

Cronos Whitepaper



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Introduction

Cronos is a decentralised, open-source, energy-efficient public blockchain with high speed and low transaction fees. Cronos is designed to support the creator economy with Web3 applications such as DeFi and GameFi, ultimately serving as the foundational infrastructure for an open metaverse. Cronos is designed to serve the next billion Web3 users and to help them experience the full promise of self-custody of their digital assets.

Cronos is an Ethereum-Virtual Machine (EVM) compatible blockchain powered by Ethermint and built with the Cosmos SDK that supports the Inter-Blockchain Communication (IBC) protocol. Accordingly, end-users can import cryptocurrencies from the Ethereum, Cosmos and other chain families into Cronos, and subsequently use, trade or invest them in innovative smart contract-based protocols leveraging the rich application ecosystem of Ethereum / Solidity, and rapidly port apps & smart contracts from Ethereum and EVM-compatible chains.

Cronos is fast, cost-effective, and frictionless. Cronos aims for high transaction throughput (from hundreds to thousands of transactions per second), fast transaction finality (5–6 seconds), and low transaction fees (from one cent to a few dimes). Its Proof of Authority (POA) consensus mechanism combines decentralisation with streamlined, scalable, and environment-friendly transaction processing. Cronos can deliver cheaper transactions than Ethereum mainnet, making decentralised applications (dApps) and smart contracts potentially more affordable, carbon-neutral, and more user-friendly.

Developers on Cronos can benefit from the support of Cronos Labs, a Web3 startup accelerator and ecosystem development fund. Builders and creators can tap into its \$100m EVM fund.

Cronos Value Proposition

As an open-source Layer 1 blockchain, Cronos aims to massively scale the Web3 user community by providing builders with the ability to instantly port apps and crypto assets from other blockchains while benefiting from low transaction fees, high throughput, and fast transaction finality. Key value propositions of Cronos include:

1. **EVM Compatibility:** Cronos is built on Ethermint, which supports rapid porting of apps and smart contracts from Ethereum and other EVM-compatible chains;
2. **Scalability:** Cronos aims to deliver faster, cheaper, and carbon-neutral transactions and smart contract

execution than proof of work chains;

3. **Interoperability:** The Inter Blockchain Communications (IBC) protocol enables interoperability and bridging to other IBC-enabled chains, such as Cosmos Hub, Osmosis, etc;
4. **Proof of Authority (POA):** Utilising POA as a more streamlined and scalable consensus mechanism while still maintaining security through a range of experienced and carefully-vetted validators;
5. **Open Source:** High involvement of the community is welcomed to proactively review and provide suggestions to strengthen Cronos.

