ENDURANCE



White Paper version 1.0

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1. Summary

Endurance is a high-performance digital entertainment-focused sidechain built on top of a proven, fully EVM Compatible blockchain infrastructure BAS. Launched by Fusion Interactive, the leading web 3.0 gaming studio created by gaming industry veterans, Endurance optimizes instant transactions and ultra-low fees, enabling millions of in-game/social transactions to be executed seamlessly. After 3 months of launch since Jan 2023, the Endurance network has had 50mm transactions and 1.4mm of total active users (source).

2. Abstract

Endurance is a blockchain ecosystem offering high-performance, cost-effective gaming, and social networking application solutions. With a focus on optimizing network performance and reducing storage requirements, Endurance aims to create a fast and efficient blockchain infrastructure for developers to build decentralized applications. The protocol supports various use cases, with a focus on gaming applications and social networking platforms. Endurance enables innovations in the blockchain space by providing a scalable and reliable blockchain solution and aims to become a leading player in the digital entertainment industry.

3. Motivation

The Endurance team has two main motivations to build the Endurance network:

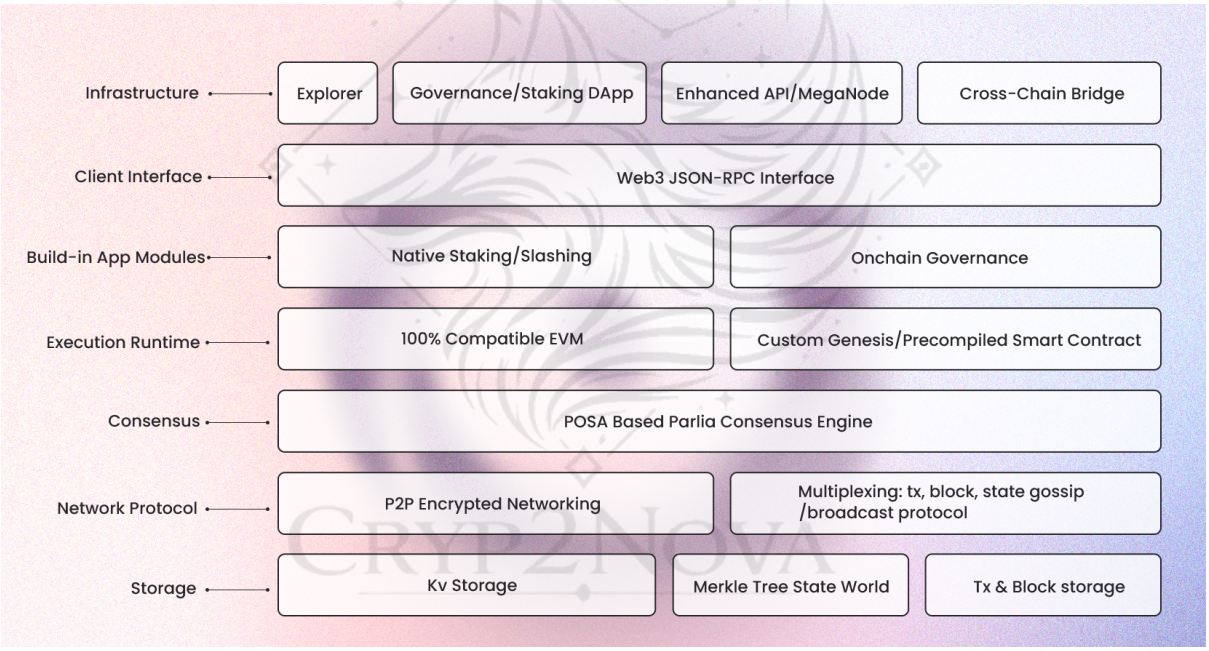
- The blockchain industry lacks a sustainable and scalable gaming+social ecosystem. Endurance offers a faster and more efficient blockchain infrastructure for developers to build decentralized applications, with a focus on gaming applications to social networking applications.
- As of today, BNB Chain is the largest chain by active users, but it is experiencing network scalability problems. The core developers have proposed using Binance Application Sidechain (BAS) in their Outlook 2022 paper to solve this problem; Endurance network is built based off of the BAS design, it offers much higher throughput, lower gas fees, and a predictable and stable fee system for users.

