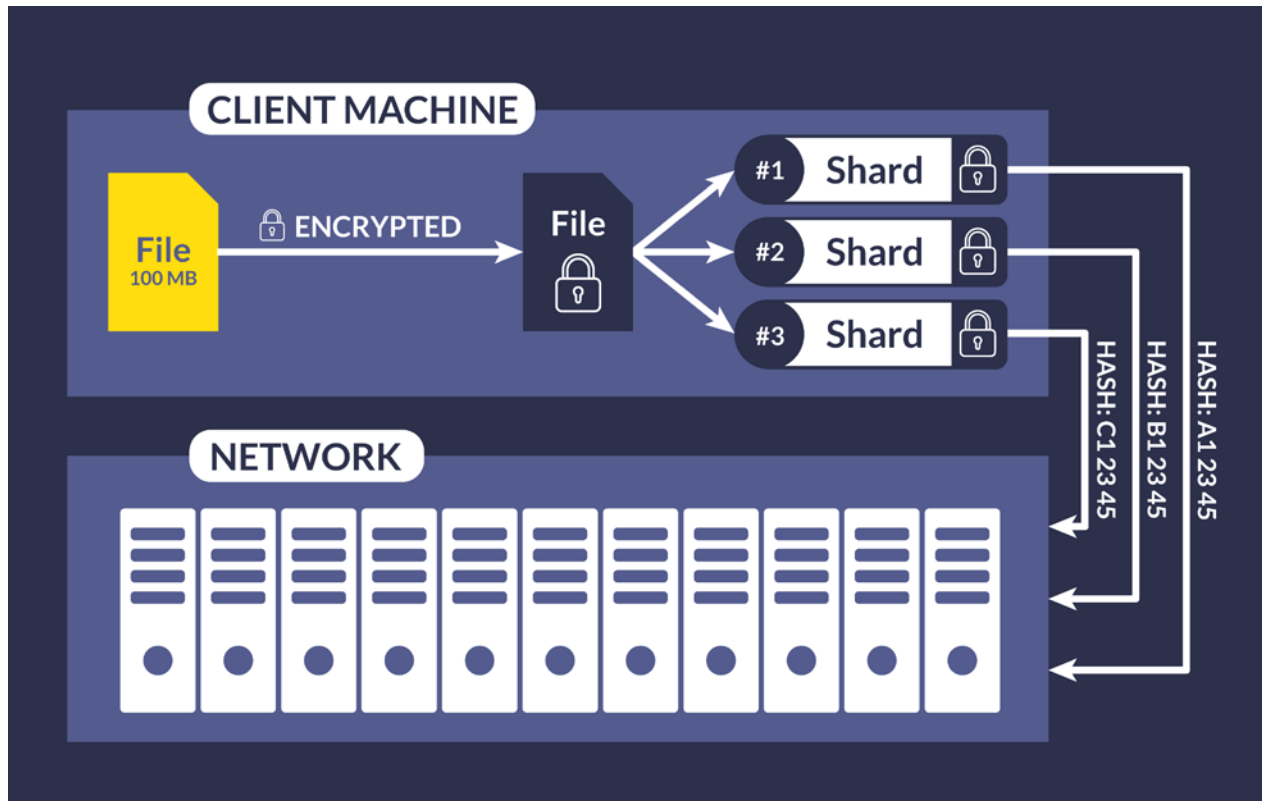


Figure 6: Decentralizing Enterprise-Grade Storage Resources

Platform As A Service Use Cases

PaaS Framework Of Development

One of the primary benefits that Platform as a Service (PaaS) provides is the reduction in coding needed to create and/or modify cloud-based applications. Titanium provides essential Blockchain capabilities such as decentralization, scalability, high availability and multi-tenant capability; all available in the form of easily accessible components. We provide this seamless and comprehensive platform so you can focus on building on top of it, saving time and money.

Business Intelligence (BI) and Analytics

The ability to analyze and mine your data is essential for organizations so as to

discover insights, uncover key patterns, forecast outcomes as well as to aid in product design changes and of course profit/loss optimization and business decisions. This is why Titanium's PaaS provides a comprehensive set of tools for Analytics and Business Intelligence (BI).

Additional Services

Titanium's PaaS offers a wealth of additional services that can be used to optimize applications in various ways from workflow and directory improvements to more effective scheduling and better security.

Platform As A Service Advantages

Platform as a Service (PaaS) builds upon the benefits of Infrastructure as a Service (IaaS) by providing essential higher level components such as development tools, middleware and a comprehensive array of critical business tools. These benefits include:

Reduction Of Programming Hours/Maximizing Existing Staff

Ready to use, user friendly application components such as directory services, workflow capabilities, security and search features are provided as part of PaaS. These drastically reduce the coding necessary when building new applications saving valuable time. PaaS enables your existing programmers to accomplish more without the additional cost and complexity of adding additional development staff with new skills by using ready-to-use plug and play components.

Platform As A Service Development: Facilitates Desktop, Mobile And More

No matter what your platform of choice: mobile (Android, iOS etc) pc (Windows, Mac etc), various browsers (Chrome, Edge, Firefox, Opera etc), Titanium provides the essential development tools to easily and effectively make cross-platform applications.

Proprietary, Optimized Tools Provide Better Outcomes

Maximize your existing budget by utilizing sophisticated development software and analytics/business intelligence (BI) tools on an 'as needed' basis that might otherwise be too expensive for your project. Our 'pay-as-you-use' model puts access to expensive state of the art development tools within reach without the capital outlay outright purchasing would require.

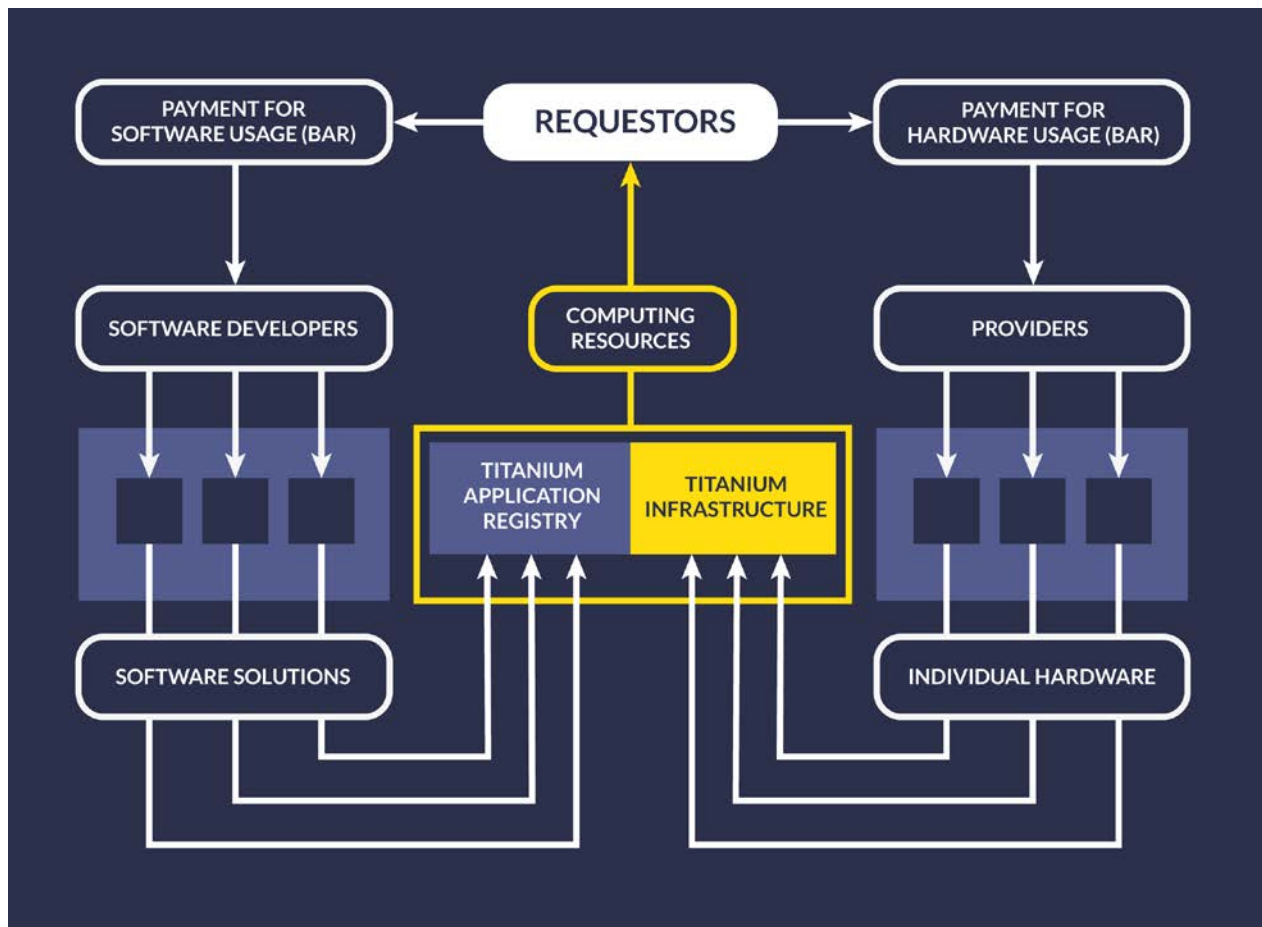
Enable Remote And Decentralized Development Teams – Around The Globe

The ability to have development teams work together despite individual team members being located in various locations is easy with our internet-based

development environment. Decentralized tools for the decentralized team.

Your Application Lifecycle Managed The Right Way

Platform as a Service provides an integrated, state of the art environment that will support you through the entire development process and application lifecycle: From coding, testing and deploying to management and updates, Titanium PaaS is the comprehensive package that will help you succeed.



Desktop as a Service™

(DaaS™): The creation of a distributed internet infrastructure also makes it possible to host entire user computers on the Titanium Cloud. Using the custom designed ultra-light TitaniumOS, TBIS users will be able to access their entire computer from any publicly available terminal or smartphone. Through navigating to their personal encrypted Titanium Desktop, they will be able to use their computer just as they would use any website. Titanium Virtualization Technologies will protect their data, ensure uptime and reliability, and make viruses and targeted attacks a thing of the past through implementation of the Titanium Hydra Fault Tolerance Suite.

Leveraging state-of-the-art SHAKE256 Titanium Sponge Cryptographic Techniques, the

user's files and TitaniumOS will be future-proof encrypted and yet will remain accessible to the user with the Titanium Key. This will combine ultimate encryption and security while also allowing for ease of access.

Company as a Service™

(CaaS™): This is an automated wizard which will allow a user to start a new business from square one through leveraging the power of Smart Contracts. Anyone who has attempted to start a business in the past is aware of the challenges presented by meeting legal requirements to establish a business.