Technology

Architecture

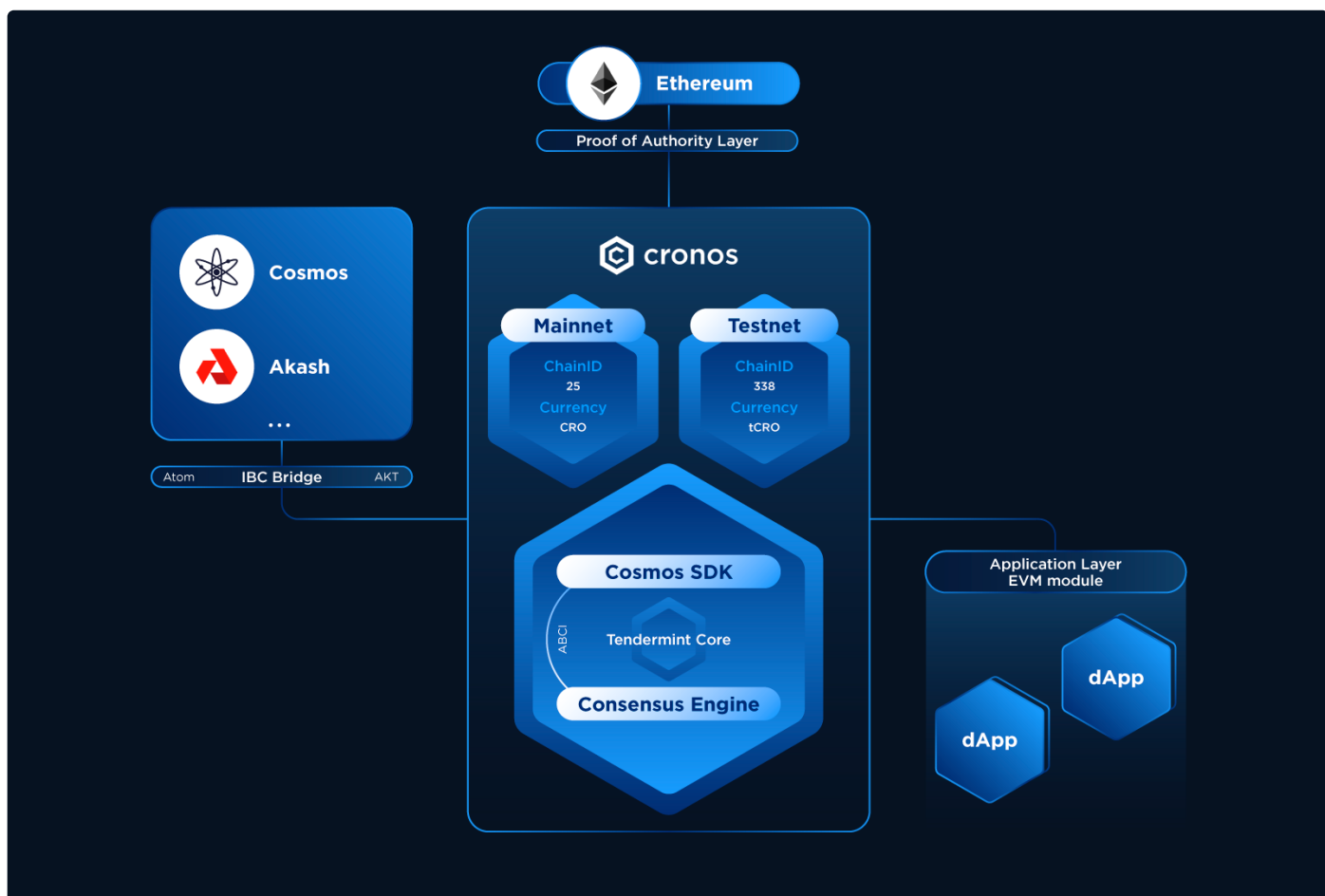
Overview

Cronos is one of the very few blockchains that exist at the intersection of the Ethereum Virtual Machine (EVM) and the Cosmos ecosystem. It is an EVM compatible Chain built on the Cosmos SDK, allowing the chain to exist in the intersection of the Cosmos and Ethereum ecosystems while enjoying benefits from both ecosystems.

Solution

Cronos incorporates the EVM and is built on top of Cosmos SDK. This unique combination enabled Cronos to support:

1. **Ethereum Virtual Machine(EVM):** Cronos is powered by Ethermint, which allows rapid porting of smart contracts from Ethereum and EVM compatible chains. Solidity developers who have prior experiences in building on Ethereum or other EVM chains can build decentralised applications on Cronos using Solidity.
2. **Tendermint and the Cosmos SDK:** Tendermint and the Cosmos SDK are the building blocks making it possible for Cronos to have a secure and consistent consensus engine and a framework for modular blockchain development in the programming language developers are most comfortable with. Interoperability (IBC + canonical Ethereum-Cronos bridge):
3. **Interoperability (IBC + canonical Ethereum-Cronos bridge):** Inter-Blockchain Communication (IBC) allows Cronos to communicate with other Cosmos SDK-based blockchains that have IBC enabled. It is a cross-chain communication protocol that has many possibilities including asset transfer and cross-chain execution. An upcoming canonical Ethereum-Cronos bridge will make it possible to bridge ERC-20 tokens from other EVM compatible chains to the Cronos ecosystem.
4. **Proof of Authority (PoA):** Proof-of-Authority (PoA) is a more streamlined and scalable consensus built on top of Tendermint's Proof-of-Stake (PoS), while still maintaining security through a range of experienced and carefully-vetted validators.