4. Structure

Endurance blockchain offers a multi-layer architecture to provide scalability and facilitate the reuse of existing modules. This architecture is composed of infrastructure, client interface execution engines, network protocols, and storage. In addition, this architecture makes it possible to modify existing smart contracts easily and efficiently.
The Endurance chain consists of multiple layers:

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- API and Tooling: Endurance provides a complete set of APIs and tools to enrich the blockchain ecosystem.
- Explorer: Endurance's explorer allows real-time analysis of blocks, transactions, contracts, and accounts on the blockchain.
- Governance/Staking App: Allows validators to easily propose, vote, and delegate through a user-friendly interface.
- APIs: Provides valuable information on NFTs and DeFi through RPC and Websocket.
- Client Interface: Offers Web3 JSON-RPC with 100% compatibility with the Ethereum network.
- Governance Modules: Enables chain governance, including staking and slashing.
- Execution Runtime: 100% EVM compatibility and smooth migration of existing Smart Contracts.
- Consensus: Endurance adopts a Proof-of-Stake consensus algorithm that combines a hybrid mechanism of Proof-of-Stake (PoS) and Proof-of-Authority (PoA).
- Network Protocol: Implements a P2P communication protocol between validators and nodes.
- Storage & State: Provides key-value storage and Merkle Tree State, Tx & Block storage optimized for high-capacity processing.



5. Specification

Endurance is a modular framework designed to create BSC (Binance Smart Chain)-compatible sidechains with optimized performance and improved scalability. Endurance brings development-ready features like staking, RPC-API, and smart contracts to the BSC ecosystem. Instead of relying on the BSC security model, Endurance provides protocols and standards for integrating third-party bridges that the Endurance validator set of other projects can manage. In addition, it offers several programmable and configurable modules like networking, blockchain & EVM, Web3 API, transaction pool, PoA & PoS consensus, and storage & state, that developers can use or modify to reach their business goals.

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Endurance brings several programmable and configurable modules that developers can use or modify to reach their business goals.
Here is an example of such modules:

- Networking - for p2p communication between different Endurance nodes;
- Blockchain & EVM - for block producing and EVM transaction execution, of course, each Endurance can define its runtime execution environment based, for example, on WebAssembly;
- Web3 API - for essential compatibility with the Web3 ecosystem, including MetaMask and other applications;
- Transaction Pool - for managing internal Endurance policies for transaction filtering and for charging fees for the system operations;
- PoA & PoS Consensus - for users to be able to vote for the honest validators in the Endurance network and guarantee the safeness of actions applied on the chain;
- Storage & State - for persisting local data.

5.0 Circulation Model and Native Asset Bridge

The critical components of each Endurance application are the native token circulation model and cross-chain bridge for native assets. Native assets of the Endurance chain are located within the Endurance application and managed directly by the sidechain. Endurance is designed to provide cross-chain functionality for the native assets, which Endurance developers fully manage. However, we leave decisions on token supply manipulation or minting/burning tokens to the developers' discretion, as they bear the risk of damaging their reputation.
To ensure active validator sets and verify the correctness of cross-chain transactions, we require block header verification for the native cross-chain bridge. Although Endurance is a technology-agnostic solution not designed to have a BSC-compatible consensus or EVM execution environment, we offer basic functionality for Endurance applications to help them set up their work and be part of the ecosystem. We trust Endurance developers, but we must ensure validator transition integrity. Therefore, we introduce a block header verification function (BHVF) that the Endurance development team must specify. BHVF, written in Solidity, verifies block headers from Endurance applications and validator transitions, but it cannot prove the correctness of state transitions. BHVF is a required parameter to register Endurance in BSC's smart contract for native cross-chain functionality.
Block header verification is not complicated; we only need to verify block headers to ensure validator transition accuracy. We can use BLS/BN to publish only epoch blocks containing new validator sets and signatures from all previous validators without passing all block headers into it to achieve confirmation.

```
interface IProofVerificationFunction {
    function verifyValidatorTransition(bytes[] calldata proofs, uint256
chainId, address[] calldata existingValidatorSet) external view returns
(address[] memory newValidatorSet);
}
```

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If we assume that block verification consumes ~50k gas (w/ state modification), then we have the following calculations:

- Per block: 50k gas/block, then its ~16k gas/sec
- Per epoch: 50k gas/epoch (epoch can be from 5 minutes up to 1 day), then it's between ~160 gas/sec (for 5 min epoch) and 0.57 gas/sec (for one-day epoch)

Of course, the gas consumption for cross-chain operations will depend on the epoch length, but Endurance doesn't need very short epochs. We recommend using an epoch length of one day for validator transition, which can be reduced to 6-12 hours based on the application's needs without significantly changing gas consumption.

