PING·42

Internet Monitoring Instrumentation for Web3

Innovating for a Connected World

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Abstract

This whitepaper outlines our mission to establish a global internet monitoring ecosystem, rooted in industry-standard tools and open collaboration. We believe in the internet as a fundamental human right and aim to help make it more reliable and accessible to all.

Global internet infrastructure is woven together by a large number of networks, with some showing better performance than others. Small nations and autonomous regions, for example, might not observe the same level of reliability of its network as the capital of a major G7 economy. The internet topology changes hundreds of times per minute, new capacity is brought up, existing infrastructure retired, important fiber optic cables get severed in natural disasters or construction projects in emerging markets and all of this has effect both on internet users and on those, like our team, tasked day to day with ensuring reliable access to the global applications that power our digital economies.

We are building a platform that will allow users, companies, and educational institutions to utilize a large network of nodes operated by volunteers and hobbyists to create a distributed network measurement instrument like no other. Our platform utilizes well understood network mechanisms to measure the availability and performance of internet infrastructure such as websites, CDNs, and online services.

It is our belief that a healthy and sustainable ecosystem is possible now more than ever due to Web3. Decentralization, governance, and innovative tokenomics, allow commercial entities to incentivise hobbyist node operators to provide monitoring and telemetry from more internet service providers and locations in the world than any other service, commercial or otherwise, currently available.

Key concepts include a node client running on systems around the world, scheduling a pipeline that distributes units of work called tests (eg, ICMP ping, traceroute, HTTP request) and sends them for execution across the network. Telemetry is captured from the last mile, and not from commercial data centers, allowing our solution to provide more realistic results.

Upon outage or reachability issues, the PING42 sensor infrastructure will notify stakeholders of outages, increased latency, packet loss, and otherwise network disruptions visible across the network.

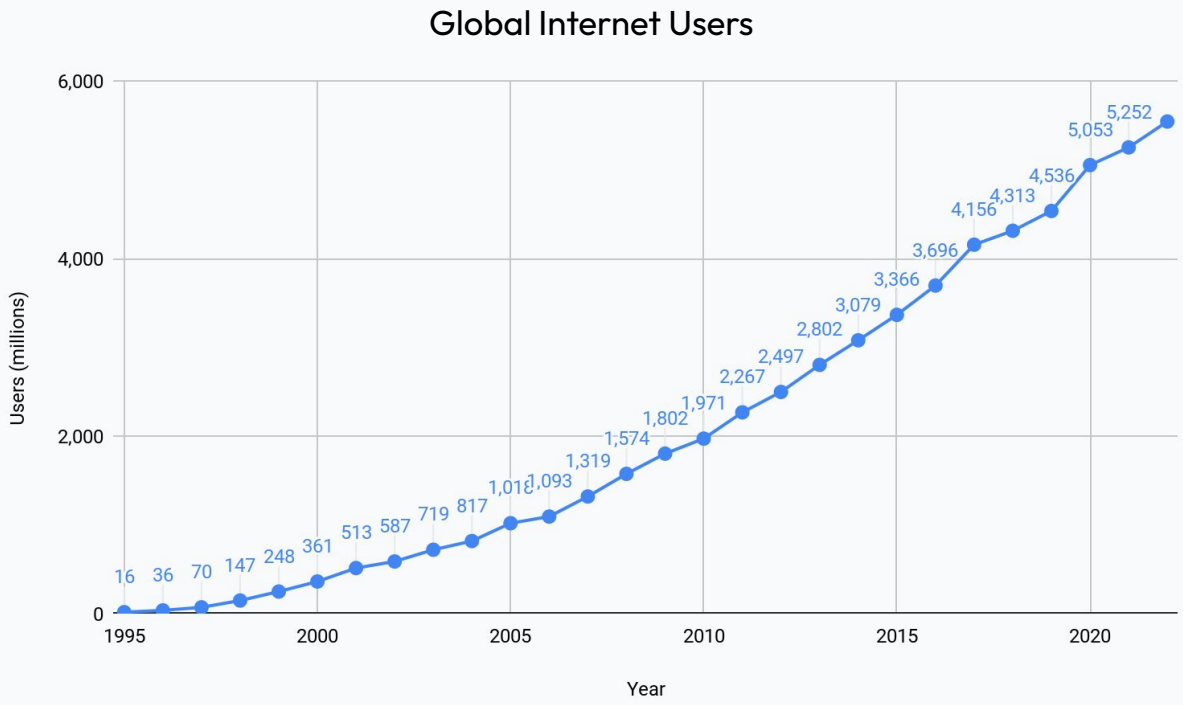
Join us in reshaping internet monitoring for a more inclusive, secure, and transparent digital world.