Consensus Engine

Proof of Authority (PoA)

Cronos is based on Ethermint, which is a scalable, high-throughput proof-of-stake (PoS) blockchain, built on top of the Cosmos SDK and EVM compatible. Ethermint makes use of Tendermint's PoS consensus engine, while having the features of Ethereum at the same time.

Cronos uses a modified version of the Tendermint PoS. In the Cronos consensus, validators are vetted by other validators based on their commitment to the Cronos ecosystem, technical ability to implement upgrades flawlessly, track record in operating high availability nodes, and economic viability. Among these permissioned validators, the voting power of each node is determined by the staking token amount that they have been allocated by the validator group. We refer to the Cronos consensus as a Proof of Authority (PoA) consensus because the admission of new validator nodes requires existing validators agreeing to donate or delegate staking tokens to these new validators.

In the Cronos consensus, the staking token is not the Cronos (CRO) token. Instead, it is a dedicated staking token that is used for governance purposes. This token is not listed and has no market value. Separately, the Cronos (CRO) token is used by end-users to pay network transaction fees which are collected by validator nodes.

Tendermint

[Tendermint](#) is a software used to consistently and securely replicate an application on many machines. There are two important components to Tendermint, the consensus engine, Tendermint Core, and the application interface, the Application BlockChain Interface (ABCI).

Tendermint core ensures that validators receive the same transactions and in the same order. Validators are running a Byzantine Fault Tolerant (BFT) consensus protocol. This means the consensus engine is able to tolerate machines failing or becoming malicious. Validators go through a multi-round voting process before coming to a consensus on the contents of a block. When the majority of the validators agree on this block, this block will be added to the blockchain.

The application interface, ABCI makes it possible for developers to use Tendermint for applications in different programming languages and select the development environment suited for them.

On a high level, these are the main reasons why Tendermint is a good fit as consensus engine for Cronos:

- Heavily [researched and peer reviewed](#);
- Robustly [tested implementation](#);
- Track record of adoption: Tendermint has been in continuous development since 2014, and has been adopted by several high-profile projects;
- Modular architecture: It offers flexibility on which and how applications are developed on top of it.

Cosmos SDK

[Cosmos SDK](#) is an open-source framework suited for PoS or PoA blockchains. With the Cosmos SDK developers can create custom blockchains from scratch on top of Tendermint, and natively interoperate with other Cosmos SDK blockchains.

The Cosmos SDK allows for composable open-source modules that can be easily integrated. Developers can use pre-built modules or create custom modules that can be imported into the existing blockchain application.

The Cosmos SDK is inspired by a capabilities-based security model, allowing developers to think more about the security of interactions between modules. Leveraging the experience from different previous blockchain state machines, the Cosmos SDK is a secure environment to build blockchains.

Inter-Blockchain Communication Protocol (IBC)

[The Inter-Blockchain Communication protocol \(IBC\)](#) is an end-to-end, connection oriented stateful protocol used for reliable, ordered, and authenticated communication between heterogeneous blockchains.

This interoperability is achieved by specifying a set of data structures, abstractions, and semantics such that they can be implemented by a distributed ledger satisfying this set of requirements.

The IBC is used for cross-chain applications such as token transfers, atomic swaps, multi-chain smart contracts and data and code sharding.

Fee Structure

Cronos has lower transaction fees than a typical PoW chain thanks to the design architecture and consensus engine. It allows for a higher transaction execution capacity with a lower cost.

Each transaction on Cronos consumes gas during execution based on the computational effort needed. The transaction fee is calculated as the total of gas consumed during transaction execution multiplied by the unit gas price.

Cronos adopts a fee market module with a [dynamic fee structure](#). At each block, a common base fee is calculated dynamically for the next block, depending on the whole network utilisation. Specifically, the fee market module has been designed to support Ethereum's EIP-1559 transaction format in order to make Cronos integration simpler for wallets and decentralised applications. The module's formula to calculate the base fee at each block is also similar to the formula used by EIP-1559. This means that transaction fees will increase when the network is congested, and they will decrease when the network has spare capacity.

In contrast with [EIP-1559](#), the fee market module implemented on Cronos does not burn any of the base fees. The base fee and priority fee continue to be collected by the validators.