Through CaaS, TBIS will be able to supply entrepreneurs with the critical support they need to get their business off the ground by completing tasks such as:

- a) Registering for Business Licenses
- b) Creating Business Bank Accounts
- c) Filing Trademarks and Patents
- d) Incorporating
- e) Leasing of office space or equipment
- f) Hiring employees or independent contractors
- g) Securing advertising space
- h) Domain registration and host acquisition
- i) Etc.

From a legal standpoint, these Smart Contracts will save business more than just time in the creation of businesses. Smart Contracts, encoded in the immutable TBIS Blockchain, cannot be tampered with or altered in any way. Once a contract has been signed, it has been etched into Titanium and will exist in perpetuity.

CryptoEscrow™

This service allows the TBIS user to use any supported cryptocurrency to purchase items, auction items, etc. and leverage an Ethereum-based escrow service based on the Smart Contract. This would enable buyers and sellers to conduct transactions free of the worries typically associated with online purchases.

The Titanium CryptoEscrow™ would make it possible to:

- j) Buy and sell online for any amount in any approved cryptocurrency without fear of non-delivery. This system is designed to use a very simple smartphone

interface that will require no experience or coding background. It is so easy, your grandmother could do it.²

- k) Generate Titanium Smart Contracts using the TBIS Blockchain and the Titanium DEX (below) to manage payment and logistics. This contract will consist of a two-part SHA256 hash which will be given to both buyer and seller, and only once these two pieces are united and delivery takes place will the funds be released from the escrow.

Bring Your Own Cloud™

(BYOC™): Beneath the surface of the Titanium Infrastructure there will be an entire suite of services that will change the computing world. Central to this effort is the desire to help users create a truly private computing environment. This can be achieved through BYOC.

People can join the BYOC secure computing environment by contributing hashpower to the network. BYOC is based on a PoW ERC20 token which generates an everchanging hash for communications encryption. When a user joins, they will be connected to a service that will download an open source Linux VPN application. Users can opt to use their own cryptocurrency miner as long as it meets the minimum requirements for OS platform, CPU, RAM, etc. Alternatively, of course, one of the many virtual miner emulation choices available via the MlaaS TBIS offering could be leveraged. Please note that the BYOC service can be used for many other functions, such as web servers, file servers, etc. A cryptocurrency mining device is only be used as an example. TBIS will provide a Centos Linux OS ISO image which has a special kick-start function, to bring the device online and initiates a minimum amount of hashing on the local GPU. At this point, the kickstart server can deploy to any server/device you connect in your private cloud environment. For mining hardware, BYOC will facilitate high-end servers being used as cryptocurrency miners.

For an ultra-secure computing environment, users can join the TBIS Instaminer Network. Based on micro-computers, which can be acquired from TBIS, a security context with the peer-to-peer blockchain can be established. If someone attempts to add a device via a method that does not include the TBIS micro-computers, the device will not be allowed to communicate on the network. The TBIS micro-computer will have an open VPN for security and will be able to deploy images to servers and miners in the local environment. Once the security context is established, files beyond the vanilla Centos OS will be obtained via our own git repository and docker swarm infrastructure. In short,

² How this might work in the real world is that Alice might hire a courier firm to deliver to Bob a guitar he purchased from Alice – under instructions to only hand over the guitar once Bob has given them the pre-image which fulfils $\text{SHA256}(\text{key}) = \text{HASH}$. Once they have this key they may send a transaction to the blockchain themselves (or have Alice do it), to release the cryptocurrency. The end result is that Bob has his prized guitar, and Alice has received her payment in the cryptocurrency of her choice. However, if Alice does not receive the correct random number from Bob during an allotted time period, the contract is voided, and the cryptocurrency is returned to Bob. An example of such an escrow contract coded in the Solidity coding language can be found in the appendix at the end of this White Paper. With that said, TBIS is actively working on strategic partnerships with other companies (also delineated below), one of which provides an intuitive UI that anyone with basic computer experience can use to create smart contracts. No Solidity, etc. coding experience is necessary. Your Grandmother could do it.

the use of the TBIS micro-computer will make setting miners and servers up completely automated.

DEXchange™

Cryptocurrencies and blockchain technologies are centered around decentralization. However, many cryptocurrency exchanges of today are based on centralized systems which are controlled by outside entities. The TBIS Titanium Exchange will provide initial support for the top twenty (20) fiat currencies used worldwide, and allow for exchange trading with the top two-hundred (200) cryptocurrencies as per <https://www.coinmarketcap.com> in an entirely decentralized fashion. Of course, TBIS reserves the right to increase or decrease the number of fiat currencies and cryptocurrencies it supports with future releases of the product. Also, DEXchange™ will charge the lowest transaction fees, and fees in general, in the world, guaranteed.

Instant ICO Incubator (III)™

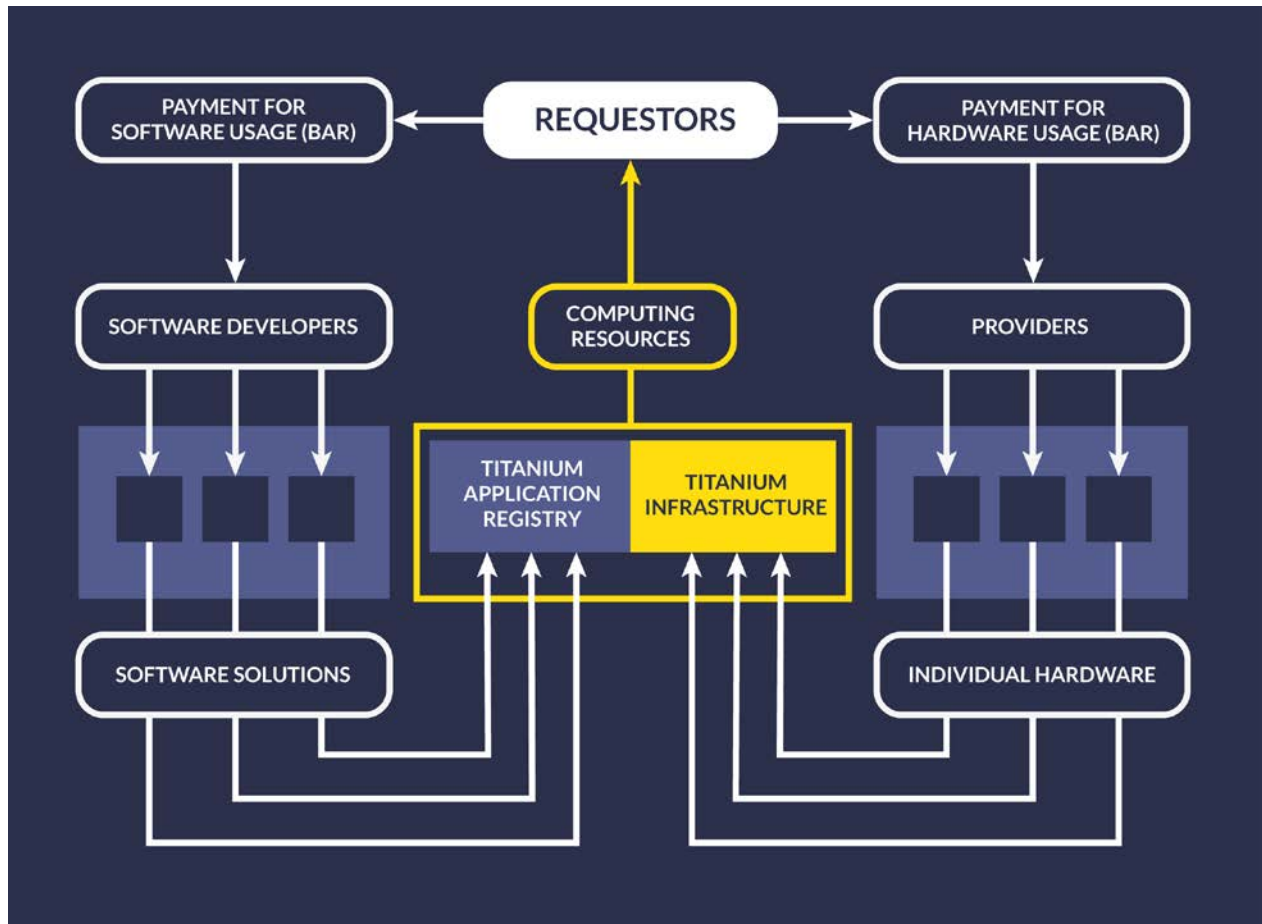
At TBIS, we know how hard it can be to get everything together for a token launch. If you have a brilliant technical idea, but need the marketing and organizational backing to bring it to life, the Titanium Instant ICO Incubator™ will take the guesswork out your token launch through providing end-to-end launch services. Also, a *Titanium Clad Accreditation* will be created and granted to ICOs that have undergone a deep-dive due diligence by Titanium personnel. There will be no guesswork, as to which ICOs are credible and primed for investment. For instance, where these accreditations are supported, Titanium will require our ICOs to have both a Better Business Bureau (BBB) and Duns & Bradstreet accreditation. Titanium does all the work for you, so your investments are as safe as possible.

The over-arching goal of Titanium Blockchain Infrastructure Services is to provide the capability for virtualization of equipment, running the gamut from simple routers, to specialized equipment such as cryptocurrency miners. Through virtualization, TBIS will be able to help guarantee that your equipment will stay updated, patched, and ready to function to protect the interests of your business.

For example, in order to remove the hazards associated with new technology being introduced that makes current mining rigs obsolete. With TBIS IaaS, you would simply run a wizard in our UI to replace a GPU-based mining rig with an ASIC mining device. When new ASIC boards are released that are more energy efficient and have a significantly greater hashing rate, the virtual boards can be upgraded, etc., by drawing on our global network of computing power.

TECHNICAL OVERVIEW

The primary innovation that Titanium's Infrastructure as a Service (IaaS) brings to the decentralized blockchain space is the use of enterprise grade systems for all of its primary working technologies including processor, memory, disk space and more. This reliance on higher spec technologies with overall quicker access times and faster execution than our competitors will permit a superior client experience at reduced cost.



Titanium Decentralized Storage

Summation

Titanium's Decentralized Storage solution joins peer-to-peer storage in the cloud with client-side encryption that takes the third-party provider out of the equation when transferring and sharing data. Reduced data failures and outages, increased privacy, security and control of data are all advantages inherent in this setup.

Production storage systems typically are not optimal with peer-to-peer connections as popularity rather than utility determines data availability. By implementing a challenge-response verification system along with direct payments this problem is mitigated. Additionally, data integrity is quantified with rewards offered to data maintaining peers. Finally, access and performance worries are mitigated through a model incorporating independent and/or federated nodes.

Introduction and Design

Compared to datacenter sourced cloud storage, cloud storage that is decentralized offers many advantages. Infrastructure failures and security intrusions are dramatically lessened through the use of client-side encryption and data integrity that is maintained through proof of retrievability.

