Contents

The Fabric Protocol

Decentralized Construction of ROBO, a Safe, Superhuman Robot

fabric.foundation & CryptoEconLab

Version 1.0
December 2025

Abstract

The Fabric Protocol proposes a decentralized way to build, govern, and evolve `$ROBO` , a general-purpose robot. Unlike other AI and robotics efforts, Fabric is designed from the ground up to balance performance with durable machine⇔human alignment. Instead of closed datasets and opaque control, Fabric coordinates computation, ownership, and oversight through immutable public ledgers, allowing humans to contribute and be rewarded. `$ROBO` will use a modern AI-first cognition stack, composed of dozens of function-specific modules. Specific skills can be added and removed via "skill chips", equivalent to apps available on the Apple store or Google Play. Contributors who help train, secure, and improve the system earn ownership through the protocol, while users pay to access its capabilities, creating an economic cycle. Fabric turns robotics into a shared public infrastructure, where intelligence and skills are open, accountable, and collectively owned.

1 Introduction

AIs such as Grok-4 Heavy are reaching scores > 0.5 on Humanity's Last Exam, created earlier in 2025 to be the final closed-ended academic benchmark for non-biological computers. In 10 months, performance has jumped 5 fold, from barely 0.1. This capability jump directly impacts both the digital and physical world. Large language models (LLMs) can now control robots through open-source code, allowing digital zeros and ones to explore and alter the physical world. A future in which we all work and live with increasingly smart and capable machines is rapidly coming into focus.

How will humanity navigate this future? Who will control this technology? How can we trust these machines? Blockchains are immutable and enable decentralized coordination, suggesting a way forward. Considering recent advances in AI, it is fortunate that millions of people, all around the world, have spent the last 18 years advancing decentralized ledgers. In 2008, Bitcoin solved decentralized event ordering and immutability. In 2013, the Ethereum authors described a decentralized Turing-complete computer that allows anyone to create digital contracts. The combination of immutability, public visibility, global reach, and ease of creating complementary economic systems, is precisely what is needed to coordinate humans with machines. Blockchains might ultimately serve as the fundamental human⇔machine alignment layer. We call this system Fabric.

2 Fabric

Fabric is a global, open network to build, govern, own, and evolve general purpose robots. The protocol coordinates data, computation, and oversight through public ledgers, allowing anyone to contribute and be rewarded.

2.1 Call to Action

There is an obvious opportunity and problem with AI and robotics. As robots become more capable, more and more digital and physical jobs can be automated. Local restrictions may temporarily slow these trends, but every parent wants their children to get to school safely, be treated by the best doctors, and be taught by the best teachers.

Increasingly, robots will be the "best" option in terms of cost, safety, and performance. Since Waymos (robotic taxis) have 8-fold fewer accidents and most of the remaining accidents are caused by distracted human drivers colliding with Waymos, presumably most parents will soon prefer the demonstrably safer choice (Waymos) over dangerous human-piloted cars. However, for the past 100 years, taxi driving has served as the first step towards the American dream, allowing humans with basic skills (a valid drivers license) to earn a regular income and feed their children. Aside from displacing traditional human jobs, digital and physical automation brings the risk of enormous concentration of power and wealth, possibly in the hands of one company or even one single human. Global systems to maximize benefits to everyone and mitigate risks are urgently needed.

2.2 Special Robot Capabilities: Instantaneous Skill Sharing

Humans acquire and improve skills one by one, with some studies suggesting that 10,000 or more hours of deliberate practice and personalized instruction are needed for expert performance. Similar considerations apply across disciplines from electricians and doctors to cooks and lawyers. The time and cost of becoming an expert means that many professions are currently limited by acute shortages of skilled humans. Machines, however, can share skills at the speed of light. These considerations apply to all industries, from call center workers in the Philippines to taxi drivers in LA, cardiologists in Singapore, and HAVC technicians in Oklahoma.

2.2.1 Numerical example: Electrician Robots

Consider a specific example, electricians in California. A unionized human journeymen in LA earns a base wage of $63.50/hour and it takes 4 to 5 years of training (8,000-10,000 hours) to reach that level of proficiency. By contrast, once a robot has become familiar with local laws, including the California Electrical Code, and has acquired the needed physical dexterity, this robot could then share that skill with 100 (or 100,000) other robots. Assuming all those robots work at (or beyond) the skill level of even the most capable human electrician, all electrical work in the state of California could be performed by about 23,000 electrician robots, each costing between $3 to $12/hour to operate. Benefits might include uniformly high work quality, reduced cost, consistent code compliance (and immutable real time documentation of code compliance), and protecting human electricians from 700 work injuries/fatalities annually. Risks include the loss of 73,000 well paid human jobs across the state, with associated loss of state and federal income taxes. One approach to mitigate job displacement is to use some of the profits to retrain affected workers, as recently argued by the CEO of the Kahn academy.