Our native asset bridge supports the following user flows:
Deposit (Endurance -> BSC): When a user calls the deposit function, their native tokens will be locked in the smart contract, and an event will be emitted. The user must then generate proof containing information about the transaction receipt (including the emitted events) with a Merkle Patricia trie proof to mint peg tokens in the BSC chain. This proof should be uploaded into the BSC chain, where the EnduranceValidatorHub smart contract can verify it and validate the signatures from the Endurance chain.
Withdrawal (BSC -> Endurance): The withdrawal of funds is the opposite of the deposit flow. The user must burn their pegged tokens in the BSC chain to use this proof to withdraw tokens from the native asset bridge smart contracts. Validators in the Endurance network will verify the correctness of this operation and prevent double-spend attacks.

Endurance developers can specify fees for cross-chain operations between the Endurance and BSC chains, and these fees or fine-related mechanisms should be specified in the Endurance smart contract rather than the BSC smart contracts or block verification functions.

5.1 Endurance Validator Hub

Endurance provides native asset cross-chain functionality to BAS applications by default. In order to register with Endurance, each application must specify the block header verification function (BHVF) and is assigned a chain ID by the Endurance smart contract. BHVF verifies block headers without state transitions and must be written in Solidity to check the block header, the correctness of the chain for N blocks, and signatures. Endurance supports default chain implementation with the Endurance Validator Hub. Still, other developers can write their own verification function, provided that they pass code auditing to be trusted by the community and avoid malicious functions or vulnerabilities.
The system contract address of the Endurance Validator Hub smart contract:
0x0000000000000000000000000000000000007000

5.2 Fast-finality and BLS cryptography

Parlia is a BFT-like consensus where only one Validator produces a block. To ensure the correctness of this operation, we must wait for the confirmation time, which is usually 2/3*N+1, where N is the number of active validators (15 blocks for the current configuration).

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We must upload at least 15 blocks to the blockchain to prove one block. BLS cryptography with Parlia's fast finality can solve this problem because we can collect one aggregated signature and send only this signature to BSC. However, we need to know the BLS public keys of each Validator. Currently, BLS cryptography is merged into the official geth repository, but BSC does not yet support it. Applying these changes to the Parlia consensus engine may take some time. Additionally, it is not strictly required to use BLS; geth has support for the BN256 curve since the Byzantium fork, which can be used as a replacement for BLS aggregated signatures.

Here are some possible solutions:

- Break compatibility with Parlia and implement fast finality in the Endurance version of Parlia using the BN256 curve.
- Wait for BSC's version of fast-finality and BLS support.
- Given the many moving parts involved, consider fast finality as an optional solution for Endurance.

5.3 System Smart Contracts

Each Endurance sidechain is also technology-agnostic, allowing developers to modify or include any module within Endurance and use any consensus or runtime execution environment. By default, Endurance provides an EVM execution environment with a set of system smart contracts for platform operation. However, developers want to add more functionality to their sidechain. In that case, they can implement it themselves or contribute it to the official Endurance template to extend the default module set with additional extensions that other developers can utilize in the future.

Predefined BSC-compatible system smart contracts:

- Staking (0x0000000000000000000000000000000000001000) - for managing validator delegations and active validator set
- SlashingIndicator (0x0000000000000000000000000000000000001001) - for slashing not active validators
- SystemReward (0x0000000000000000000000000000000000001002) - treasury for the system rewards to cover relay fees and others

Endurance-defined smart contracts:

- StakingPool (0x0000000000000000000000000000000000007001) - a staking pool that helps to aggregate stakes and optimize gas consumption for the reward calculation
- Governance (0x0000000000000000000000000000000000007002) - default on-chain implementation by Compund's Alpha governance
- ChainConfig (0x0000000000000000000000000000000000007003) - configuration for the consensus that is managed by on-chain governance
- RuntimeUpgrade (0x0000000000000000000000000000000000007004) - smart contract for managing runtime upgrades in the chain
- DeployProxy (0x0000000000000000000000000000000000007005) - a proxy for managing ACLs for deploying and doing calls (under development, address is reserved for future needs)