Introduction

Rapid Internet and Internet Infrastructure Growth

In an age defined by connectivity, where digital landscapes intersect with real-world experiences, the expansion of network infrastructure has emerged as a driving force for transformation. As we find ourselves on the verge of a perpetual digital revolution, we observe the growth of both network infrastructure and the increase in internet users, two parallel forces converging with the power to redefine our world as unprecedented number of devices join the network.

Historically, the internet has evolved from a mere curiosity to an indispensable part of our lives. For the past 27 years, the number of internet users has multiplied over 340 times, from 16 million in 1995 to over 5.5 billion in 2022[1]. It is clear that the demand for internet connectivity is ever-increasing. From the early days of dial-up connections to today's high-speed fiber optics and 5G networks, the expansion of the internet has propelled humanity forward and at the same time reaching unprecedented complexity.



[2] Internet World Stats, "History and Growth of the Internet from 1995 till Today"

Revenue from network infrastructure, has an expected annual growth rate of 3.9%, which translates to a market volume of $237.2B USD by 2027[3]. Most of the revenue is expected to come from China.

[1] Stackscale, "The Internet: Evolution and Growth Statistics", found here.
[3] Statista, "Network Infrastructure - Worldwide", found here.

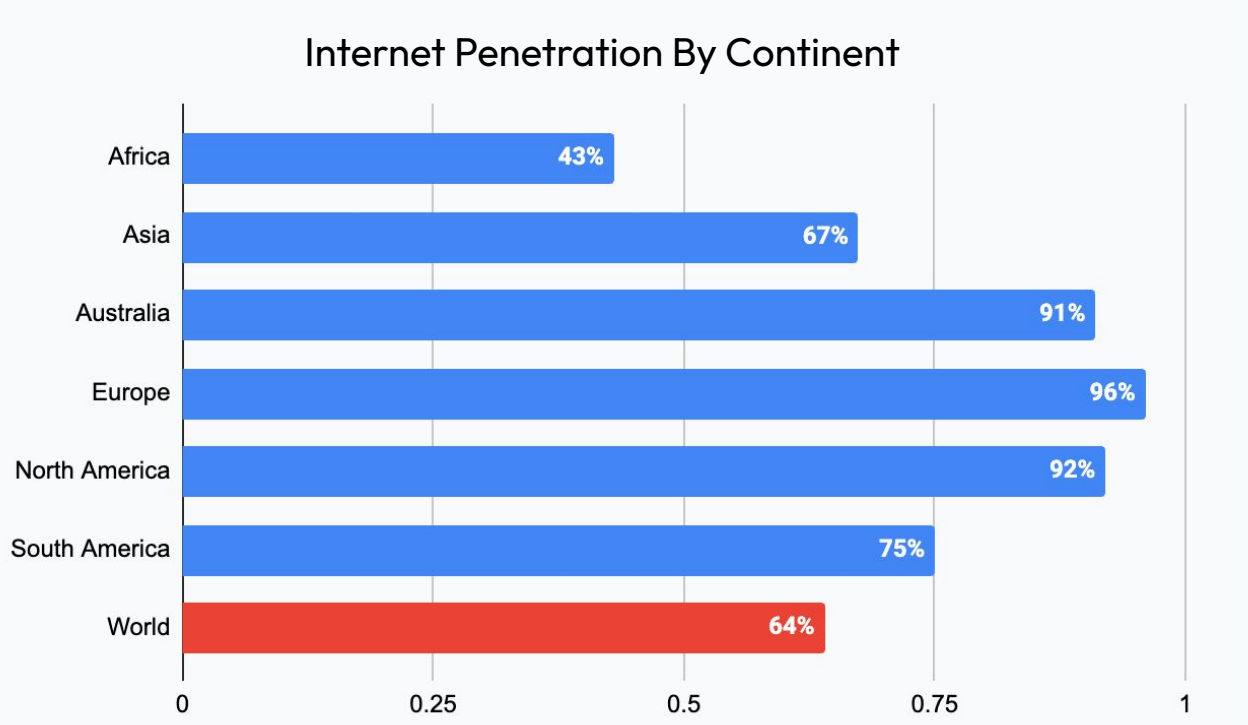
Introduction

With every passing second, more individuals, communities, and organizations are becoming connected, transcending geographical boundaries and cultural differences. This surge in internet users has unlocked new markets, fostered innovation, and redefined how we interact with the world around us.

New business models are born every day by digitally savvy and young internet users. The pace of digital asset adoption is evidence to that, and the rapid proliferation of the connected smartphone has put the internet in the hands of many for the first time. The median age of G7 countries is over 40, while the majority of the people on the planet are younger and live in parts of the world that are rapidly connecting to the internet[4].