2.3 Risk of Winner Takes All

Once suitable hardware and software has been developed, economies of scale tend to favor a "winner takes all" scenario. To continue growing, a company or organization that controls a particular skill or system of robots, could incrementally add more skills to the same robots (e.g. plumbing or HVAC), branching into additional verticals. Conceivably, the first company (or country) to bring this technology to market could quickly control entire swaths of the global economy.

2.4 Towards Material Abundance

Can the benefits and risks of smart machines be addressed through economic mechanisms that interconnect skill contributors, affected workers, and the customers and beneficiaries of robots? Getting this right could help humanity attain an abundant future, where physical goods and services are affordable and widely available. There is no law of nature that dictates that a car costs $\frac{1}{3}$rd the annual income of a teacher or that some families must choose between life saving medications and food. Just as one example, consider an economic system in which people fractionally own robots and help to improve skill chips for these robots, which then perform useful work, which then supports personalized human education. Beyond generating income, this system could also bring transparency, safety, and resilience, by broadly engaging people around the world.

2.5 Architectural Inspiration

The architectural inspiration for Fabric comes from biological life. We humans use long chains of nucleic acids (DNA-based genomes) to store our blueprint. Small random changes to our genomes are the basis of evolution and give us a unique identity. The remarkable ease and speed with which robots can share and utilize data and skills makes it important to promptly develop roughly equivalent systems, except blueprints/identity will be based on digital chains rather than physical chains of nucleic acids. In this analogy, each robot will have a unique identity based on cryptographic primitives and publicly expose metadata relating to capabilities, interests, composition, and the rule-sets that govern its actions.

2.6 The Road Ahead

We propose to prototype and de-risk individual protocol functionalities through smart contracts deployed on existing EVM-compatible chains, such as Ethereum Mainnet and Coinbases Base L2. In parallel, work has begun to design a modern L1 focused on the special needs and capabilities of non-biological machines. Prototyping and long term development will both be community driven. The digital and physical designs will develop through involvement of all stakeholders; our role is to help start and then nurture a global ecosystem with particular goals - namely, durable alignment of humans with quickly-advancing robots. The Fabric protocol could help convene stakeholders, support them, and hold competitions to quantitatively evaluate progress towards `$ROBO` . Gaps will be addressed through bounties, hackathons, and grand challenges, similar to what worked in the mid 2000s to kickstart the development of autonomous cars, foster collaboration, and push the technology beyond initial expectations.

3 ROBO

3.1 Design for Alignment

Human understanding and the ability to transparently guardrail robot actions are important considerations when building advanced technology. Imagine if the US Constitution were stored as a Burrows-Wheeler Transform. This would certainly facilitate data transmission, but many people would probably prefer the current human readable version. Other considerations include resistance to malicious code or models. This means that composable modular stacks (e.g. Vision Language Models (VLMs) → LLM → action generation) might be favored over monolithic end-to-end AI or Vision Language Action models (VLAs), since arbitrary, potentially malicious behaviors can be more readily hidden inside them.

3.2 Roadmap to L1

`$ROBO` technical blueprints will be publicly developed through an open process. Interim technical reports summarizing progress should be expected on a regular cadence. We will proceed in three phases.

Phase 1 - Prototyping with off-the-shelf hardware. Cold-start data collection to improve models for social robots. Software stack focuses on human⇔machine alignment, high level decision making, and situational understanding of complex, dynamic environments. Where possible, reuse existing open source components (motion policies, foundation models, ASR, autonomy, payment rails, VLMs). Use existing blockchains for rapid prototyping.

Phase 2 - Ensure that all needed functionality (software and hardware) has one or more open source alternatives, making the stack resilient. Complete specification of Fabric L1; Fabric testnet. Revenue sharing from robot models begins to reward early skill contributors.

Phase 3 - Fabric L1 Mainnet. Sustainable operations through L1 gas fees; robot tasking; App store revenue. National and international regulatory bodies are valued partners and contributors to Fabric governance. A growing, healthy open source alternative to closed robot ecosystems has been born.