Security & Performance

Cronos is powered by the Tendermint consensus engine, which is a Byzantine-Fault Tolerant (BFT) protocol. It has the following characteristics:

1. **Instant finality:** Transactions are confirmed immediately once they are included in a block.
2. **Scalability:** Tendermint can process more transactions per minute than the EVM, making it faster, cheaper and carbon-neutral to execute smart contracts.
3. **Security:** BFT can tolerate up to 1/3 network node's failure and includes detection of explicit malicious behaviour.

Instant finality

A typical PoW consensus does not provide fast finality in the sense that blocks could be re-organised to a certain block height given a 51% attack. The probability of a transaction being revoked goes down as the number of confirmations goes up, so typically users need to wait at least 6 confirmations before their transaction is added to the blockchain. In Cronos instant finality refers to the fact that transactions are finalised once they have been included into a block.

Scalability

Cronos can run more transactions per second than a typical PoW chain, as it is based on Tendermint's PoS, providing fast finality. The advantage of having higher throughput in the network is that it becomes cheaper to run smart contracts. As transactions are processed up to 20x faster, there is less backlog driving up the fees, which in turn helps saving transaction fees.

Because of the peg zones and hub design of the Cosmos network, it is possible to scale horizontally by adding a second, third, etc. Ethermint zone, increasing the TPS with each zone that is added.

Security

As Cronos utilises Tendermint's consensus engine, a Byzantine Fault Tolerant protocol, it is resistant, even if up to $\frac{1}{3}$ of the nodes fail or decide to act maliciously.

Validators currently are invitation-only and are selected based on security and performance criteria, including background check, to ensure they are of highest standards. On the technical side, validators are expected to comply with a security checklist and follow [best practices when running their nodes](#).

This includes having:

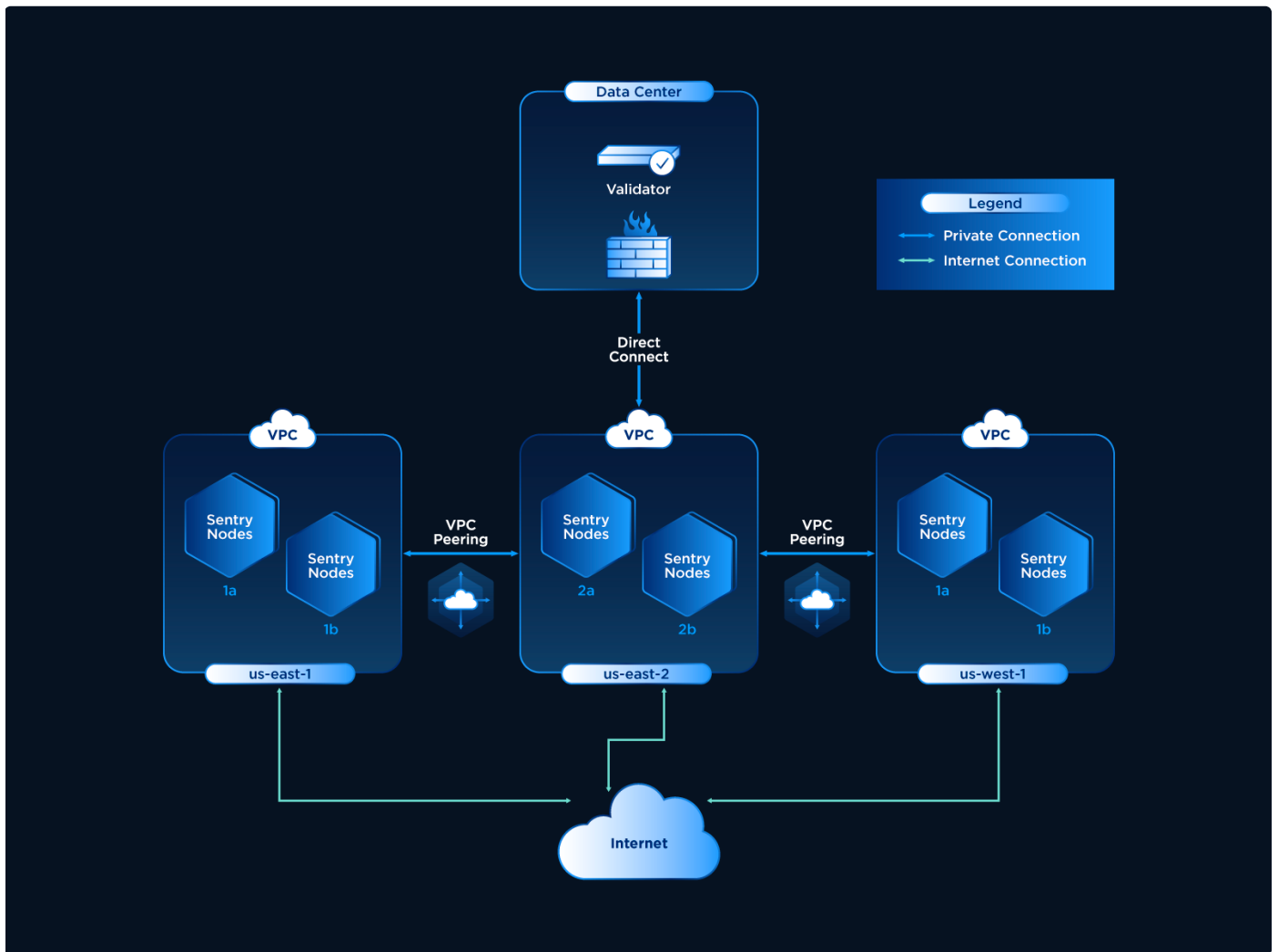
- A secure operating data centre
- Backup and redundant hardware to ensure high availability and reliability
- Sentry node architecture for DDoS prevention
- Intrusion detection / prevention system installed
- General security checks, including automated patching
- Account security, remote access controls and KMS e.g. HSM
- System monitoring and alerting