Connectivity and Latency Problems in Emerging Markets

While the world's most developed regions enjoy high-speed connectivity, a substantial portion of the global population, particularly in emerging markets, struggles with connectivity and latency challenges. Globally, nearly 2.5 billion people lack access to the internet[1]. Meaning, only 64% of the world's population enjoys fixed broadband. A breakdown of the world's internet penetration rates by continent is presented below.



[5] Statista, Internet Penetration rate for Africa, Asia, Australia, Europe, North America, South America, & the World.

[4] Visual Capitalist, "Median age by Continent", found here.

Introduction

Emerging markets, with their rapidly growing populations embed massive opportunities. For every 10 percentage points of increased internet penetration, GDP per capita can increase by 1.2%[6]. Network downtimes are also a costly issue, estimated to cost average enterprises $5,600 per minute or over $330K per hour[7]. Over thousands of network outages happening every month, billions of dollars per year in commerce activity are lost to unreliable network infrastructure[7]. Survey data indicates that 88% of online customers are unlikely to revisit a website after a negative experience[7]. This could be detrimental to smaller businesses, digital gig economy workers, and consumers from emerging markets, whom we hope to add to the global economy.

Exposure to the current network infrastructure limitations highlights the need for innovative solutions to better understand and mitigate connectivity challenges. A web page that loads slowly is no longer a mere inconvenience; it is a barrier to progress.

Data Center Insufficiency

As our world becomes increasingly interconnected, the reliability and performance of websites and online services underpinning modern life, along with the networks that power them, becomes paramount. Websites are no longer static entities - they are dynamic ecosystems that facilitate commerce, communication, and community-building. Their seamless operation is not just a matter of convenience but often one of survival for businesses, institutions, and even entire economies. With all this in mind, the role of website monitoring services becomes critical. Engineers tasked with site reliability have for years been buying the same few inadequate commercial solutions from giants like Cisco and Solarwinds, which are as expensive as they are limited[8]. Notable commercial efforts such as Renesys, acquired by Dyn and later Oracle, failed to create a sustainable monetization model for these kinds of internet measurement instrumentation.

[6] Schroders Capital, “The digital infrastructure that could help emerging markets leapfrog developed economies”, found here.
[7] Syntropy, “Top 4 Growth Industries Limited By Latency”, found here.
[8] ITPRC, “The Best Cisco Network Monitoring Tools”, found here.

Introduction

As evident from the tables in the Appendix list, a monitoring bias is apparent - all commercial vendors boast that their monitoring infrastructure is located in high tier data centers, but little is known about the last mile, where the actual users experience the internet[9]. We believe that a new approach is needed to understanding network reliability from a user vantage point. A Web3 approach is needed when emerging markets, such as the sprawling economy of Indonesia, a country home to 275 million people spanning over 17,000 islands, has much infrastructure that is a mixture of peer to peer radio, satellite, and fiber optics connecting its young and diverse economy eager to be online[10] [11].

Current solutions offer limited capabilities. They typically measure from a select few, well-connected data centers, usually numbering in the hundreds[9]. While these centers are strategically positioned to offer a broad overview, they fall short in capturing the complex details of a digital realm spanning millions of individual devices routing, and processing traffic between the users and the applications they access.

[9] ThousandEyes, "The Simplest Way to See Global Connectivity", found here.
[10] The World Bank, "Population, total - Indonesia", found here.
[11] Consulate General of the Republic of Indonesia in Vancouver, Canada, "Indonesia at Glance", found here.

Introduction

The current monitoring solutions struggle to account for the many points of connectivity and potential failure. The internet is a complex ecosystem with countless interdependencies. From undersea cables to cloud servers, the network's health relies on the strength of each link in the chain.

User Experience Undermined

End users, whether tapping through an e-commerce site, streaming content, or accessing banking information, are experiencing the internet in different ways depending on where their devices are and what networks they are connected to. Their experience is influenced by countless variables, such as the:

- Device they use
- Network they are connected to (3G, LTE, DOCSIS, Fiber)
- Geographical location
- Speed of their internet connection
- Time of day and its impact on network use
- Adverse atmospheric events and natural disasters

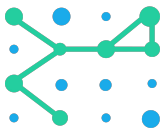
These dynamic elements form a rich range of user experiences, and yet, there is little that operators of networks can do when someone in upper management asks the annoying question: “Why is our application down in Jaipur?”.

PING42 as an open source project is our attempt to create a vibrant community of volunteers, corporations, and academics to monitor their applications, run large-scale internet studies or monitor global censorship. By implementing a basic tokenomics model and providing a marketplace for demand to meet supply for internet telemetry, incredible open tools could be developed to compete with outdated and unsustainable commercial solutions available today.

Key Concepts

Transforming Internet Monitoring

Our mission at the heart of the PING42 DAO is fixing application reliability monitoring via an open source model and an inclusive global ecosystem. Web3 models can now enable such application ecosystems to achieve sustainability over prolonged periods of time.