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To incentivize users to stake their funds and vote for honest validators, Endurance also supports the Parlia consensus engine. This makes Endurance sidechains more decentralized and trustworthy while allowing stakers to earn rewards from their stakes by receiving fees from block producers. To interact with the Parlia consensus engine, Endurance supports a staking contract that is compatible with the following interface:

```
interface IValidatorSet {
  function init() external;
  function getValidators() external view returns (address[] memory);
  function deposit(address validator) external payable;
  receive() external payable;
}
interface ISlashingIndicator {
  function init() external;
  function slash(address validator) external;
}
interface ISystemReward {
  function init() external;
  receive() external payable;
}
```

Endurance provides a default implementation and financial model for staking that is embedded in the Genesis block as a system smart contract. However, Endurance developers can also choose to implement a different staking model based on their specific business requirements. This flexibility allows for customization and optimization of staking mechanisms to best suit the needs of each project using the Endurance framework.

5.4 Staking Smart Contract

The default implementation of Endurance includes staking smart contracts written in Solidity for the EVM execution environment. This smart contract extends the IValidatorSet interface and enables users to manage active validators based on the total delegated amount and distribute rewards between stakeholders. While it's not strictly necessary to have an EVM implementation of such smart contracts, it can benefit default Endurance solutions. It's worth noting that the specific ABI methods for these smart contracts are implementation-defined and can be customized by Endurance developers to meet their particular requirements.

5.5 PoSA Consensus

The consensus algorithm is a crucial component of any blockchain network as it enables decentralized nodes to agree on the validity of transactions without relying on central authorities. Endurance, being a public blockchain, also relies on a consensus algorithm to verify the validity of transactions and ensure the protocol rules are followed. Therefore, it is designed to process a high volume of transactions, with a target of 10,000 transactions per second, and pursue immediate transaction finality. Endurance aims to achieve this by

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implementing a fast block creation time of 2 seconds and allowing more than 20 consensus nodes to participate in the consensus.

Proof of Staked Authority (PoSA):
Endurance uses a hybrid consensus algorithm called PoSA, which combines the Proof of Staking (PoS) and Proof of Authority (PoA) mechanisms. PoSA allows only authorized validators to generate blocks, and validators must stake a certain amount of Endurance's native token ACE to participate in the consensus. The ranking of validator candidates is determined by the number of ACE tokens deposited, and the top validator candidates (Candidate Validators) are elected as Active Validators. The governance process determines the number of Active Validators, and delegators can delegate their ACE tokens to validators or candidates to receive block rewards.

Validators and delegates on Endurance are subject to slashing penalties for bad behavior, such as double signing and node instability. To ensure that validators cannot misuse their power, Endurance has an unbonding period for validators and delegates to prepare for possible misbehavior. The PoSA consensus algorithm of Endurance ensures faster block generation and lower costs while maintaining decentralization and community engagement.

5.6 Gas Fee

Network activity and market decisions influence transaction fees on the Endurance blockchain. As a result, excessive fees can hinder usability, while low fees may cause security concerns. To address this, Endurance introduces the Elastic Fee, which allows for flexible application of transaction fees based on external factors.

The Elastic Fee system lowers barriers to entry by providing different and flexible fees, enabling flexible responses to various situations that may arise. Particular transactions, which are essential for using Endurance services, do not incur a fee for users; instead, the system pays the fee. Different fees will be charged for all other user transactions based on the membership provided. Smart contracts ensure the execution of these different fees is transparent and secure.

Endurance will establish a standard fee policy under Endurance governance, which will be applied flexibly through the Elastic Fee policy. This will ensure that fees are aligned with appropriate levels, promoting usability and addressing security issues.

5.7 Runtime Upgrade

The Endurance blockchain allows easy upgrades without requiring a hard fork, meaning all nodes do not need to upgrade their client modules simultaneously. In case of functional improvements or security changes, upgrades can be made through the System Genesis Contract. However, proposals and votes are required through an on-chain governance process before any enhancements can be implemented, which can only be done by selected validators.