The [Sentry node architecture](#) is one example of how to set up a validator node to mitigate risk of DDoS attacks. A sentry node is similar to a full node, but uses one or more peers to connect to. These peers can be either a validator or a node. The sentry node serves as a protection layer, similar to a frontend/backend separation. In case of DDoS attacks, multiple sentry nodes with the ability of dynamic scaling can make it much harder to impact the validator node.

The validator uses private connections and is not directly exposed to the public internet. This approach together with proper networking and security best practices such as multiple subnets, firewalls and redundancy devices, are expected of validators. Below is a solution example on a cloud provider, but one can use any other solution that suits.

The Ethermint implementation of Tendermint has also been thoroughly audited by Kudelski Security, and was found to be of high standard. This audit consisted of the following tasks:

- Security analysis and architecture review of the original protocol
- Review of the code written for the project
- Assessment of the cryptographic primitives used
- Compliance of the code with the provided technical documentation



The Sentry node architecture

More details on the report can be found in the [security audit report](#). Note that this audit was based on the code as of 11 Feb 2022.

Sustainability

In terms of sustainability, PoS/PoA networks are generally less energy-intensive than Proof-of-Work networks because validators do not need to solve complex puzzles as in PoW, hence their required processing power is much lower.

Furthermore, Cronos nodes can be hosted with ARM chips, compare to standard intel x86_64 architecture, It further reducing [carbon footprint](#) of hosting a node from around 1380 kgCO₂eq to 240 kgCO₂eq per year.

Compared to 74.95 kgCO₂eq for Ethereum and 823.96 kgCO₂eq for Bitcoin, Cronos has an approximate value of -0.005kgCO₂eq emissions per single transaction, making it much more sustainable with its low carbon footprints.

Governance

Cronos validators hold two types of tokens: CRO, which validators collect from users in the form of transaction fees; and the Cronos Staking Token, which is allocated to validators as part of the Proof of Authority governance of the Cronos chain and represents their voting power in the consensus and other on-chain decisions.

The Cronos community may make governance proposals as they see fit. For example when there is a request to change blockchain parameters or community spending, community members can draft an initial proposal with feedback from the community. To officially submit a proposal on the mainnet, a minimum amount of CRO needs to be deposited during the deposit period, which lasts 14 days or until the minimum amount of deposit is reached. After which the voting period starts, and voting power is counted depending on bonded stake. A [governance proposal](#) is passed when the deposit requirements are met (i.e. 33.33% of the network's voting power has voted and a majority of the voting power has backed the "yes" vote).