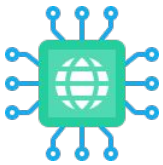


Global Community-Run Telemetry Nodes

In the PING42 ecosystem, global community members will actively contribute by running our application on their computers and servers. This distributed network coverage will span real, end-user networks, enabling comprehensive monitoring that reflects the actual user experience.

Dockerized Testing Nodes

The testing client, referred to as a "node," will be designed to be accessible and adaptable. Packaged as a Docker container and pre-compiled to run on popular CPU architectures, these nodes will be hosted on a wide range of hardware, from Raspberry Pi to Synology NAS, and even aging Windows or Linux computers. This versatility will empower users to repurpose existing hardware, or run our nodes along side their existing workloads.



Community-Managed Organizations

Community members could establish their own "test node pools" by setting up organizations. This approach will allow members to run nodes across various locations and even private networks. Leveraging public and private nodes, organizations with considerable network sizes can get unprecedented visibility.

Web Portal for Easy Node Integration

The web-based interface of our dApp will serve as the gateway to interacting with the PING42 network. It allows users and organizations to add monitoring for their applications, manage where those test are ran from and what telemetry data is being captured. Node operators will be able to manage their nodes and collect their protocol rewards.

Key Concepts

Transforming Internet Monitoring

Demand-Driven Test Assignment

Our backend system will operate on a demand and supply model, intelligently assigning test cases to different Points of Presence (POPs). This dynamic approach ensures that test cases are distributed effectively to achieve the best telemetry results, optimizing performance monitoring.

Default and Custom Tests

PING42 will offer several default tests, including ICMP Echo, TCP Round trip, TCP connection, and HTTP(S) requests. These tests cover a broad spectrum of monitoring needs. Furthermore, our platform will provide a Test Development SDK, allowing organizations and individuals to create custom tests in JavaScript, expanding the possibilities for advanced telemetry infrastructure.

Use Cases: SSL Observatory

As an illustrative use case, the SSL Observatory will demonstrate the practical application of our monitoring capabilities. This feature will empower users to assess SSL certificate validity, encryption strength, and adherence to security best practices, contributing to a more secure digital landscape.

These key concepts serve as the foundation of the Ping42 project, enabling a decentralized, community-driven approach to internet monitoring that fosters collaboration, innovation, and inclusivity.

Tokenomics

A Framework for Internet Monitoring

In our pursuit of democratized internet monitoring, we're not only redefining how we measure the digital landscape but also how we value and incentivize our ecosystem. Our Tokenomics framework plays a pivotal role in shaping this new paradigm.

Introducing the PING42 Token

At the core of our Tokenomics framework is the PING42 Token.
PING42 is the lifeblood of our ecosystem, serving multiple crucial functions:

Network Access

By installing our network monitoring software and connecting a wallet to it, various tests executions and outage alerts can be received.

After paying in USDC, individuals and companies would be able to monitor their infrastructure, and researchers can conduct large scale internet tests.

Community Rewards

Community members who run nodes will be rewarded in PING42, recognizing and encouraging their contributions to our ecosystem.

Governance

PING42 holders, will play a crucial role in shaping the direction of our ecosystem. PING42 holders who have staked their tokens will be able to vote on DAO proposals and are entitled to 15% of protocol revenue.

Tokenomics

A Framework for Internet Monitoring

Payment Flexibility

In order to avoid heavy price fluctuations of utility tokens, we will denominate all transactions in USDC and accept various payments methods. This approach will provide stability and ease of use for our clients.

Competitive Pricing

Our aim is to compete with stable, annual pricing for basic checks, aligning with services like Pingdom, which currently offers similar features at $240 per year. We will offer uptime monitoring and basic notifications for just $29.99 per year.

Platform Fee

A platform fee of 15% will be charged, which will support ongoing development and the maintenance of our ecosystem. These 16% of revenues will be relocated in the DAO's treasury.

Staking

PING42 tokens would be able to be staked, offering a yield. The higher the revenues of the DAO in respect to the total amount of tokens staked, the higher the staking reward.