More parties competing using their existing devices will drive down costs for various storage devices and create an open market for data storage. Censorship, unauthorized access, data failures and tampering of data will all be greatly reduced on the network. Implementation of such a network and the tools used in its interaction are described in this paper.

In the past, large storage providers serving as trusted third parties that transfer and store data are what cloud storage has relied on. However, there are inherent weaknesses in this trust-based model. Non-standard encryption on the client-side of the traditional cloud creates openings for various security issues including but not limited to malware, man-in-the-middle attacks as well as flaws in applications that might expose both consumer and corporate data. Storage systems, which are dependent on the same infrastructure share similar vulnerabilities.

Titanium Storage allows for the creation and execution of storage contracts between peers as part of a distributed network. The Titanium Storage protocol allows for negotiated contracts, data transfer, verification of both the integrity and availability of remote data, data retrieval and the ability to pay nodes between these peers on the network. Very little human interaction is required as each peer acts as an autonomous agent. The tools required to create and execute these interactions are described in this document.

The Sharding Process For Files

The Titanium Network uses 'Shards', or small parts of encrypted files that are stored on the network. The advantages of sharding include but are not limited to increased performance, availability, privacy and security. Before files are sharded they are encrypted on the client-side. Although convergent encryption or other desirable systems could be implemented, our reference implementation uses AES256-CTR. While the data owner retains control over the encryption key and over access to data, this implementation protects the data content from the storage provider/farmer that is housing the data.

As the set of shards increases in the network it becomes much more difficult to find a specific set without accurate location information, therefore the owner of the data may on their own separately obtain information on both how a file is sharded and the precise location on the network for easy reference. The security of the file is in proportion to the square of the size of the network.

In order to preserve privacy, shard sizes should be standardized as byte multiples such as 8MB or 32MB. This use of standardized sizes helps mask the flow of shards through the network as smaller files with random data or zeros filled in could enable side-channel attempts to determine content of individual shards. Reducing the burden of content delivery on a given node, large files like video content are sharded and distributed across nodes. This distributes demand more consistently across the network. End-uses can also utilize parallel transfer networks peer-to-peer and BitTorrent.

There is typically no correlation of data failure among peers because they are using different hardware and infrastructure. Because of this, applying a parity scheme or creating redundant mirrors of shards is a very effective way of ensuring availability. The number of nodes storing data determines the proportionality of Availability.

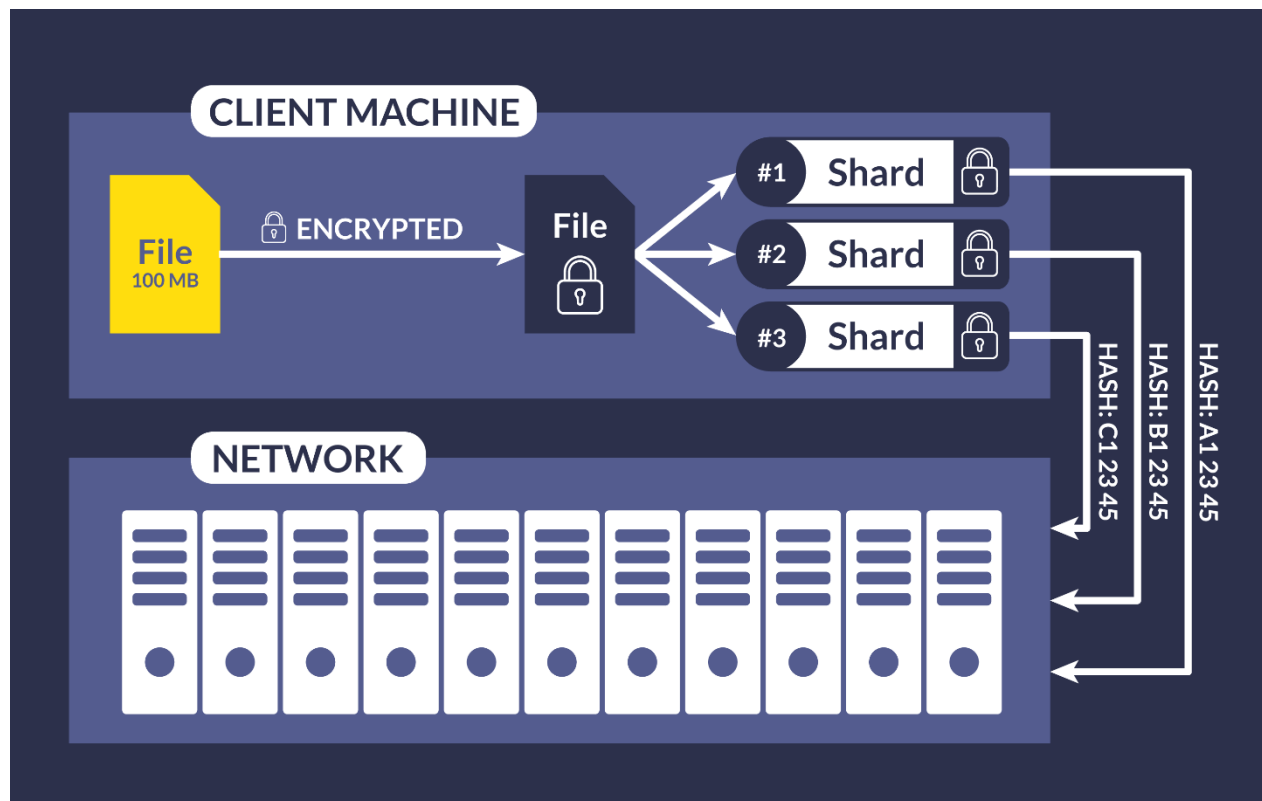


Figure 7: Visualizing the Sharding Process

File Sharding Procedure

1. Encryption of Files.
2. Multiple files are combined to form a shard or shards are created by splitting encrypted files.
3. Each shard undergoes audit pre-processing.
4. Transmission of shards to the network.

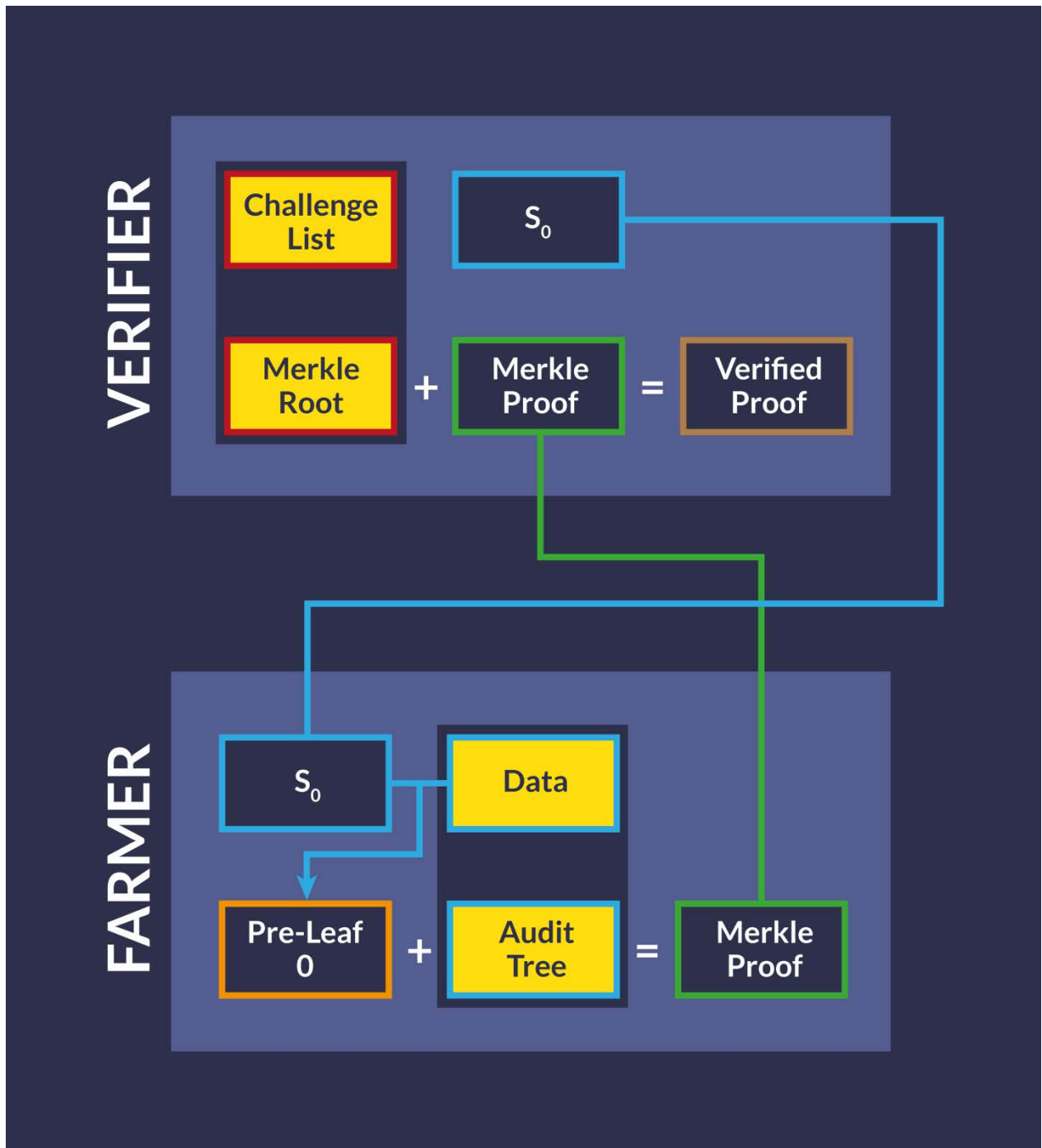


Figure 8: Titanium Storage Audit Tree with $jlj = 4$.
Red outlines indicate the elements of a Merkle proof for s_0

The set of challenges, both the Merkle root and the depth of the Merkle tree is stored by the data owner who then transmits the Merkle tree's leaves to the farmer. The leaves are stored by the farmer with the shard. From time to time, a challenge is selected by the data owner from the stored set, and it is

transmitted to the farmer.

Both the data and the challenge are used by the farmer to create the pre-leaf. This pre-leaf as well as the set of leaves is used to create a Merkle proof which the data owner receives back. Challenges should never be reused, although they may be selected by any sensible pattern.

The farmer has only a probabilistic assurance that he retains the entire file when doing a partial audit. When the verifier believes an intact shard is held by the farmer but it has actually been changed or partially deleted, a false positive result might result. However, the false positive probability of an individual partial audit is able to be calculated.

