GalaChain Decentralization White Paper

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1. Executive Summary

GalaChain, currently a layer one built on Hyperledger Fabric, an LF Decentralized Trust project, is continuing upon its transformative journey towards decentralization. This white

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paper outlines our comprehensive four-phase plan to evolve GalaChain into a robust, decentralized network that features the benefits of both centralized and decentralized systems.

Our decentralization roadmap encompasses:

1. GalaChain, built on Hyperledger Fabric, is strengthening its ties with the open-source foundation LF Decentralized Trust. Joining this community allows GalaChain to leverage tools, contribute gaming innovations, and enhance scalability, security, and interoperability, driving development and decentralization across industries.
2. Gala is developing decentralization features and contributing the migration plan of Raft consensus to Byzantine Fault Tolerance (BFT) consensus in Hyperledger Fabric networks.
3. Execution of the consensus migration plan on GalaChain.
4. Global distribution of peers and orderers
5. Integration with Gala Founder's Nodes
6. Implementation of GalaChain Improvement Proposals (GIPs)

This strategic evolution will enhance GalaChain's security, scalability and fault tolerance while preserving its high transaction throughput and flexibility that are hallmarks of our current system.

By the end of this process, GalaChain will offer:

- Improved fault tolerance and network resilience
- Decentralized governance and operation
- Acceptable high transaction throughput

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- Enhanced decentralized auditing and control mechanisms

This sets up GalaChain as a leading blockchain solution that doesn't compromise on speed or decentralization.

2. GalaChain Overview

2.1 Description and Key Features

GalaChain is a high-performance blockchain network built on Hyperledger Fabric, initially designed to support the GalaChain ecosystem, consisting of our 3 entertainment based businesses (Gala Games, Gala Film and Gala Music), as well as many external builders and broader blockchain applications. GalaChain is a powerful solution in this space, leveraging the robustness of enterprise blockchain technology while maintaining the flexibility required for gaming, entertainment and digital asset management.

Key features of GalaChain include:

- High transaction throughput
- Low latency finality
- Smart contract support
- Native token management
- Interoperability with other blockchain networks
- Strong governance mechanisms

Our decentralization initiative aims to enhance these features by distributing the chain's

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processing, support and governance across a wider network without sacrificing the performance and compliance that make GalaChain unique.

2.2 GalaChain Architecture is Based on Hyperledger Fabric

GalaChain's current architecture leverages the core components of Hyperledger Fabric:

1. **Peers:** Maintain the ledger and execute smart contracts (chaincode)
2. **Orderers:** Manage the ordering and distribution of transactions
3. **Certificate Authorities (CAs)**: Handle identity management and access control **4.** **Channels:** Provide data isolation and privacy

Galachain's key technical specifications are:

- Consensus Mechanism: Raft-based ordering service
- Smart Contract Language: typescript
- Network Topology: Star topology with centralized orderers
- Transaction Throughput: Currently capable of thousands of TPS

In conjunction with the Hyperledger Fabric core, GalaChain's ecosystem is also supported by the Gala Founder's Node network, consisting of 40k+ nodes.

3. Moving Along the Path to Decentralization

3.1 Raising the Bar with Decentralization

While GalaChain's current architecture has served well so far, we're ready to move forward with the next steps of our decentralization plan with the following goals:

1. **Enhanced Security:** Decentralization mitigates single points of failure and reduces

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the risk of targeted attacks.

2. **Improved Fault Tolerance:** A globally distributed network can continue to operate even if multiple nodes or an entire region experiences outages.
3. **Enhancement of the Network's Trustless Nature:** Distributed authority is a key blockchain principle.
4. **Empowerment of the Community:** Decentralization allows for broader participation in network governance and operation, aligning with blockchain ethos.
5. **Improved Scalability:** A decentralized architecture can more easily scale to meet growing demand by leveraging globally distributed resources.

Importantly, our decentralization strategy is designed to achieve these benefits without compromising on the high performance and useful features that GalaChain currently offers.