Token Utility and Beyond

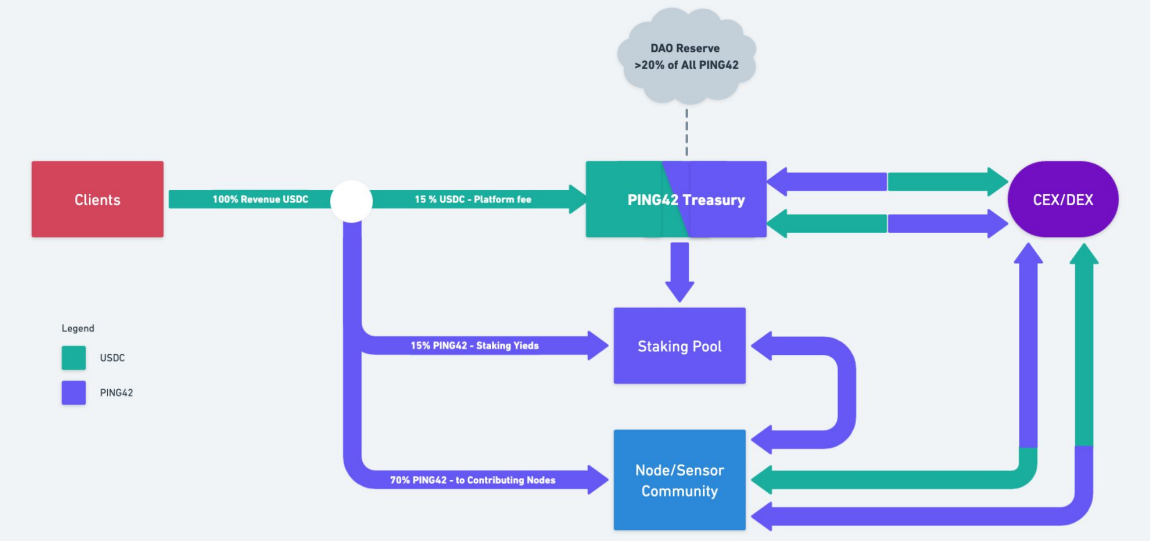
PING42's utility will go far beyond our internal ecosystem. It has the potential to extend to a multitude of applications, including but not limited to:

- Enabling more decentralized internet monitoring initiatives.
- Creating opportunities for innovative insights in global human development, internet access, and quality.
- Advocating for internet access as a fundamental human right.

As we develop our Tokenomics framework, our vision is to create an ecosystem where the value of the PING42 Token extends beyond mere transactions. It will become a symbol of empowerment, unity, and progress in the ever-evolving landscape of internet monitoring.

Tokenomics

A Framework for Internet Monitoring



Revenue Distribution

Clients' money for monitoring services will be received in USDC, having various payment methods available.

The obtained revenue from clients will be distributed in the following way:

• **15%** - will be transferred to the DAO's treasury as USDC, through the platform fee to support future operations.

• **15%** - will be transferred to DAO's treasury, through the staking back fee, as USDC toback the corresponding amount of PING42 tokens that will be distributed as a reward to community members, who have chosen to stake their PING42 tokens.

• **70%** - the remaining revenue will be converted to PING42 tokens and distributed to the community members, who have contributed sensor capacity to the network.

The Vault

The PING42 DAO will have a treasury consisting of both:

• **USDC** - both obtained through the 15% platform fee to support future operations, and USDC to back the PING42 tokens in circulation, through the staking back fee, and

• **PING42** - that will be minted, ensuring that the DAO has at least 20% of the existing PING42 tokens

Trading

Exchange of PING42 tokens will NOT be possible, unless the tokens are staked. Trading staked PING42 tokens will be possible through different decentralized (DEX) and centralized exchanges (CEX) at any given moment.

Proposed Features

Our commitment to delivering a comprehensive and accessible internet monitoring platform goes beyond the basics. We are continually exploring and developing new features to enhance the PING42 ecosystem. Here are some of the exciting features we have in the pipeline.

1. Page Speed Reporting

We understand the critical role that pagespeed plays in user experience. Our vision is of a Pagespeed Reporting feature that would provide detailed insights into the speed of your web pages. Thus, having the ability to identify bottlenecks, optimize load times, and ultimately offer a smoother experience to your visitors. This will allow users to create scripts that request diverse assets from monitored endpoints that measure real application performance by allowing the upload of HAR files.

2. Diverse Monitoring Types

- Uptime Monitoring (Per Region)

We are planning on expanding our regional monitoring capabilities, which will allow users to track uptime from specific geographic regions. This feature will ensure that clients' web services will be available to users in their respective locations.

- Latency Monitoring (Region/Global)

Keeping an eye on latency is essential for delivering a seamless user experience. Introducing advanced latency monitoring will enable clients to measure and mitigate delays in both regional and global contexts.

Proposed Features

3. Full Transaction Monitoring

We recognize that monitoring shouldn't stop at basic uptime checks. Our Full Transaction Monitoring feature would empower clients to simulate complete user interactions, such as adding items to a shopping cart, filling out forms, and making purchases. This in-depth monitoring will ensure that users' critical processes run smoothly, enhancing your users' experience.

4. Public Status Pages

Transparency is vital in maintaining trust with users. With Public Status Pages, clients will be able to display the real-time status of their services, demonstrating commitment to reliability. These pages will be easily shared with clients' community and stakeholders.