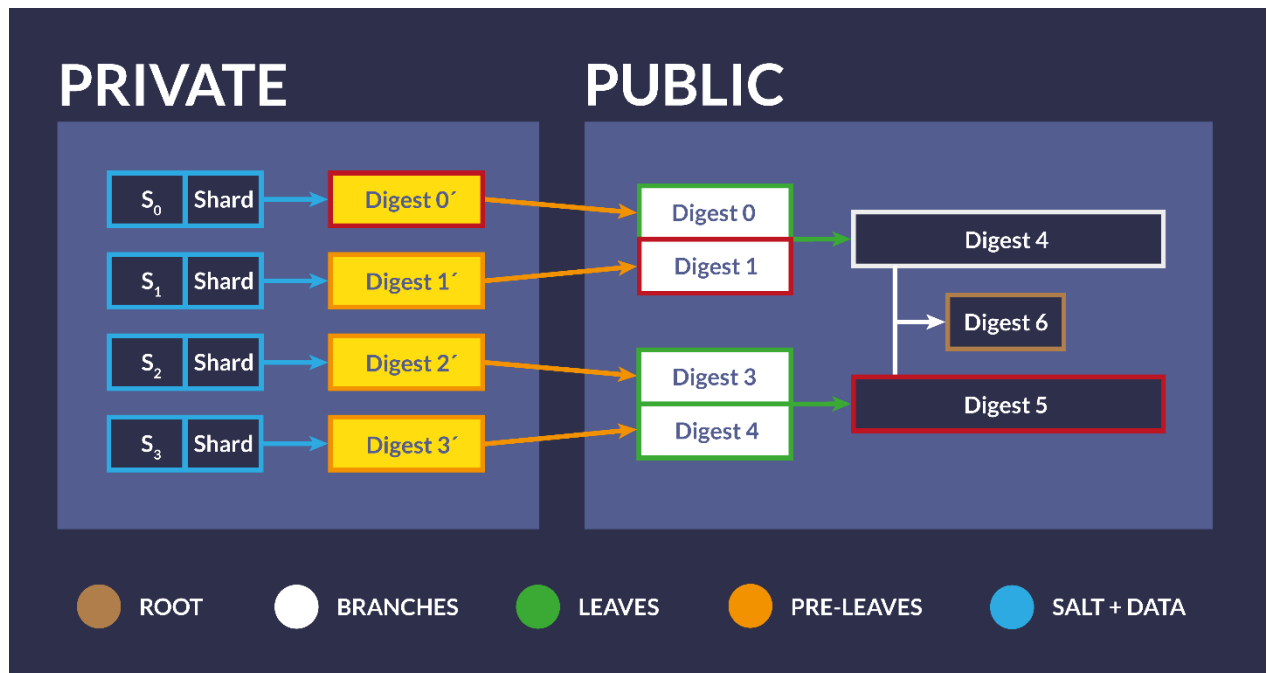


Figure 9: Issuing and Verifying Titanium Storage Audits

Publish/Subscribe for Negotiation and Contracts

Titanium Storage uses a publish/subscribe system in order to put parties together that are interested in creating a contract. A standard contract is used to negotiate for data storage. The contract consists of a versioned data structure that outlines the relationship between the farmer and the data owner. All information necessary in order for each node to create a relationship, transfer data, create and respond to audits and arbitrate

payments are contained in the contract. This information includes shard size, hash, audit strategy, and information on payments.

The contract exists exclusively for the benefit of the data owner and farmer and therefore each party should securely save a signed copy. No other node exists that will be able to verify the terms of the contract or state of the relationship, so this is an imperative. As Titanium develops in the future, options may exist allowing contract data to be stored in the DHT or a blockchain's external ledger among other technology options that may allow external access and verification of relationship and contract terms.

Titanium Bar (BAR) Micropayment Channels

Micropayment channels permit direct pairing between a payment and an audit which minimizes the trust needed between data owners and farmers. Titanium BAR micropayment channels that are still in development will be used in our reference implementation. Audit payments are typically very small, on order of \$0.000001 per audit since data storage is so inexpensive.

There are several advantages that the Titanium BAR provides compared to other competing currencies. These include the use of more granular payments which minimizes trust between parties. Also, the entire value of the channel is escrowed for the entire life of the channel due to the mechanics of the micropayment channels. Value fluctuations that severely impact a micropayment channel's economic incentives are decreased through currency velocity.

In order to create considerable insulation from the volatility of the outside market, the Titanium BAR not only uses a unique token but also one whose supply reduces the token's effective escrow on the market.

There are a number of necessary components that new payment strategies require. Among these are a currency, storage price, retrieval price and a destination for payment. New payment schemes should also take into consideration how farmers verify receipt without direct person-to-person interaction and how data owners prove payment. Some examples of other micropayment networks include the Raiden (Ethereum), Plasma and Lightning Networks (Bitcoin). Interested parties may study the implementation details of other strategies for their own knowledge.

The Titanium Storage Rivet System

RIVET is Titanium Storage's proprietary peer-to-peer publish/subscribe system. Rivet utilizes Bloom filters which are topic-based pub/sub [12]. The topics, including contract size and bandwidth commitment, describe variable contract parameters that are desired by the broadcasting node. The contract offers and negotiation process is facilitated through the use of a standardized topic list on the protocol level and is easy to extend. This helps ensure that messages reach interested nodes.

Redundancy

Usually, to save their customer's files, cloud object facilities own or lease their servers. To protect their network from physical or network failure they use RAID schemes or a multi-data center configuration. Due to the nature of Titanium Storage's distributed network approach utilizing untrust peers to store objects, it is not expected that farmers will be relied on to institute the same level of safeguards against data loss and corruption as these aforementioned cloud storage facilities.

In fact, it is to be expected that some farmers will shut their node down at any given time. Therefore, it is necessary for data owners to institute their own redundancy schemes in order to guarantee the safety and corrupt free nature of their files. Many redundancy schemes can be used since the protocol deals only with the contracts for individual shards. Three of these are hence described:

Shard Mirroring

Mirroring shards across several nodes is probably the most obvious and straightforward solution. Multiple copies of each shard exist since multiple copies are made. This protects against hardware failure as well. Using this technique, the shard availability is $P = 1 - \prod_{n=1}^N (1 - a_n)$ where a_n is the uptime of the node storing shard n .

Availability of the file is the same as the availability of the least available shard since all shards are required for the file to be assembled. A redundant copy of a shard can be found and a new location assigned to it on the network in the case of a dropped contract. Our reference implementation uses this current technique.

File Storing

Titanium Storage uses a local file store in order to facilitate farmer's on-disk storage. The file system is typically used at first directly to store shards by the farmers. Eventually, a single DB instance is used by the farming client. Both of these schemes did not scale. As an example, the compaction of LevelDB processing time scales in a linear way with store size but locks both reads and writes while it is in use. Significant performance degradation resulted and affected the availability of nodes that were storing over 100GB. KFS acts as an abstraction layer with a range of LevelDB occurrences that tries to tackle scaling problems.

There are several benefits to scalability by horizontally scaling many DB instances. First, it lessens the effect on operations of impact compaction. In each occurrence, compaction runs individually rather than along the entire data set the scaling issues compaction might cause are minimized. Also, compaction along the entire shard occurs separately for each instance but it still takes the same approximate amount of computation (compaction and data scale linearly). Therefore, compaction is actually 256 smaller processes that are independently running.

Transferring of Data

HTTPS/SSL/TLS is used to transfer data. Uploading or downloading shards by applications is done where Farmers expose endpoints. Previous CONSIGN and RETRIEVE messages authenticate client's requests via tokens they receive. There are many other possible implementations of the transfer mechanism that may be available in the future and this specific scheme is not essential to the protocol.

Accessing the Network

The work of maintaining high availability and integrity of data on the Titanium Storage Network is largely the data owner's responsibility. Data owners are required to negotiate contracts, pre-process shards and issue, verify audits, provide payments, manage file states via the collection of shards and manage of encryption keys since individual nodes can't be relied upon and hidden data such as challenge sets can't reliably be sent to an untrusted peer to process.

Superior uptime as well as greater infrastructure are required by many of these functions, especially per active set of files. Thus, user run apps such as synchronization of files can't be expected to manage files efficiently.

Titanium Storage uses a thin-client model to delegate trust to a dedicated server. This server handles data ownership and allows for simple access to the network from the most varied array of client apps. This is not unlike the concept of the SPV wallet used in Bitcoin and other crypto currency schemes.

There are number of ways in which the data owner can share the responsibilities between the client and the server. Through varying degrees of delegated trust, a wide array of other valuable services could be provided by the server. Bridge is the name used for this type of dedicated server and it's available as a type of Freeware. In order to speed up network access, any group or individual can run their own bridge server.

Bridge

Both a client server and a Bridge server are used as part of Titanium's reference implementation. The main use of Bridge is to make an API known to application developers by providing an object store. Bridge is usable by developers with a simple client without extensive understanding of audit procedures, the network or cryptocurrencies. What the Bridge API really consists of is an abstraction layer that makes the development process go faster and easier. Developers can then produce more applications using Titanium's Storage network and allowing for mass adoption.

Bridge doesn't cache encrypted shards nor hold encryption keys, although it does cache public buckets. This is because Bridge is limited to holding only metadata. Metadata like access patterns are the only information of the file that Bridge can share with third parties. The system delegates the burden of keeping file availability on the network to the Bridge and protects the privacy as well as gives complete control to the client over access to his data.

At times a Bridge client may desire to be in charge of managing pointers to shards and/or issuing and validating audits. In order to minimize the trust, it places in either Bridge server, a client might also desire to enable two or more unrelated Bridges to handle its audits. Therefore, it is important to envision upgrades to Bridge that allow for trust to have different levels of delegation. Ultimately, by delegating trust the data owner can split any function across multiple parties.

Client and Bridge API Structures

It is the objective of Titanium Storage Network to allow user to interface with the service through user friendly controls and user interfaces. Since files can't easily

be posted to API endpoints, the client and Bridge API structures are not the same as existing object stores. Because of the complexity of the underlying file management, clients are utilized to that end and simple function calls are used that bely the complex network operations underneath. While the Bridge APIs full documentation is outside the scope of this document, it is available elsewhere. Javascript is used in the initial implementation while those in Python, Java and C are under development.

Upload Process Summary:

1. Data is gathered and pre-processed by the client.
2. Bridge is notified that data is waiting to upload by the client.
3. Contracts are negotiated between Bridge and network nodes.
4. The authorization tokens and IP addresses of contracted nodes are returned to the client by Bridge.
5. Farming nodes are contacted and data is uploaded via IP addresses and tokens by the client.
6. In order to delegate trust, audit information is transferred by the client to the Bridge.
7. In order to prove that all data was transmitted successfully, an audit is issued and a response is verified by the Bridge.
8. Audit issuance, farmer payments and file state management are the responsibility of Bridge.
9. File metadata is exposed to the client by Bridge using the API.

Download Process Summary:

1. An identifier is used to request a file by the client.
2. A list of farmer IP addresses and tokens are provided by Bridge upon the validated request.
3. File is retrieved using the addresses and tokens by the client.
4. Client-side decryption and reassembly of the file takes place.