Reward/Penalties

Validators are expected to maintain a stable infrastructure and help to secure the network. If the validators fail to achieve this, they are subjected to certain forms of punishment depending on the severity. Such punishments include:

Jailing - Liveness Faults (Low availability)

Validators are "jailed" if they do not sign blocks for a certain period of time. During the jailing period, validators are excluded from the active validator list and are not allowed to sign any blocks. The jailing period provides validators a chance to recover their infrastructure without further impacting the network stability. At the same time, the exclusion from signing blocks is a punishment to the validator because they cannot obtain any rewards during this period.

Byzantine Faults

A validator makes a byzantine fault when they sign conflicting messages/blocks at the same height and consensus round. Tendermint has mechanisms to publish evidence of validators that signed conflicting votes so they can be punished by being slashed.

When byzantine faults are detected, validators are immediately slashed and jailed. Their stake will be deducted and validators who commit this double-signing fault will also be put into the "tombstone state", which means they are blacklisted and jailed forever.

Roadmap (as of Q2 2022)



Protocol and Database Optimisations

Cronos currently produces one block every 5 to 6 seconds. As of June 2022, each block has a total compute capacity of 20M gas (gas is a unit that measures the computing power required to execute EVM transactions). While Cronos's capacity is currently utilised only at 20% to 50% on average, the Cronos open-source development community is planning significant capacity increases in 2022, given strong demand. Depending on performance tests, a 3x to 5x increase of block capacity seems reasonable for short to medium term. Additionally, the Cronos open-source development community is working on many database optimisations to make Cronos nodes faster (for example, making nested contract call execution time linear instead of exponential) and more responsive when reading on-chain data.

Further structural upgrades are being investigated in order to significantly increase the throughput of Cronos chain in 2023 and beyond.

Connectivity and Interoperability

Users can transfer CRC-20 tokens from and to other IBC-enabled chains in a decentralised manner, which means that the transfers are confirmed by validators and enjoy the same level of security as other transactions on the Cronos chain.

Additional IBC channels and features will also be introduced. Users will be able to transfer crypto assets from other chains of the Cosmos ecosystem, or other IBC-compatible chains, to Cronos. Upcoming Cosmos SDK and IBC interoperability modules will bring several functionalities to Cronos:

- **Interchain accounts (ICS-27):** this module allows an account on Cronos chain to securely control an account on another IBC-compatible chain and to get it to send transactions on its behalf.
- **Relayer incentives (ICS-29):** this module makes it possible for the operator of an IBC bridge relayer to charge end-users flexibly, which enhances the economic viability of the bridge. As a result, the number of relayers between Cronos and other IBC-compatible chains will grow.
- **Non-fungible token standard:** this module will support the transfer of NFTs between Cronos and other chains that support NFTs (e.g., OmniFlix, IRISnet, Pylons).
- **EVM packets over IBC:** this module will allow Cronos users to interact with proxies of smart contracts that live on another EVM-compatible blockchain (e.g., Evmos, Umee).

Tooling and Infrastructure

Many of the development frameworks, libraries, and tools used by blockchain developers are already available on Cronos. Examples of developer tools include Truffle Suite, Hardhat, Open Zeppelin contract libraries, web3.js, ethers.js and web3.py.

By 2022, most of the tooling that Dapp developers have come to expect from a leading EVM-compatible chain will be available on Cronos:

- Highly reliable commercial RPC endpoints for access to on-chain data, plus additional protocols and vendors to query large numbers of on-chain data points.
- Additional self-custodial wallets besides the ones already available for Cronos users (follow the [blog](#) for a list of existing integrations)
- Additional analytics platforms besides the ones already available on Cronos (e.g. Debank, vFat.tools, Defillama, Ape Board).
- Full integration with at least two of the most prominent oracle solutions (ChainLink and Band Protocol) to enable reliable on-chain & off-chain price feeds for Dapps.

Decentralised Applications (dApps)

Cronos is an open ecosystem supported by a wide range of more than 100 contributors, validators, and Dapp developers. Moving forward, several other ecosystem-bootstrapping initiatives will be launched to raise awareness of Cronos among Dapp developers and support builders working on innovative DeFi, NFT, and Metaverse projects.