5. Enhanced Integrations

We understand the importance of efficient communication when incidents occur. Our expanded Integrations feature will include seamless connections to various platforms, including Twilio, OpsGenie, Discord, Slack, PagerDuty, and VictorOps. These integrations will ensure that client team stay informed and can respond swiftly to any emerging issues.

6. PING42 Token Utility

- **Telemetry Test Rewards** - PING42 tokens are exclusively earned by running telemetry tests, ensuring that token distribution directly correlates with active participation in network monitoring.
- **USDC-Backed Tokens** - The DAO reserve holds an equivalent amount of PING42 tokens in USDC, backing the circulating tokens, ensuring stability and trust.
- **Redemption Options** - Token recipients can choose to hold, stake, or redeem PING42 tokens through a dedicated dApp, facilitating flexible token management.

Proposed Features

7. DAO Treasury Management

- **Initial Seed Funding** - The project begins with a $100K seed fund, sustaining DAO operations for three years and facilitating token minting.
- **Treasury Reserves** - The initial seed fund is stored in the DAO treasury and used to mint the first billion PING42 tokens, which remain in reserve.
- **Token Redemption Process** - Community members can opt to redeem their PING42 token rewards, receiving the equivalent USDC value, while returning the tokens to the treasury for burning.
- **Staking Incentives** - Staked PING42 tokens are locked for one year, during which stakers receive staking yields and gain voting power proportional to their stake amount.
- **Trading Eligibility** - Staked PING42 tokens can be traded on CEXs/DEXs, providing liquidity, and their price dynamically adjusts based on market supply and demand.

As we continue to develop and refine these features, our goal remains the same: to provide a comprehensive and user-friendly internet monitoring platform. We are dedicated to help maintain the reliability and performance of digital services, keeping users satisfied and clients' online presence strong. Stay tuned for these and more exciting enhancements coming to PING42!

Governance

Empowering the Community

PING 42's decentralized governance will prioritize transparency and community empowerment. Our model prevents dominance by any single entity, be it, corporate giants, like ThousandEyes/Cisco, Dyn/Renesys, Oracle, or established services like Pingdom by Solarwinds. Governance will be facilitated through the PING42 Token.

Ownership Transfer

To safeguard project integrity, we enable the transfer of ownership to a diverse community. This ensures collective decision-making, resisting undue influence from any single entity.

Scientific Involvement

We actively involve the scientific community in steering the project. Their participation fosters innovation, encourages research, and ensures an open exchange of ideas, reinforcing our commitment to a community-driven internet monitoring ecosystem.

Governance

Empowering the Community

PING42 Token

The PING42 token will serve a dual purpose as the native token and governance token within the Ping42 DAO ecosystem. Holders of PING42 tokens, who have staked their tokens could actively participate in the governance process, exercising their voting rights to influence decisions shaping the PING42 protocol.

Governance Proposals

Any holder of staked PING42 tokens would be able to create a proposal to suggest changes or improvements to the PING42 protocol. Proposals can cover various aspects, including adjustments to interest rates, new features, changes to protocol parameters, and changes to fee structures.

- Governance Forum

Discussions and debates regarding proposals take place on the PING42 Governance Forum, an online platform where the community can share their perspectives, suggest improvements, and engage in discussions related to the protocol's development.

- Voting System

Staked PING42 holders cast their votes on proposals using the PING42 voting system. The voting system involves a continuous approval voting mechanism where PING42 holders can vote "Yes," "No," or "Abstain" on each proposal. The voting power is determined by the number of PING42 tokens staked.

- Quorum and Approval

To validate proposals, a minimum quorum of all minted PING42 tokens will be required, emphasizing the importance of broad community participation. Proposals will also need a minimum approval rate threshold to be implemented. The minimum requirements for quorum and approval rate will depend on proposal type.

- Delegated Voting

Staked PING42 holders would be able to choose whether to delegate their voting power to another address. Delegated voting allows users to assign their voting rights to a trusted party, enabling participation in governance without actively voting.

Implementation

If a proposal successfully passes the voting process, it can be implemented, and the changes become part of the PING42 protocol. The implementation is carried out by either of 3 alternatives: the PING42 development team, an open source team or through a decentralized execution mechanism, such as a smart contract.

Network Security and Fairness

In building the PING42 ecosystem, fraud resistance is a paramount concern. We are committed to ensuring the integrity and security of our network to protect both users and the ecosystem as a whole. Our approach to fraud resistance encompasses several key strategies:

Decentralization

By distributing monitoring nodes across a global network of community-run infrastructure, we mitigate the risk of single points of failure and reduce the susceptibility to coordinated attacks or manipulation.