Peer-To-Peer File Sharing

One of the issues we face are standardization and identity management problems that the coexistence of all files on a shared network creates. Eventually, further development of the Bridge will enable applications or users to share specific files.

Another way to tackle the secure person to person file sharing problem would be to use another party as a source of identity outside of the two peers, such as a PGP key server or key base. Another way to permit sharing of individual files

would be a tiered keying strategy.

There are other cryptographic protocols such as proxy re-encryption that hold promise. For instance: If authenticated by Key base, files could be shared to any social media handle, but only if file keys are escrowed with a Bridge and encrypted strongly. Additionally, to enable access to a file and not expose it to Bridge or modify the file, a corresponding client could be sent a single key file and a transposition key by Bridge.

Complete explanations of key management plans is beyond the subject matter of this document. Suffice to say, a dedicated Bridge can help in a myriad of situations with many useful strategies used sometimes simultaneously.

Data Ownership and Bridge Nodes

Negotiating contracts and managing a file's state fall under the responsibility of data owners. Contract selection inherently is a strong tool for maintaining file state due to enough data about peers on the network. A Bridge will have much information about farmers due to the fact that the Bridge will have a multitude of active contracts with many farmers. This information could be used by the Bridge to distribute shards intelligently among farmers with the intent of achieving deliberate and specific performance goals.

As an example, a Bridge node collects data concerning farmers latency of communication, audit response latency, success rate and availability all through the execution of a contract. The Bridge could then collect data regarding the nodes available bandwidth with very little extra work required. Therefore, through the collection of a great amount of reliable information about farmers a group of farmers can be intelligently chosen by the Bridge node which thus gives a probabilistic guarantee of an expected efficacy of service.

Thus, in order to cater the service to the specific needs of a client, the Bridge can use its knowledge of network peers and utilize it to such ends. A Bridge could put together a collection of contracts in order to adapt to any service requirement rather than only to a select but limited amount of service tiers.

The client thus is able to determine just the correct latency, file location, or bandwidth and be sure that it will meet its objectives. i.e. an archival storage app might need solely high availability while a video download app may require high bandwidth. With a robust enough network any requirement could be fulfilled.

A unique strength of the Bridge is ability to bring a probabilistic quality of service

reliant on the knowledge gained about the performance and reliability of its farmers. This is something that a distributed network operating by itself cannot provide and addresses the persistent unsolved problem of secure distributed computation.

Enterprise Class Decentralized Computations and Memory

Main Benefits and Utility

Titanium is the world's first enterprise class decentralized super computing platform and by its formation creates a new world-wide market for all those in need of such higher-level computer access. By providing this global enterprise class super computer to those that previously did not have access to such power and combining this access with professional, intuitive tools to help developers create, distribute and monetize their applications is changing the way enterprise class workflow is done in a value-leading way.

Titanium is sure to be a key partner for future software developers and internet service providers through its support and creation of decentralized microservices and asynchronous task execution. Accessibility and availability to everyone is greatly increased through Titanium's value proposition which reduces the price of computations and thus such intensive applications as scientific calculation, machine learning and CGI rendering.

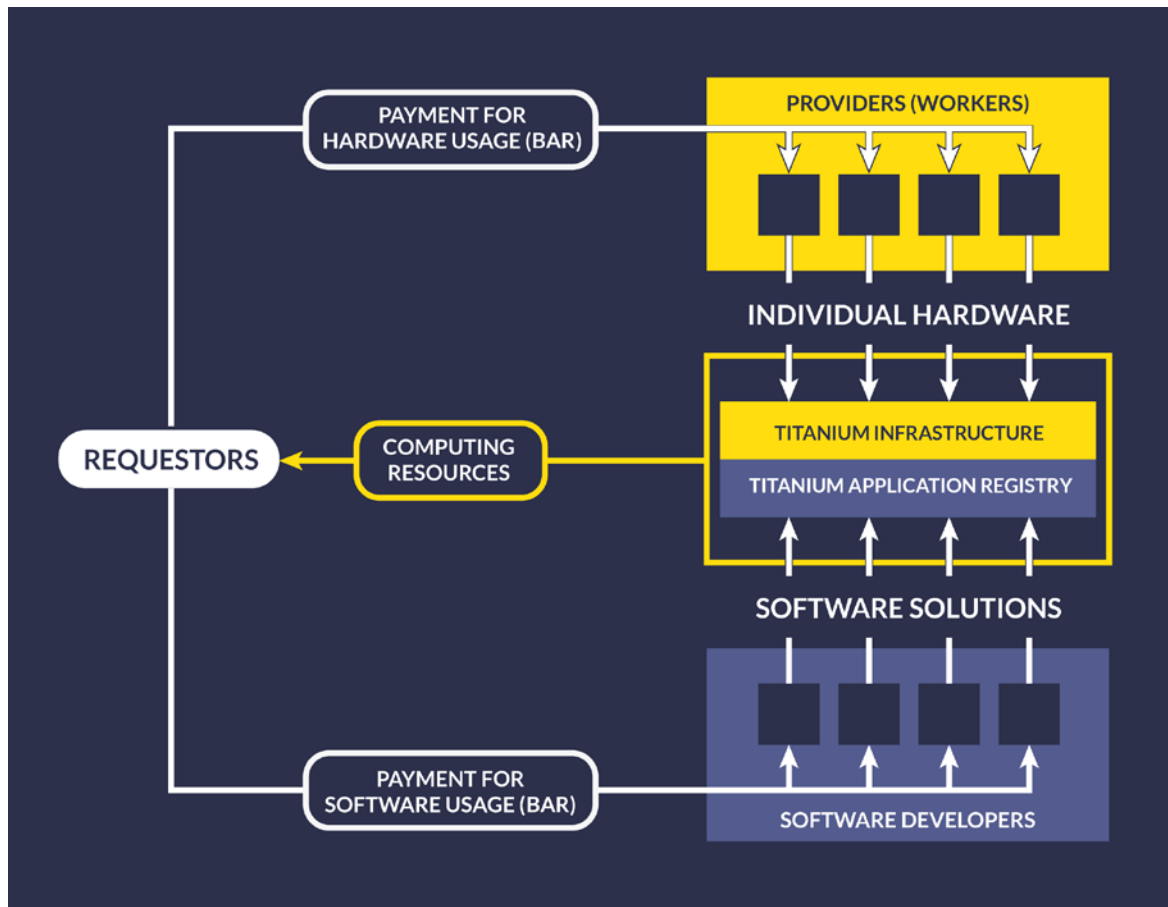
The concept behind Titanium is simple. Application owners as well as individual users (requestors), rent enterprise class computing power that are provided as part of a peer-to-peer network of machines that are provided by other users. (providers). The nature of the network provides computing resources of indeterminate and flexible size and thus can be 'rented' for projects that require just about amount of calculation intensity or duration.

If one were looking to access such computational resources today, one would need to contract with a centralized cloud base provider which have inherent disadvantages to our decentralized system including proprietary payment systems, hard-coded provisioning operations and closed, often outdated networks and tools. Titanium's system avoids these and other limitations and provides a dedicated Ethereum-based transaction system allowing for direct payments among all parties (providers, requestors and app developers).

Titanium provides the infrastructure of an enterprise class peer-to-peer decentralized computing landscape encompassing both Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS). This is only the tip of the iceberg however because the true potential is unleashed through Titanium's innovative

and comprehensive inclusion of dedicated software integration and the open and permissive atmosphere which encourages developers to submit their own software and tools to Titanium Network's Application Registry.

Developers can also adapt and customize the payment mechanism with the aim of creating new models of software monetization when combined with Titanium's transaction framework.

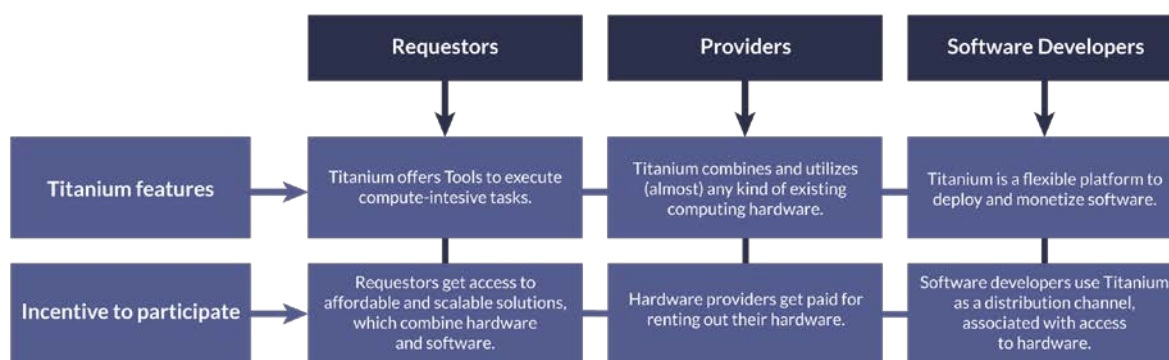


The Titanium Ecosystem

Up until recently, the computer services arena has been primarily the domain of such industry heavyweights as Amazon, Google, IBM, Microsoft and a handful of other old-school behemoths providing mostly centralized solutions and whose businesses practices assured their retaining of market dominance and generous margins but also a lack of aggressively priced solutions for the customer. Titanium's use of cutting edge technology changes this and due to recent advances in technology can be deployed in innovative, more economical and more strategic ways. Key to this are the contribution of individual and enterprise

computer owners in concert with new software contributions to Titanium's Application Registry.

The structure of Titanium's platform relies on a trifecta of connected components that work complimentary to each other in creating this unique solution. These include those who create tasks ('requestors'), those who provide computing hardware and infrastructure ('providers') and lastly the developers of the software themselves, ('software developers').



Titanium Infrastructure

'Providers' provide the hardware that powers Titanium network and provides the infrastructure's computing 'heart'. Enterprise class hardware resources whether downtime of a university's mainframe or mini to dedicated datacenter contributions to a Fortune 500's networked minis on off-hours, thousands of individual processors, memory, hard disks and other hardware that measure up to 'enterprise class' provide the backbone of Titanium's decentralized system. 'Providers' are incentivized to provide their resources by monetary compensation that 'requestors' provide for a given computing problem or project to be solved. Titanium's proprietary software solution provides an easy to navigate control interface that guides providers through the process of deciding on pricing and what the most beneficial use of their available resources is.

Near-Limitless Need For Computing Power And Access

Titanium's business proposition relies on luring requestors who are in need of computing resources as well as attracting providers who will provide them. A huge market exists for those requestors who need enterprise class solutions to perform computing tasks but either do not have or do not need to purchase fully

deployed systems themselves on a full-time basis for a variety of reasons. Titanium's ease of deployment of our software solutions, the flexibility of our resource backbone and our competitive pricing fulfill this need and provides a new highly efficient market that compares favorably with current and legacy cloud-based solutions.