Ecosystem Support

Cronos Labs

Cronos Labs is a blockchain startup accelerator that focuses on Decentralised Finance, blockchain games, and the Cronos chain ecosystem development.

Cronos Ecosystem Development

Cronos Labs helps builders create user-friendly applications on Cronos and drive mainstream adoption of Web3. Ecosystem programs include financial incentives, technical support, marketing support and investor introductions.

- **Cronos Ecosystem Grants** - The ecosystem grant program focuses on accelerating the implementation of infrastructure components, developer tools, product integrations and user/developer education programs that are critical for the development of the Cronos ecosystem.
- **Cronos Accelerator** - The accelerator program is a structured 10-week launchpad that helps app builders to achieve product-market fit and significantly increases the effectiveness of their fundraising efforts.
- **Cronos Labs Incubator** - Cronos Labs incubates talented Dapp product development teams and

provides them with the means and tools to create outstanding DeFi and GameFi applications.

- **Strategic Partnerships** - Cronos Labs establishes ad-hoc partnerships with proven founders, Web3 protocols and technology companies who can significantly advance the user and developer experience on the Cronos chain.
- **Hackathons** - Cronos Labs supports a number of hackathon programs as organiser, sponsor or judge.

Cronos Ecosystem Grants

Purpose

The Cronos Ecosystem [Grants program](#) aims to support early-stage projects on Cronos by bootstrapping initial product development and providing technical support. We aim to align incentives with new builders and teams by helping their projects grow with the broader ecosystem.

Program Benefits

- **Milestone Incentives**

The Cronos Ecosystem Grants is not a source of venture capital funding but rather a form of monetary support provided by Cronos Labs. Project recipients would be awarded grants based on the quality of the team, the potential of the project execution capabilities, and its contribution to Cronos. Grants will be awarded based on certain pre-agreed milestones (for example, delivery of MVP, beta launch)

- **Technical Support**

To reduce the friction of producing a well functioning Minimal Viable Product (MVP) on Cronos, grants recipients can expect technical support and assistance from Cronos developers.

- **Marketing Support**

Projects may receive marketing support across social media channels on Cronos.

- **Ecosystem Introductions**

Projects may be connected with ecosystem partners who could potentially decide to support future development of the projects.

Requirements

Projects should be following these standards and guidelines to qualify for funding consideration:

1. Projects must be building an application directly on the Cronos blockchain
2. Projects must be building an application that fall within the following categories:
 - **DeFi** (AMM/DEX, lending, structured finance, yield aggregators, derivatives, liquid staking)
 - **NFT** (NFTs, NFT marketplaces, Inter-NFT applications)
 - **Gaming & Metaverse** (Metaverse, Play-To-Earn game, Play-And-Earn game)

- **Tools & Analytics** (DeFi protocols tools, charting solutions, dashboards, analytics, developer tools)
 - **Critical Infrastructure Projects** (Oracles)
 - **Social Goods and Community Engagement Projects** (community forums, governance toolings, DAO projects, educational youtube videos, dedicated medium articles)
 - **Other Web 3.0 Applications** (decentralised storage, decentralised social media, decentralised IP management)
3. Project must uphold high security standards, such as code audits and verification of smart contract code on the Cronoscan block explorer.

Note: Cronos Labs reserves the sole rights to decide the acceptance/rejection of the grant application.

Cronos Play

Cronos Play is a comprehensive modular suite of developer tools and services to streamline the creation of gaming and GameFi applications in the Cronos ecosystem. Cronos Play is an essential pillar of Cronos's strategy to bring tens of millions of end-users to Web3. The developer platform will consist of integrations, developer products, and services supporting multiple game platforms and languages such as the Unity engine, the Unreal Engine, and the C++ programming language.

ChainSafe Integration

ChainSafe is a leading blockchain research and development firm specialising in infrastructure solutions for web3. Alongside its contributions to major ecosystems such as Ethereum, Polkadot, Filecoin, Mina, Cosmos, and more, ChainSafe has a growing portfolio of web3 products — Files, Storage, the Gaming SDK, and ChainBridge. As part of its mission to build innovative products for users and improved tooling for developers, ChainSafe embodies an open-source and community-oriented ethos to advance the future of the internet.