Tokenomics Design

Our tokenomics framework is designed to disincentivize fraudulent behavior by aligning incentives with network integrity. Token holders are rewarded for contributing to the ecosystem's growth and penalized for malicious activities that undermine its stability.

Continuous Monitoring

We implement robust monitoring and auditing processes to detect and respond to suspicious activities in real-time. Through advanced analytics and anomaly detection algorithms, we can identify irregular patterns indicative of fraudulent behavior and take appropriate action swiftly.

Collaborative Security Efforts

We actively collaborate with industry peers, security researchers, and regulatory bodies to stay abreast of emerging threats and best practices in fraud prevention. By fostering an environment of collaboration and information sharing, we strengthen our collective defenses against fraud.

Immutable Blockchain

Leveraging the immutability of blockchain technology, we record all transactions and governance decisions on a transparent and tamper-proof ledger. This ensures transparency and prevents unauthorized alterations to critical system parameters.

Community Governance

Our governance model empowers the community to actively participate in decision-making processes, including the detection and mitigation of fraudulent activities. Through transparent governance mechanisms, stakeholders can propose and vote on measures to enhance fraud resistance.

Smart Contract Security

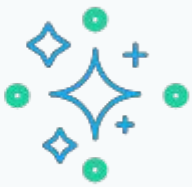
Any smart contracts deployed within the Ping42 ecosystem undergo rigorous security audits to identify and mitigate potential vulnerabilities. By adhering to best practices in smart contract development and auditing, we minimize the risk of exploit and ensure the integrity of our protocols.

Through a multi-faceted approach encompassing decentralization, blockchain immutability, tokenomics design, community governance, continuous monitoring, smart contract security, and collaborative security efforts, we are committed to building a resilient and fraud-resistant ecosystem that safeguards the interests of all stakeholders.

Roadmap

PING42 will undergo Numerous Stages of Development

1



Q1

- Operational Private
- Sensor Infrastructure
- Telemetry Data Archival
- Basic Dashboard
- Private Beta

2

Q2

- Community Beta
- Hosted Prometheus for Advanced Data Insights
- Public Token Airdrop to Sensor Operators (5% of Tokens)

3

Q3

- Operational Private Sensor Infrastructure
- Operational Private Sensor Infrastructure
- Telemetry Data Archival
- Basic Dashboard

Private Beta

4

Q4

- First 1000 Nodes
- Tools for Academia for Internet-Wide Study

Web 2.0 Competitors: A New Approach to Internet Monitoring

In the world of internet monitoring, Web 2.0 competitors like Pingdom and Catchpoint have long been established players, offering valuable services to users. However, PING42 sets itself apart by bringing a fresh perspective to the field. Here's how we differentiate ourselves ...

1 Decentralized Community

Other firms primarily operate within the framework of a centralized service model. In contrast, PING42 will leverage the power of a decentralized community. Our network will comprise individual users, geeks, academics, and organizations, all contributing to a global internet sensor. This decentralized approach promotes inclusivity and allows users to actively participate in shaping the service.

2 Empowering the Scientific Community

While current competitors focus on providing monitoring services, PING42 will actively involve the scientific community.We recognize the importance of academic research and insights in advancing internet measurement. By allowing the scientific community to steer our project and contribute to a large internet sensor, we will foster a culture of innovation and collaboration.

3 Governance Model

Our web 2.0 competitors operate with established corporate structures and centralized decision-making processes. PING42, on the other hand, will embrace a governance model that facilitates the transfer of project ownership to a diverse set of stakeholders, ensuring that no single entity can dominate or manipulate the project's direction.

4 Tokenomics and Pricing

PING42 introduces a unique token-based system, the PING42 Token, which will incentivize user participation. We will denominate test assignments in our native token while accepting payments in USDC with the aim of having non-fluctuating prices for our clients, while also, providing competitive pricing, ensuring affordability for a broader user base.

5 Innovative Features

While current solutions offer conventional monitoring services, PING42 is committed to introducing innovative features.

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Appendices

Appendix 1 - Competitor Table (Long)