A key 'secret weapon' in Titanium's cost and resource efficiency as well as marketplace penetration is the facility to encourage requestors to also serve as providers. As previously stated, many of these requestors may require additional computing resources on a non-full time basis and can themselves provide enterprise-class resources when not in use to other 'providers'. For some, this could enable them to recoup some or all of the Titanium fees they require as requestors and this duality of service encourages loyalty to the Titanium system.

[Titanium's Application Registry, Proprietary Software and Microservices](#)

One of the primary goals of Titanium's business model is to encourage the development of unique and essential proprietary software applications that will fully maximize and exploit our decentralized infrastructure and 'requestor/provider' need/use scheme. While our in-house developers will provide initial 'big picture' apps for CGI rendering and other heavily in-demand use cases, our Application Registry and Transaction Framework play pivotal and essential roles in the growth of Titanium's ecosystem. Our intent is to create a full library of easy to use, essential tools that will be indispensable and outright preferable to use than competitors' offerings in the development, deployment, distribution and monetization of projects by Titanium's client base. In addition, this is a perfect solution for the entire microservices and decentralized app (dApp) industry and could also be utilized by open source and even existing proprietary software solutions that are adapted to the Titanium system.

[Long term vision: Titanium Provides the Platform for the Backbone of Internet v3.0](#)

Titanium's long-term goal is to be a primary mover and essential resource for Internet 3.0. In the new future we expect much of the current 'centralized' structure of the internet to become 'decentralized'. An essential feature of this decentralization will be the availability of direct peer-to-peer exchange of content in a secure and professional manner without the reliance of 3rd party involvement and administration as is so common today. Thus, our systems will be useful for mass-rent machines for operations in a self-administering network in addition to specific projects. Some of these use cases will require such still incubating technologies as advanced AI which are currently on the cusp of wider use but will develop into widely used and accepted protocols in the future while other technologies already ripe can be used sooner.

An example of one area that is still being developed but has picked up steam lately are decentralized data storage and retrieval protocols and technologies such as those being spearheaded by Siacoin and Storj among others.

In the same vein, in the future as further advances are achieved in decentralized infrastructure Titanium may morph into a platform for microservices providing users with both small (a chat client) and large (CGI rendering) apps. The possibility of this is also reliant on the further development of Ethereum's network as it scales upward, becomes more robust and is able to offer a full network of micropayment channels that require little oversight. These near-future use cases make a great case for Titanium's future.

The Bar's (BAR) Role Within the Titanium Ecosystem

Central to Titanium's protocol and the fuel that powers the system is the Bar (BAR) Token. Having its genesis during the initial pre-ICO period the Titanium Bar is utilized in a number of ways throughout the ecosystem. Chief among these uses are the payment to providers by requestors for the use of decentralized resources on the system and the incentivization and compensation of developers that contribute code/software to Titanium's application registry. Both of these use cases are conducted with the exclusive use of the 'BAR' token.

In the future additional uses for the BAR token will manifest. An example is software validation, certification, remuneration and transactions utilizing the transaction framework. These transactions will be easily customized within a conditional protocol that users will be able to use to adjust parameters for the specific transaction at hand.

There will be a defined amount of BAR tokens set during the Pre-ICO period.

The Titanium Application Registry

As part of Ethereum's protocol is the ability to create 'smart contracts' that provide specific functionality that can be utilized as part of a larger scheme. The 'Application Registry' is just such a smart contract and the functionality it provides Titanium is the ability of developers to contribute proprietary software solutions in the form of applications that are designed to exploit the strengths of the Titanium network. Through these contributions, developers provide a resource for requestors who are looking for specific software tools for their projects. It also offers providers a way to exercise control over the code they choose to run on their hardware, alleviating some of their security concerns.

Another aim of the application registry has to do with security. The review and validation process of applications submitted to the application registry cannot be solely an automated process and thus community involvement will be essential to make sure malicious code whether by intent or accident is discovered and excised or fixed. As a decentralized network with a level of autonomous use by requestors, applications will be run on provider's systems utilizing their hardware. Despite sandboxing of code within parameters and limited privileges it is expected that host machines could conceivably be hijacked or that bugs could render them inoperable or to be used for nefarious purposes.

Because of these possibilities, Titanium separates the Application Registry into different sections, those for authors, validators and providers.

The Authors are those that publish the applications, while validators add applications to a white list once they are deemed certifiably safe and have undergone a review process. Validators may also quarantine an application from the whitelist and report it as malicious as well as add it to a blacklist. Likewise, Providers may add applications to their own white and black lists which might be influenced by prior experience running such apps on their hardware. This knowledge could be used by other providers in their decision process of what software to allow on their systems. This setup also allows providers to select validators they trust and to utilize their white lists in deciding which code to run and how it will affect their systems. Overall, it provides a democrat system of information that can be used by the entire Titanium community to both utilize and optimize both applications and hardware resources optimally and to continually improve the service organically.

Upon initial operation Titanium will include a procured list of applications that can be trusted and known to run optimally on Titanium's network. These 'white-listed' apps will act as a core platform to be built upon. Providers thus have a solid base to start with and can then add to or delete to their own personalized white list as they have more experience with the network and can choose validators that they find dependable. Another scenario might find a provider relying almost exclusively on black lists if for instance they were running a 'farm' of computers and needed to avoid possible troublesome applications. Like the prior example, with further use the provider could add to or subtract from their own blacklist as they become more familiar with the network and specific validators.

The Titanium Transaction Framework

Titanium is part of a new and evolving revolution in computing utilizing decentralized resources in new and innovative ways and serving existing, new and evolving markets. Thus, it is impossible to know with any certainty all of the potential use-cases, permutations and new opportunities that this technology will attract and be used for. Instituting a common remuneration and monetization model and payment system for all developers is therefore impossible as developments will certainly shape how Titanium deals with these aspects as needed.

However, utilizing the underlying Ethereum network and its trustless contracts on which Titanium is built allows us to offer a transaction framework in varying models that most closely matches the use-case the developer has at the time. The transaction framework then utilizes a variety of factors combined with actions to facilitate the transaction within the framework. These include: Entry of the application into the application registry, the use of open source and/or a deterministic environment such as EVM with associated community approval and/or rating of the transaction model, and the use of the Titanium Bar for rewarding resource providers and software developers.

Ethereum's trustless smart contracts enable Titanium's transaction framework to provide a range of components including: nano-payments and batching, off-chain payment channels, individual receipts, software developer remuneration, software rental administration on a per-use basis.

Future implementations in Titanium's ecosystem might include more dynamic and complex schemes to the transaction framework in order to tackle specific additional needs. Some examples of these include; escrow accounts utilized by requestors for those situations where heavy resources are needed and specialized hardware is warranted but can only be made available if certain thresholds are guaranteed by requestors; situations where a provider necessitates a deposit by a requestor for various reasons, task registration as part of a TrueBit-style conflict resolution mechanism, circumstances that might necessitate a provider to offer a deposit such as if a requestor needs to be in control of a time-locked BAR.

Resilience of The Titanium Network

Built upon Ethereum's network, Titanium has Byzantine fault tolerance properties inherent in its design. As a decentralized, open source, censorship free peer-to-peer network, Titanium has near-immunity from single point-of-failure. It's use of

smart contracts requires consensus on the blockchain and thus adds mutability in transactions, shared data and metadata where applicable. Deployment, execution of tasks, validation and transactions are all benefits of this consensus and add to the network's resilience.

While initially relying on Ethereum's state and redundant validation schemes, as Titanium's network matures, further optimizations will be added both through software upgrades and system architecture tweaks to achieve cost benefits, throughput increases, improved consensus validation and integrity protocols, peer-to-peer network creation, one-off unique transactions, off-chain state movements and overall improve resilience, adaptability and reliability throughout the Titanium network.

The Ethereum Foundation's devp2p protocol series serves as the predecessor of Titanium's peer-to-peer network and thus will benefit from the continuing development and improvements in reliability, confidentiality, modularity and inclusiveness that are parcel to the standards upheld to libp2p and the Interplanetary File System (IPFS).

These future developments will include further improvements in resilience while resilience 'practices and procedures' maximize resilience today. These include; institution of white- and black-list protocols that limit application execution by providers to those in trusted networks and by trusted developers, authenticity assurance by the use of messages that are signed and encrypted in Titanium's network, mitigation of malicious code through the use of a reputation system that includes entities to help in accurate, fastidious and confidential task routing.

Other strategies may include utilization of Ethereum's transaction framework for proprietary remunerated security mechanisms such as deposits, insurance, escrows and audit proofs, utilizing non-intrusive environments for computation relying on exclusive and limited privileges and firewalled or closed connectiveness to outside networks, regular auditing by objective third-parties, utilization of the transaction framework and app registry to eliminate and/or de-incentivize Sybil and whitewashing attacks through participation in internal incentives, reputation metrics or optimal connectivity as well as participation computational and economic costs.

Future Development of Titanium Capabilities

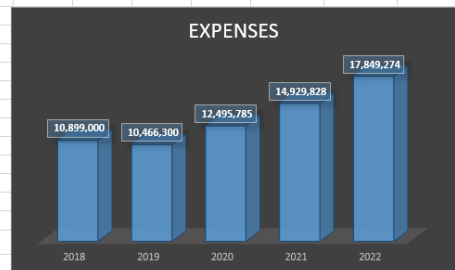
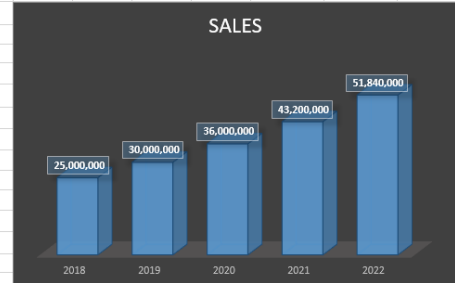
This is an exciting time for the computer services industry. With Ethereum and other decentralized platforms paving the way for numerous decentralized applications (dApps) we expect to see brand new opportunities and markets that Titanium could adapt or grow to service, some known and some

unforeseen. Some of the predicted additional capabilities that Titanium currently foresees that might be added to the network depending on various factors include; decentralized identity services services, task verification solutions and reputation integrations, various solutions in the payment channel arena utilizing peer-to-peer transactions and routing and various external decentralized storage platforms and schemes.