Cronos Play can be integrated with ChainSafe's Gaming SDK, web3.unity, an open-source software developer kit maintained by ChainSafe, a leading blockchain R&D firm specialising in infrastructure solutions for web3.

ChainSafe's Gaming SDK, web3.unity, enables mobile, web, and desktop games created with the Unity engine to easily interact with common web3 smart contracts such as ERC20 and ERC721 token contracts and ERC721 and ERC1155 NFT contracts. Game developers can access on-chain data in-game, fetch user wallet addresses, connect to the Cronos chain, query cryptocurrency and NFT balances, send transactions, and transfer NFTs as part of the suite of out-of-the-box functionalities.

Roadmap

The Cronos Play roadmap includes integration with many open-source libraries and connectivity to commercial services such as Crypto.com Pay. Games will be able to receive payment cards and crypto payment processing easily. Users will be able to sign blockchain transactions via the Crypto.com DeFi wallet, the MetaMask wallet, or other wallets compatible with Wallet Connect.

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Graphics

All graphics included in this whitepaper are for illustrative purposes only. In particular, graphics with price references do not translate into actual pricing information.

Risk statements

Purchasing Cronos-supported tokens or interacting with Cronos-supported applications or protocols involves substantial risk and may lead to a loss of a substantial or entire amount of the money involved. Prior to purchasing Cronos-supported tokens or interacting with Cronos-supported applications or protocols, you should carefully assess and take into account the risks, including those listed in any other documentation. A purchaser should not purchase Cronos-supported tokens for speculative or investment purposes. Purchasers should only purchase Cronos-supported tokens if they fully understand the nature of the Cronos-supported tokens and accept the risks inherent to such tokens, their relevant applications and protocols, and the Cronos network itself.

Cryptographic

tokens may be subject to expropriation and/or theft; hackers or other malicious groups or organizations may attempt to interfere with the Cronos network or relevant applications or protocols in various ways, including malware attacks, denial of service attacks, consensus-based attacks, Sybil attacks, smurfing, and spoofing which may result in the loss of your cryptographic tokens or the loss of your ability to access or control your cryptographic tokens. In such event, there may be no remedy, and holders of cryptographic tokens are not guaranteed any remedy, refund, or compensation.

The regulatory status of cryptographic tokens and digital assets is currently unsettled, varies among jurisdictions and is subject to significant uncertainty. It is possible that in the future, certain laws, regulations, policies or rules relating to cryptographic tokens, digital assets, blockchain technology, or blockchain applications may be implemented which may directly or indirectly affect or restrict cryptographic token holders' right to acquire, own, hold, sell, convert, trade, or use cryptographic tokens.

The uncertainty in tax legislation relating to cryptographic tokens and digital assets may expose cryptographic token holders to tax consequences associated with the use or trading of cryptographic token.

Digital assets and related products and services carry significant risks. Potential purchasers should take into account all of the above and assess the nature of, and their own appetite for, relevant risks independently and consult their advisers before making any decisions.

Professional advice

You should consult a lawyer, accountant, tax professional and/or any other professional advisors as necessary prior to determining whether to purchase Cronos-supported tokens or operate applications on top of the Cronos network.

Caution Regarding Forward-Looking Statements

This whitepaper contains certain forward-looking statements regarding the business we operate that are based on the belief of Cronos Labs as well as certain assumptions made by and information available to Cronos Labs. We do not purport to make any statements with respect to the conduct or operations of any third parties whose actions (including commercial activity) may affect the Cronos network. Forward-looking statements, by their nature, are subject to significant risks and uncertainties. Forward-looking statements may involve estimates and assumptions and are subject to risks, uncertainties and other factors beyond our control and prediction. Accordingly, these factors could cause actual results or outcomes that differ materially from those expressed in the forward-looking statements. Any forward-looking statement speaks only as of the date of which such statement is made, we undertake no obligation to update any forward-looking statements to reflect events or circumstances after the date on which such statement is made or to reflect the occurrence of unanticipated events.