Name	Sensors	Monitoring Protocols	Annual Cost	Telemetry Data
Pingdom	~100	HTTP(S) Uptime, Transaction, RUM, Page Speed, DNS, TCP Port, Ping, SMTP, POP3, IMAP, FTP, SSL Certificate	$33K-$79K*	Limited
ThousandEyes	200-300	Network Path Visualization, BGP Route Visualization, Network Device Monitoring, Internet Outage Detection, DNS Tests, IPv6 Tests, Web Page Load Tests, API Endpoint Tests, VoIP and Video Call Tests, Cloud and SaaS Application Tests, DDoS Attack Detection, TLS Certificate Tests	~$20K	Extensive
Catchpoint	2600	Web Transaction Monitoring, Page Load Performance, DNS, Network, Server, API Monitoring, Synthetic, RUM, Endpoint Security	~$180	Extensive
Uptime Robot	~50	HTTP(S), Ping, Port, Keyword, Heartbeat, SSL Certificate	~$2600*	Limited
Monitor Uptime	~30	HTTP(S), Ping, Keyword, Port, Uptime, SSL Certificate	$300 - $6600*	Limited
Uptime Monitor	~30	HTTP(S), Ping, Port, Keyword, SSL Certificate	$2400*	Limited
SolarWinds NPM	Customizable	Network Performance Monitoring, SNMP Monitoring, NetFlow Traffic Analysis, Device Health Monitoring, Application Monitoring, WAN Performance Monitoring, Virtualization Monitoring	Contact for pricing	Extensive
ManageEngine OPManager	Customizable	Network Performance Monitoring, Fault Management, Traffic Analysis, Bandwidth Monitoring, Configuration Management, IP Address Management, Network Mapping	Contact for pricing	Extensive
PRTG	Customizable	SNMP Monitoring, WMI Monitoring, Packet Sniffing, NetFlow Analysis, HTTP Monitoring, SMTP Monitoring, Ping Monitoring, FTP Monitoring, SSH Monitoring	~$1900	Extensive
Site24x7	~100	Website Monitoring, Server Monitoring, Application Performance Monitoring, Cloud Monitoring, Network Monitoring, Real User Monitoring, IT Automation	$399	Extensive
ManageEngine Application Manager	Customizable	Application Performance Monitoring, Server Monitoring, Database Monitoring, Website Monitoring, Cloud Monitoring, Container Monitoring	Contact for pricing	Extensive
PingPlotter	Customizable	Network Performance Monitoring, Ping Monitoring, Traceroute Visualization	$199	Limited
Kentik	Customizable	Network Traffic Analysis, DDoS Detection, Cloud Performance Monitoring, SD-WAN Monitoring, Internet Peering Analytics, Network Security Analytics	Contact for pricing	Extensive
Syncro	Customizable	RMM (Remote Monitoring and Management), PSA (Professional Services Automation), Endpoint Monitoring, Patch Management, Ticketing System	$75	Extensive
Domotz	Customizable	Remote Monitoring and Management (RMM), Network Device Monitoring, Network Performance Monitoring, Remote Power Management	$19	Extensive
Obkio	Customizable	Network Performance Monitoring, Network Traffic Analysis, WAN Performance Monitoring, Application Performance Monitoring	$199	Extensive
Pandora FMS	Customizable	Network Monitoring, Server Monitoring, Application Monitoring, Virtualization Monitoring, Cloud Monitoring, Log Monitoring, SNMP Monitoring	~$900	Extensive
WhatsUp Gold	Customizable	Network Monitoring, Server Monitoring, Application Monitoring, Cloud Monitoring, Virtualization Monitoring, Log Monitoring	$1,785	Extensive
Malwarebytes for Business	Customizable	Endpoint Security, Endpoint Monitoring, Endpoint Protection, Malware Detection, Ransomware Protection, Exploit Protection	Contact for pricing	Limited
vSphere	Customizable	Virtual Infrastructure Monitoring, Virtual Machine Monitoring, Performance Monitoring, Resource Management, Capacity Planning	Contact for pricing	Extensive
PING42	**Limitless**	**Everything**	**$30**	**Extensive**

Appendices

Appendix 2 - Competitor Table (Short)

Name	Sensors	Monitoring Protocols	Annual Cost	Telemetry Data
Pingdom	~100	HTTP(S) Uptime, Transaction, RUM, Page Speed, DNS, TCP Port, Ping, SMTP, POP3, IMAP, FTP, SSL Certificate	$33K-$79K*	Limited
ThousandEyes	200-300	Network Path Visualization, BGP Route Visualization, Network Device Monitoring, Internet Outage Detection, DNS Tests, IPv6 Tests, Web Page Load Tests, API Endpoint Tests, VoIP and Video Call Tests, Cloud and SaaS Application Tests, DDoS Attack Detection, TLS Certificate Tests	~$20K	Extensive
Catchpoint	2600	Web Transaction Monitoring, Page Load Performance, DNS, Network, Server, API Monitoring, Synthetic, RUM, Endpoint Security	~$180	Extensive
Uptime Robot	~50	HTTP(S), Ping, Port, Keyword, Heartbeat, SSL Certificate	~$2600*	Limited
Monitor Uptime	~30	HTTP(S), Ping, Keyword, Port, Uptime, SSL Certificate	$300 - $6600*	Limited
Uptime Monitor	~30	HTTP(S), Ping, Port, Keyword, SSL Certificate	$2400*	Limited
PING42	**Limitless**	**Everything**	**$30**	**Extensive**

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