FIVE-YEAR FINANCIAL PROJECTIONS

Titanium Blockchain Infrastructure Services Inc Statement of Income & Expense 5 Year Company Projections

	2018	2019	2020	2021	2022
Ordinary Income/Expense					
Income					
Sales	25,000,000	30,000,000	36,000,000	43,200,000	51,840,000
Total Income	25,000,000	30,000,000	36,000,000	43,200,000	51,840,000
Expense					
Advertising and Promotion	530,000	636,000	763,200	915,840	1,099,008
Automobile Expense	180,000	216,000	259,200	311,040	373,248
Compute, Infrastructure and Internet	2,500,000	2,750,000	3,300,000	3,960,000	4,752,000
Depreciation Expense	25,000	25,000	25,000	25,000	25,000
Employee Benefits	300,000	360,000	432,000	518,400	622,080
Insurance	48,000	57,600	69,120	82,944	99,533
Interest Expense	40,000	40,000	40,000	40,000	40,000
Legal & Professional Services	230,000	276,000	331,200	397,440	476,928
Office Expenses/Leasing	260,000	312,000	374,400	449,280	539,136
Office Supplies	130,000	156,000	187,200	224,640	269,568
Outside Services	1,800,000	2,160,000	2,592,000	3,110,400	3,732,480
Payroll Tax	250,000	300,000	360,000	432,000	518,400
Rent	120,000	120,000	120,000	120,000	120,000
Research & Development	230,000	276,000	331,200	397,440	476,928
Salaries & Wages	2,600,000	3,120,000	3,744,000	4,492,800	5,391,360
Security Expense	50,000	52,500	55,125	57,881	60,775
Taxes & Licenses	1,350,000	1,620,000	1,944,000	2,332,800	2,799,360
Telephone	36,000	43,200	51,840	62,208	74,650
Training & Education	120,000	144,000	172,800	207,360	248,832
Travel	280,000	336,000	403,200	483,840	580,608
Utilities	120,000	126,000	132,300	138,915	145,861
Total Expense	11,199,000	13,126,300	15,687,785	18,760,228	22,445,754
Net Ordinary Income	13,801,000	16,873,700	20,312,215	24,439,772	29,394,246
Net Income	13,801,000	16,873,700	20,312,215	24,439,772	29,394,246



TOKEN MECHANICS AND SALE DETAILS

This Token Mechanics and Sale Details summary does not constitute an offer to sell or a solicitation of an offer to buy TBIS's token, called "BAR", and is provided for informational purposes only in respect of TBIS's platform. The following summary reflects TBIS's current expectations with respect to token mechanics and sale of BAR, which are subject to change.

Soon, the TBIS token (BAR) will be sold. As part of this sale, a fixed pool of BAR will be generated. **No further BARs will be created in the future. BAR will be a deflationary currency.** Once the sale concludes, a portion of BAR tokens will be allocated and given to the TBIS team as an incentive for the success of our platform, and a separate portion will be held as a reserve pool and expenditure fund. The community will hold 60% of all BAR, the TBIS team will hold 20% of BAR (subject to a freeze period), 10% of BAR will be reserved for various community bounties and 10% of BAR will be allocated for the reserve pool.

The BAR cryptocurrency serves several key operational functions with respect to the TBIS platform for its holders:

1. BAR will be the only means of paying for products and services within the TBIS ecosystem.
2. BAR owners will be allowed to participate in milestone completion votes, which will be used to unlock reserves for BAR expenditure.
3. BAR will serve as the primary mechanism for verifying third-party marketplace smart contracts in a decentralized and secure way.
4. When TBIS smart contracts are deployed by users, the BAR that is paid as a fee will be re-sold and circulated back into the ecosystem at market value.

Titanium BAR Token Sale

BAR tokens will be offered at an exchange rate of 300 BAR for 1 ETH, for a sale duration of approximately sixty (60) days. During the first 72 hours, all BAR purchased will be sold at a reduced rate. **The sale is slated to begin on January 1, 2018, at 1 PM (GMT-7) and will end on March 1, 2018, at 11:59 PM (GMT-7).** A hidden, undisclosed hard cap will be cryptographically signed using the keccak256 hashing algorithm and released as part of the smart contract. If this cap is reached, then it will be revealed and the sale will immediately end. Otherwise, the sale ends once the sale period has ended. The cap can be verified by comparing the revealed value with the hash included in the original contract. A security cap of 350,000 ETH will be hardcoded into the contract, as a safety net against unforeseen complications. This security cap is not the hard cap for TBIS, and is not intended to be reached.

The TBIS team has pre-determined a minimum goal (denoted in US Dollars) that

represents the runway necessary for the core TBIS platform to be finished and released. If the minimum goal is not reached by the end of the sale duration, then all contributed Ether will be marked for a refund. Anybody who contributed will be able to withdraw their Ether from the sale contract. The soft cap figure will be \$1,000,000. The hard cap figure will be \$35,000,000.

Titanium BAR Pre-Sale and “Early Bird” Bonus Periods

Before the January 1, 2018 BAR token sale, a pre-sale period of approximately one month will transpire. During that time, investors that are willing to invest a minimum of \$5,000 in the project will receive a 20% bonus. This would equate roughly to **1.2 BAR for \$1 USD**.

Three (3) bonus periods will be offered at the beginning of the sale to provide early bird contributors a small incentive. During the first 24 hours of the funding period, the exchange rate will be **1.15 BAR for \$1 USD**, a 15% bonus. For the 48 hours after that, the exchange rate will be **1.1 BAR for \$1 USD**, a 10% bonus. For the 48 hours after that, the exchange rate will be **1.05 BAR for \$1 USD**, a 5% bonus. After the early bird periods, the price of BAR will remain at 1 BAR for \$1 USD for the rest of the sale.

Note: *The exact start date, duration of the discount period, and duration of the sale will be determined by block numbers, and thus are approximated with an accuracy of a couple of minutes.*

Half of the tokens (10% of the total token pool sold) retained by the TBIS team will be frozen for one year (12 months) from the end of the sale, with the other 10% remaining frozen for an additional year (a total of 24 months). This freeze period ensures that no developer tokens will enter circulation before the TBIS platform is live.

Any tokens purchased as part of the sale will be immediately allocated to the buyer, but will be locked from transfers until the minimum goal has been reached. In a short amount of time after the sale starts, these tokens will be spendable in the TBIS mainnet demo app, once the minimum cap is reached.

Unsold BAR Tokens

Titanium BAR tokens are created as they are sold. The team and bounty, etc. allocation gets created at the same time. Once the sale is over we will terminate the crowdsale contract, which will prevent new tokens from being minted. Therefore, BAR tokens will not be “burned.” However, it will have the same effect on scarcity, as they will never be created.

Referral Bonus

During the pre-sale and general ICO crowdfunding periods, a referral bonus of 5% will be paid to existing Titanium BAR Token owners, if they refer other individuals to the Titanium BAR Token sale that proceed to purchase the minimum amount of Titanium BAR Tokens, equivalent to 0.01 ETH or greater.

Secondary Milestone Voting

The TBIS team is committed to delivering on our promises. We believe in our product, and wish to show good faith by remaining accountable to its success. Thus, we are implementing a completion-based release model. Active users who are involved in the TBIS platform will be given a vote in determining if deadlines and milestones have been met. The TBIS team will open votes for each milestone as they are released, and TBIS users will have a window of time to signal the milestone as “complete” or “incomplete”. If a majority of votes signal the feature as “complete”, the reserves associated with that milestone stage will be released.

In the event that a milestone is deemed “incomplete”, we will engage with the community for feedback to determine our shortcomings, and address those as necessary. The vote will then be repeated after a cooldown period, up to a maximum of three votes in total. In the case of three failed votes, the lock will be released at the discretion of the team, no less than one month after the final completion vote. This protects the long-term functionality of the TBIS platform from being locked over vote manipulation or contentious issues.

The specific milestones that have voter-locked access attached are noted in Figure 1. The TBIS team will lock 30% and 10% of the token sale proceeds until the completion of the first and second noted milestones in Figure 8.1, respectively. **The specific amounts locked may change according to the results of the token sale and the TBIS team’s needs. Once finalized post sale, these numbers will not change.**

OPERATIONS AND ROADMAP

Our team wants to proceed with due care and caution to minimize potential asset loss for users. As these smart contracts are deployed on the Ethereum blockchain as immutable code, it is particularly crucial that everything is thoroughly battle-hardened and easily updateable to handle bugs. As part of the development process, we will source independent professional software auditing for all smart contracts, in addition to our internal verification pipeline – this comprehensive testing routine is allocated its necessary portion of time and is reflected in the paced release schedule. TBIS features will be released in the following order:

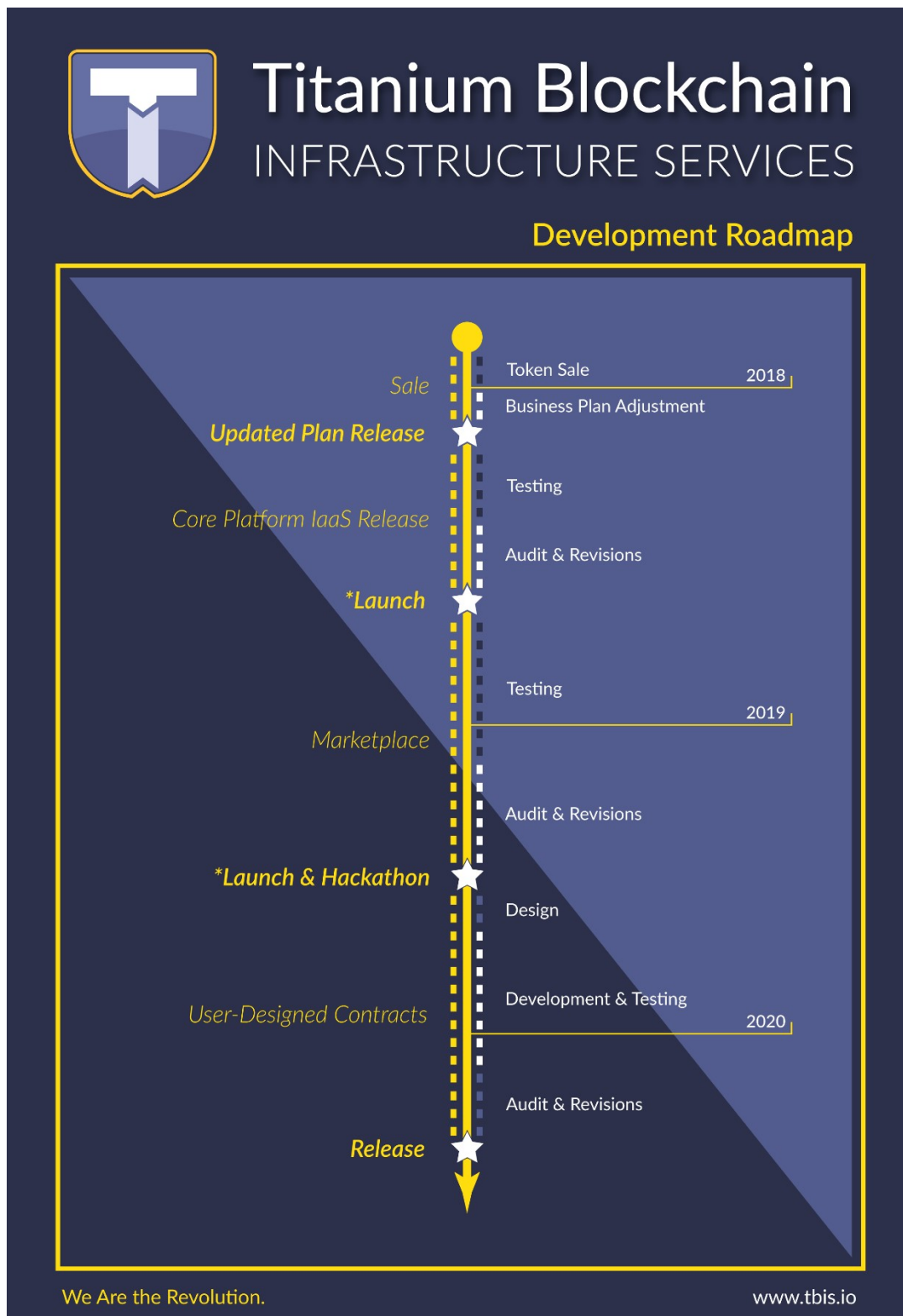


Figure 1: The feature release schedule for the TBIS platform. Vote-based unlocking will occur for the milestones marked with an asterisk “*”.