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5.8 Validator Selection

As mentioned above, to become a validator on the Endurance chain, a certain amount of $ACE is required for staking, and the selection of an active validator is determined in the following order:

Candidate Validator: To become a validator candidate, a certain amount of $ACE coins must be deposited as collateral.

Voting Period: Active Validators submit proposals to add new validator candidates to the Validator Hub. Active Validator Operators can vote for, against, and abstain during the voting period. When a proposal reaches a quorum or a minimum threshold defined by the protocol, it is passed on to the next stage.

Authorized Validator: When multiple Active Validators accept a proposal, the Proposed Validator immediately becomes an Authorized Validator.

Active Validator: At the next epoch, the consensus engine selects a top Authorized Validator as the Active Validator to propose blocks and secure the network. Only Active Validators can participate in voting, proposals, and block creation. The number of Active Validators can be regulated by governance, and the staking quantity of $ACE selects Active Validators.

5.7 Governance

Each Endurance sidechain should have an on-chain governance mechanism that allows users to vote for new proposals. This governance system is designed to provide Endurance users with a voice in the decision-making process and ensure that the network evolves in a decentralized and community-driven manner.

The governance system in Endurance is based on the Compound's alpha governance, and validator owners in the chain have the ability to create and vote for new proposals. The voting power is distributed based on the total delegated amount to the Validator. Once ⅔ of the quorum is reached and >51% of votes are for the proposal, it can be executed by anyone on the chain.

The Endurance governance system is able to manage staking parameters like felony threshold or jail period to ensure the network's security and stability. Through this mechanism, Endurance aims to promote transparency, accountability, and community participation in the governance of the network.

6. Tokenomics

$ACE total supply is 147 millions, it is used as the native asset on the Endurance blockchain, and is used by network users to pay for nodes that process the requested operation.

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- Gas Fee
- Digital Asset Purchase (NFT Marketplace) and Service Fees
- Token for all apps independently developed by the Team
- Used for staking in Endurance validator nodes

Description	Allocation	Amount	TGE	LOCKUP (Mth)	VEST (Mth）
Team	15.00%	22,050,000	0%	12	36
Early Equity Investor	2.30%	3,381,000	100%	0	0
Eco-Fund	11.60%	17,052,000	20%	-	36
Incentive Pool	26.00%	38,220,000	20%	2	45
Initial Reward Pool	1.00%	1,470,000	100%	-	-
Treasury/Reserve	9.00%	13,230,000	20%	12	36
Strategic Investors	2.50%	3,675,000	20%	12	36
Marketing & Collaborators	3.50%	5,145,000	20%	-	16
Launch Pool	7.00%	10,290,000	100%	-	0
Nexus Bond Airdrop	3.40%	4,998,000	3.68%	0	24
Jump Start	1.00%	1,470,000	100%	-	0
Early Investors	17.70%	26,019,000	0%	12	36

6.0 Minting

The initial release of 1.47 million $ACE tokens, representing 1% of the total supply, will be available for the first 60 days after launch. Should these tokens be claimed(Engage to Earn) by users during this period, additional tokens may be made available from the <Reserved Reward Pool> to the <Initial Reward Pool>

6.1 Reward Distribution

To ensure that the Endurance network grows and the ecosystem remains sustainable, 15% of the $ACE token will be used for the Ecosystem Fund. The use of the Ecosystem Fund will be divided into two categories as follows:

● Establish a strong and sustainable ecosystem by incentivizing its most outstanding partners. This can be done by providing them with a certain percentage of ACE tokens or by offering a token swap between ACE and their upcoming tokens, creating a deep binding between the two projects. By doing so, Endurance can motivate its partners to improve their products and create valuable content for Endurance users, thus creating a stable and sustainable ecosystem. This approach will also foster collaboration and innovation within the community, developing new and exciting use cases for Endurance.

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● Used for marketing (Airdrop) to secure initial users using Endurance networks (game services, content services, NFTs, etc.)

6.2 Burning

Endurance aims to create a highly sustainable closed-loop ecosystem that enables the best developers to acquire WEB3 users while also allowing users to continuously gain substantial long-term rewards from the content created by these developers.
If Endurance's partners generate income in $ACE on the network, 20% to 40% of it will be burned every two weeks, determined by the project and track types.
For developers who generate $ACE revenue on the Endurance network, 100% will be burned every two weeks.
We aim to maintain a deflationary $ACE token to achieve long-term stability.