3.2 Performance Considerations: Maintaining Performance During Decentralization

GalaChain's decentralization process is meticulously designed to preserve the high-performance characteristics of Hyperledger Fabric while enhancing the network's resilience and trustlessness. Our approach ensures that the transition to a more decentralized architecture does not significantly impact transaction throughput or latency.

Key performance considerations:

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1. **Optimized Consensus Mechanism:** The migration from Raft to Byzantine Fault Tolerance (BFT) is carefully engineered to maintain acceptable transaction throughput.
2. **Scalable Network Design:** Advanced networking protocols and optimized data replication strategies minimize latency across geographically dispersed nodes.
3. **Hardware Acceleration:** Continued use of hardware acceleration for cryptographic operations ensures that increased security measures don't bottleneck transaction processing.
4. **Efficient State Database:** Optimized database configurations ensure rapid state queries and updates, critical for maintaining acceptable TPS in a decentralized environment.

We project that the migration will maintain GalaChain's 1500 TPS (per Certik) throughput without significant performance degradation or impact on end-user experience. When coupled with the multiple channel feature of Hyperledger Fabric, this indicates that GalaChain is capable of scaling from very high to ultra-high throughput levels.

3.3 Enhancing Global Operational Standards Through Decentralization

GalaChain's decentralization process is designed to enhance global operational standards. Key features include:

1. **Permissioned Network with Enhanced Decentralization:** Supports controlled

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access while distributing governance and decision-making across a wider network of participants.

2. **Immutable Audit Trails:** Provides stronger guarantees of immutability for audit trails.
3. **Smart Contract Governance:** Allows for community-driven updates to smart contracts, ensuring swift implementation of regulatory requirements.
4. **Flexible Privacy Controls:** Maintains advanced operational privacy features for customizable data visibility, ensuring sensitive information is shared only with authorized parties.
5. **Real-time Monitoring:** Enhances capabilities for faster detection and response to potential issues associated with network performance, transaction validation, and security vulnerabilities.

4. Decentralization Roadmap

4.1 Phase 1: Consensus Migration from Raft to Byzantine Fault Tolerance (BFT)

Objective: Transition from the Raft consensus mechanism to a more decentralized and fault-tolerant BFT algorithm.

Steps:

1. **BFT Algorithm Selection:** Leverage BFT-based algorithms such as SmartBFTt from Hyperledger Fabric initially based on security, and scalability requirements.

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- Customize the chosen BFT algorithm to optimize it for GalaChain's specific use case and network topology.

2. **Performance Optimization:** Confirm the new consensus mechanism maintains acceptable throughput and low latency.
    - Message Aggregation: Implement message aggregation techniques to reduce communication overhead and improve efficiency.
    - Parallel Processing: Enable parallel processing of transactions to maximize throughput.

3. **Security Analysis:** Conduct rigorous testing to confirm the BFT implementation maintains best-in-class security procedures against various attack vectors.
    - Formal Verification: Use formal verification methods to mathematically confirm the correctness and security of the BFT protocol.
    - Penetration Testing: Perform extensive penetration testing to identify and mitigate potential vulnerabilities.

4.2 Phase 2: Global Distribution of Peers and Orderers

Objective: Geographically distribute the network components to enhance decentralization, fault tolerance, and acceptable performance.

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Steps:

1. **Node Distribution Strategy:** Develop a plan for optimal global node placement.
    - Geographic Analysis: Conduct a geographic analysis to identify strategic locations for node deployment, considering factors such as latency, regulatory environment, and infrastructure reliability.
    - Partnerships: Establish partnerships with data centers and cloud providers in different regions to facilitate node deployment.
2. **Network Latency Mitigation:** Implement strategies to minimize latency in the distributed network.
    - Optimized Routing Protocols: Use optimized routing protocols to ensure efficient data transmission between nodes.
3. **Data Replication and Consistency:** Ensure data remains consistent across the globally distributed nodes.
    - Consensus Mechanisms: Use consensus mechanisms to ensure all nodes agree on the state of the blockchain.
    - Conflict Resolution: Implement conflict resolution strategies to handle data inconsistencies and ensure eventual consistency.