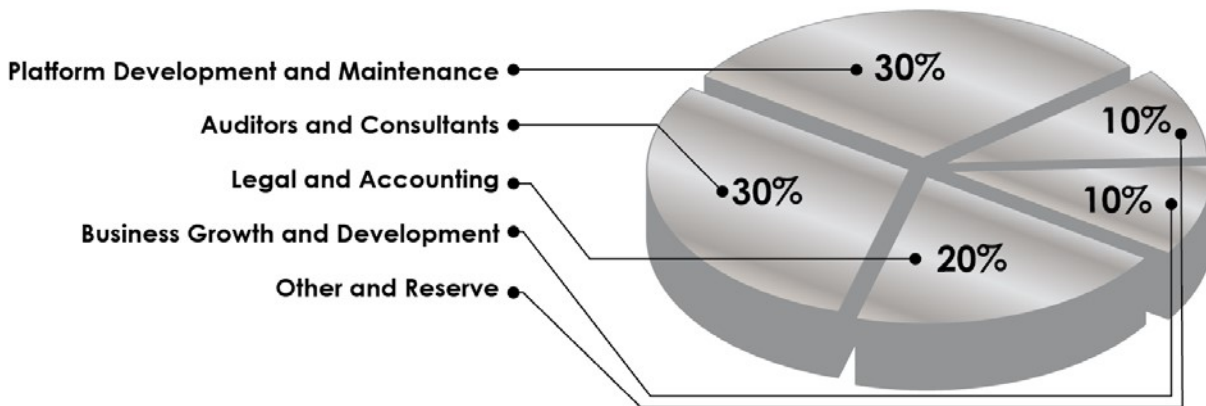


Figure 2: The expected expenditures in percent of total costs for the TBIS platform.

KEY ACTIVITIES

Disclaimer: The projected financial expenditure plan and release timeline are only estimates and serve to illustrate the general plan for the future of TBIS. We reserve the right to make adjustments as reasonable based on available resources and other constraints.

Our projected cost breakdown is shown in Figure 2. We briefly summarize core activities and specific expenditures below.

Platform Development, Testing, and Maintenance

Further development and continued maintenance of the core TBIS platform is the primary cost that TBIS will expense in the near future. This allocation of resources will be put towards the compensation of the core TBIS team, and any future personnel who are signed onto the TBIS team, as necessary. This will primarily consist of Software Engineers, Platform and Infrastructure Engineers, Customer Service and Support Specialists, and Product Strategists.

Auditing

To minimize risks to TBIS users, we have reached out to multiple trusted security and software verification firms which specialize in smart contract auditing. These auditors will be responsible for verifying our smart contracts before deployment,

in addition to the rigorous set of internal testing performed by the TBIS team. Given the sensitive nature of TBIS's platform, we believe that it is better to err on the side of caution and will devote all of the necessary resources to ensuring a safe and secure platform for all TBIS users.

Business Growth and Development

We will be marketing our platform to ensure healthy growth. This is not only important for ensuring that TBIS remains the best platform for deploying smart contracts, but also for marketplace participants, as their ability to earn BAR will depend entirely on the size of the user base. We intend to acquire new users via targeted marketing, first focusing on targeting early adopters and businesses already building on blockchain technology. We will quickly extend our efforts towards additional channels to bring new users to both the TBIS platform and Ethereum in general. We intend to appeal both personal uses as well as businesses. That said, we view business growth in a holistic manner. We believe in demonstrating value first, as well as attracting attention through collaboration. As noted in our roadmap, we intend to organize at least one hackathon to jump start the contract marketplace. For this event, we intend to create voter tokens and to have participants choose winners. These winners will receive free auditing and early availability of their developed smart contracts on the marketplace. We will also form partnerships with other blockchain innovators to create mutual value for our users. We will focus our business development efforts on those technologies with identifiable synergies and compatibilities with TBIS. We put open and honest relationships first, and seek to mutually encourage innovation and growth.

Legal

Our platform will require users have a clear understanding of the rights and responsibilities of all parties involved in using TBIS. Once our token sale has concluded, we will invest the necessary time and capital in developing user agreements for smart contract deployment and marketplace sellers. Future legal costs are also accounted for here.

Future Goals

Bugs and unforeseen flaws are an inevitable risk with any programming code, regardless of how thoroughly they have been vetted and reviewed. TBIS will strive to provide its users with the maximum amount of assurance possible by implementing enhanced security measures in any contract where appropriate. The ability to stop a rogue contract in a structured, pre-determined way will prevent high-value losses and ensure a safe platform for everyone, without resorting to or relying on controversial hard-forks. We also recognize that the technology landscape is quickly evolving, and that our platform infrastructure must remain agile and adapt to changing conditions. As new technology and solutions such as decentralized hosting and storage stabilize and gain adoption, we intend to move more and more of the TBIS platform to these services. This will ensure that our platform remains the preferred solution for smart contract deployment.

LEGAL CONSIDERATIONS

The most current version of this document, accessible on the web at:

<https://tbis.io/titanium-infrastructure-services-white-paper-2/>

The version available at that URL represents the only valid version of our whitepaper.

BAR are only functional tokens intended to be used to compensate TBIS for use of its platform. These tokens will give access to the TBIS mainnet demo app as soon as the minimum cap is achieved. BAR are not for speculative investment. No promises regarding value or future performance are made regarding BAR. No promises regarding any particular value of BAR are made. No other rights associated with holding BAR are given. Proceeds of the token sale may be spent as the company sees appropriate, which may change as deemed necessary in the maturation and advancement of TBIS.

Our team is investing heavily in the safety and security of the services TBIS provides, as detailed previously. However, we cannot protect against all possible sources of error, especially those in parts of the technology stack we cannot control. Therefore, all risks assumed by using the TBIS platform in any capacity, including but not limited to deploying smart contracts, creating and destroying virtual devices, and collecting BAR through the marketplace are solely assumed by the user. Users must measure the gravity of potential value loss against their trust in the services TBIS will provide and act as they see appropriate. Never trust anything that one cannot afford to lose to any entity, TBIS or otherwise, without fully understanding all of the mechanics involved in the whole procedure. BAR tokens are meant to be held and used by those well-versed in cryptographic tokens, only for the purpose of accessing the services offered on the TBIS platform.

TBIS and its team must abide within the laws set forth in its operational country(ies).

We intend to provide our services in as decentralized a fashion as reasonably feasible, but our legal entity must act according to the rules and bounds encoded in applicable laws. This includes but is not necessarily limited to laws governing financial operations, employment, fee charging, and sales.

POTENTIAL STRATEGIC PARTNERSHIPS THAT ARE UNDER SERIOUS CONSIDERATION

1. BlockCAT:

A simple UI that is an Ethereum smart contract creation wizard, allowing users with no coding experience whatsoever to create smart contracts.

<https://blockcat.io/>

2. Sia:

Provisions decentralized storage at a fraction of the cost of current cloud-based services such as Dropbox or Amazon Web Services.

<http://sia.tech/>

3. ShapeShift:

A cryptocurrency transformation service, which would allow TBIS to accept most existing cryptocurrencies as payment for our products and services.

<https://shapeshift.io/>

4. Changelly:

A cryptocurrency transformation service, which would allow TBIS to accept most existing cryptocurrencies as payment for our products and services.

<https://changelly.com/>

APPENDIX A: Example Solidity Escrow Contract

```

contract decentralisedAuction{
    struct auction {
        uint deadline;
        uint highestBid;          address
        highestBidder;           uint bidHash;
        address recipient;
    }
    mapping(uint => auction) Auctions;  uint
    numAuctions;

    function startAuction(uint timeLimit) returns (uint auctionID){
        auctionID = numAuctions++;
        Auctions[auctionID].deadline = block.number + timeLimit;
        Auctions[auctionID].recipient = msg.sender;
    }
    function bid(uint id, uint biddersHash) returns (address highestBidder){
        auction a = Auctions[id];
        if (a.highestBid + 1*10^18 > msg.value || a.deadline > block.number)
        {
            msg.sender.send(msg.value);
            return a.highestBidder;
        }
        a.highestBidder.send(a.highestBid);
        a.highestBidder = msg.sender;
        a.highestBid = msg.value;
        a.bidHash = biddersHash;
        return msg.sender;
    }
    function endAuction(uint id, uint key) returns (address highestBidder){
        auction a = Auctions[id];
        if (block.number >= a.deadline && sha3(key) == a.bidHash) {
            a.recipient.send(a.highestBid);
            clean(id)
        }
    }
    function clean(uint id) private{
        auction a = Auctions[id];
        a.highestBid = 0;
        a.highestBidder = 0;
        a.deadline = 0;
        a.recipient = 0;
        a.bidHash = 0;
    }
}

```


APPENDIX B: A List of Titanium Storage Message Types

A.1 Kademlia

1. PING - Determine whether a node is online.
2. STORE - Store a value in the DHT.
3. FIND NODE - Find a node in the DHT.
4. FIND VALUE - Find a value in the DHT.

A.2 Tunneling

5. PROBE - Determine whether the sender is publicly addressable.
6. FIND TUNNEL - Find a publicly addressable node offering tunnels.
7. OPEN TUNNEL - Open a tunnel with a node offering tunnels.

A.3 Rivet

8. SUBSCRIBE - Request filter lists from neighbors.
9. UPDATE - Notify neighbors of updated filters.
10. PUBLISH - Broadcast a message to interested nodes.

A.4 Contracting

11. OFFER - Propose or finalize a contract.
12. CONSIGN - Request a PUSH token from a farmer.
13. MIRROR - Instruct a farmer to retrieve and mirror data from another farmer.
14. AUDIT - Issue an audit challenge to a farmer.
15. RETRIEVE - Request a PULL token from a farmer.