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7. Development Tools

7.0 Smart Contracts

Smart contracts development with Endurance enables you to build your smart contracts for any use, including cryptocurrency exchanges, smart contract-based dApps, and more. Smart contracts are programming logic that are executed automatically when a certain condition(s) are met. In Endurance, smart contracts can be written in Solidity programming language. Please refer to the official documentation of Solidity for any queries.

7.1 IDE

Multiple IDEs and libraries can be used for developing and deploying smart contracts.

- Remix IDE: A powerful open-source tool that helps you write Solidity contracts straight from the browser. It is written in JavaScript and supports both usages in the browser, but runs locally and in a desktop version. Remix IDE has modules for testing, debugging, deploying smart contracts, and much more.
- Intellij Solidity Plugin: Every aspect of IntelliJ IDEA has been designed to maximize developer productivity. Together, intelligent coding assistance and ergonomic design make development not only productive but also enjoyable.
- BSC Studio: Blockchain Labs building graphic IDE to expedite dApp development.
- Chainide: A Cloud-Based Multi-Chain IDE.

7.2 Development Framework

- Truffle: A world class development environment, testing framework and asset pipeline for blockchains using the Ethereum Virtual Machine.

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- Embark: Embark is a platform that enables easy development and deployment of decentralized applications.
- Waffle: The most advanced framework for testing smart contracts.
- OpenZeppelin: OpenZeppelin provides security products to build, automate, and operate decentralized applications. We also protect leading organizations by performing security audits on their systems and products.
- HardHat: Hardhat is a development environment for Ethereum software.

7.3 Solidity Code Quality

- Solhint: This is an open source project for linting Solidity code. This project provides both Security and Style Guide validations.
- Ethlint: Ethlint (Formerly Solium) analyzes your Solidity code for style & security issues and fixes them.
- Manticore: Manticore is a symbolic execution tool for analysis of smart contracts and binaries.
- Slither: Slither is a Solidity static analysis framework.
- Echidna: Echidna is a program designed for fuzzing/property-based testing of Ethereum smart contracts.

7.4 Front-End Programming

- Web3.js: Access full node capabilities without running your own.
- Ethers.js: Designed to make it easier to write client-side JavaScript based wallets, keeping the private key on the owner's machine at all times.

7.5 Back-End Programming

- Web3.py: A python interface for interacting with the Ethereum blockchain and ecosystem.
- Web3.php: A php interface for interacting with the Ethereum blockchain and ecosystem. Native ABI parsing and smart contract interactions.
- Java Web3: Lightweight Java and Android library for integration with Ethereum clients.
- Net Web3: Bringing the love of .NET to Ethereum. An open source .NET integration library for blockchain.
- Ruby Web3: Ethereum library for the Ruby language.

7.6 Wallet SDK

- Venly: Wallet creation by social accounts.
- Sequence.app: Wallet creation by social accounts.
- Web3Auth: Wallet creation by social accounts.
- BSC Connector: This example demonstrates how to support the Binance Chain Wallet through a custom connector.

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7.7 Multisig

- Gnosis: The purpose of multisig wallets is to increase security by requiring multiple parties to agree on transactions before execution.

JSON RPC Endpoints

Chain Name	Endurance Smart Chain Mainnet
Chain ID	648
Ticker	ACE
RPC Endpoint	https://rpc-endurance.fusionist.io/
Explorer	https://explorer-endurance.fusionist.io/

7.8 JSON-RPC API

The JSON-RPC API method of Endurance blockchain is fully compatible with Ethereum. Please refer to the link underneath for more details about the API Spec.
https://ethereum.org/en/developers/docs/apis/json-rpc/#json-rpc-methods

7.9 Decentralized storage

- BNB Greenfield: Core consists of a storage-oriented blockchain (BNB Greenfield) and a decentralized network of Storage Providers (SPs).
- IPFS: A peer-to-peer hypermedia protocol designed to preserve and grow humanity's knowledge by making the web upgradeable, resilient, and more open.
- Arweave: A decentralized on-chain data storage.
- Filecoin: Filecoin is making the web more secure and efficient with a decentralized data storage marketplace, protocol, and cryptocurrency.

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