4.3 Phase 3: Integration with Gala Founder's Nodes

Objective: Leverage the existing network of Gala Founder's Nodes to enhance

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decentralization, fault tolerance, and community engagement.

Steps:

1. **Node Software Deployment:** Distribute a customized node software package to Founder's Node operators, enabling them to run GalaChain nodes with minimal setup.
    - Automated Deployment Tools: Utilize containerization (e.g., Docker) and orchestration tools (e.g., Kubernetes) to simplify deployment and management.
    - Compatibility Testing: Conduct extensive compatibility testing to ensure the node software operates smoothly across diverse hardware and network environments.
2. **Consensus Participation:** Enable Founder's Nodes to participate in the BFT consensus process.
    - Dynamic Validator Set: Implement a dynamic validator set mechanism, allowing Founder's Nodes to join and leave the consensus group based on predefined criteria (e.g., performance, uptime).
3. **Data Synchronization:** Ensure Founder's Nodes have access to the latest blockchain state and data.
    - Efficient Data Propagation: Implement efficient data propagation protocols to minimize bandwidth usage and ensure timely data synchronization.
    - State Snapshot Distribution: Provide periodic state snapshots to facilitate rapid node synchronization and recovery.

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4. **Incentive Structure:** Create a reward mechanism that incentivizes Founder's Node operators to support GalaChain operations, ensuring network stability and growth. Ideas under consideration:

    - Token Rewards: Distribute native GalaChain tokens to Founder's Node operators based on their contributions to network operations (e.g., consensus participation, transaction validation).
    - Performance-based Rewards: Implement a performance-based reward system that adjusts payouts based on node uptime, transaction throughput and consensus participation.
    - Reputation System: Develop a reputation system that tracks the performance and reliability of Founder's Nodes, offering additional incentives (e.g., bonus tokens, governance privileges) to high-reputation nodes.

5. **Performance and Security Measures:** Implement safeguards to maintain network integrity and performance with the inclusion of Founder's Nodes.

    - Security Hardening: Enhance the security of Founder's Nodes to protect against potential threats and attacks, including secure boot mechanisms, regular firmware updates, and intrusion detection systems.
    - Collateral Mechanism: Implement a collateral or “deposit” system as a requirement for Founder's Nodes to run critical chain processes.
    - Load Balancing and Redundancy: Implement load balancing and redundancy measures to optimize network performance and reliability, including geographic load balancing and redundant communication links.
    - Monitoring and Analytics: Develop a comprehensive monitoring and

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analytics platform to track network performance and identify potential issues, providing real-time dashboards and predictive analytics for proactive network management.

4.4 Phase 4: GalaChain Improvement Proposal (GIP) Implementation

Objective: Establish a decentralized governance framework that enables community-driven development and decision-making.

Steps:

1. **GIP Structure and Workflow:** Define the format and process for submitting, reviewing, and approving proposals.
    - Proposal Submission: Develop a standardized template for GIP submissions, detailing the problem, proposed solution, and implementation plan.
    - Review Process: Establish a multi-tiered review process involving technical committees and community feedback.
    - Voting Mechanism: Implement a secure, on-chain voting system where stakeholders can vote on GIPs. Utilize smart contracts to automate the voting process and ensure transparency.

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5. Economic Model and Incentives

This section is still being worked on. When complete it will describe the economic framework supporting the decentralized GalaChain including:

1. **Token Economics:** Outlining the role and distribution of native tokens in the ecosystem.
2. **Node Operator Incentives:** Detailing the reward structure for maintaining network infrastructure.
3. **Developer Incentives:** Encouraging continued development and innovation on the platform.

6. Conclusion

The decentralization of GalaChain represents a significant evolution in our blockchain infrastructure. By carefully balancing the benefits of decentralization with the need for high performance, we are creating a unique blockchain solution. This initiative will position GalaChain at the forefront of enterprise blockchain technology, offering a decentralized, high-performance platform for a wide range of applications.

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