3.3 Technical Highlights

- Support multiple physical form factors (humanoid, wheeled bipedal, quadruped)
- Interface with many hardware platforms (K-Bot, LimX, DoBot, AGIBot, Unitree, and others) through drivers such as OM1 configuration files
- Use ERC-7777 and ERC-8004 and similar for identity, governance, and trust
- Skill chips and the App store - anyone can build and contribute - this assumes abstracting the hardware and low level software
- Related software for coordination - dVPNs for CycloneDDS and Zenoh
- Identity solutions via TEE or other hardware where possible
- Payment system / wallet built in - Coinbase and Circle - see for example OM1
- Teleops built in to allow humans to work across continents and remotely assist machines
- Support open source hardware teams and designs such as the K-Bot, an open-source humanoid robot designed by K-Scale Labs

The remainder of this document focuses primarily on the *economic* design of the Fabric protocol. As a global decentralized effort, we cannot impose specific digital architectures and technical robot designs. Successfully navigating a future in which humans work and live with highly capable robots is not a purely technical or scientific problem but will be based on how human society builds, harnesses, and deploys the technology.

The next section (4) gives a high level economic design. Section 5 formalizes the emission controller. Section 6 describes the demand mechanisms. Section 7 presents the graph-based reward system. Section 8 details the verification economics and penalty structure. Section **??** specifies the initial token distribution. Section 9 illustrates the operation of the protocol in real world examples, where software, robot hardware, and humans collaborate to invent, cure, teach, build, and provide. We discuss governance in Section 11 and finalize this document with some conclusions in Section 12.

4 Fabric Economic Design

Like all protocols, Fabric must address the "cold-start" problem, i.e., initially bootstrap supply-side participation while ensuring long-term economic sustainability. In addition, Fabric should ultimately incentivize (1) adaptations that boost efficiency and (2) gracefully accommodate continued cognitive and physical advances, suggesting a fundamentally evolutionary design. Among other limitations, traditional fixed-emission token models fail to adapt to network conditions, leading to either excessive dilution during low-utilization periods or insufficient incentives during high-growth phases. We introduce a three-component economic mechanism:

1. The *Adaptive Emission Engine*, which functions as an autonomous economic policy, adjusting token emissions in response to network capability and utilization as well as quality signals.
2. The *Structural Demand Sinks*, which create usage-driven token demand that scales with real economic activity.
3. The *Evolutionary Reward Layer*, a graph-based reward system that distributes rewards based on verifiable contribution, also alleviating the cold-start problem by smooth transition from activity-based to revenue-based incentives.

We now mathematically formalize each component and analyze incentive compatibility under adversarial conditions.

5 The Adaptive Emission Engine

The emission engine determines the total token supply available for distribution in each epoch. Its purpose is to use inflation strategically during network bootstrap, then taper emissions as network activity and associated fee revenue grow. The mechanism is a discrete-time feedback controller that responds to utilization and quality signals.

5.1 Controller Specification

Let E_t denote total emissions in epoch t. Define network utilization as

$$U_t = \frac{R_t}{C_t} \tag{1}$$

where R_t is total protocol revenue (USD) and C_t is aggregate robot capacity (USD-equivalent throughput). Let $Q_t \in [0,1]$ denote the mean service quality score, aggregated from validator attestations and user feedback.

The emission update rule is:

$$E_{t+1} = \text{clip}\Big(E_t \cdot (1 + \alpha(U^* - U_t)) \cdot (1 + \beta(Q_t - Q^*)),\ E_t(1-\delta),\ E_t(1+\delta)\Big) \tag{2}$$

where $\text{clip}(x, a, b) = \max(a, \min(x, b))$.

The parameters are:

- $U^* \in (0, 1)$: target utilization rate
- $Q^* \in (0, 1)$: target quality threshold
- $\alpha > 0$: utilization sensitivity coefficient
- $\beta > 0$: quality sensitivity coefficient
- $\delta \in (0, 1)$: maximum per-epoch adjustment (circuit breaker)

5.2 Equilibrium Analysis

At steady state, emissions stabilize when $U_t = U^*$ and $Q_t = Q^*$. The controller exhibits the following behavior:

Proposition 1. *Under the emission rule (2), if $U_t < U^*$ (underutilization), emissions increase to attract additional supply. If $U_t > U^*$, emissions decrease. Quality below threshold Q^* reduces emissions regardless of utilization, creating pressure to maintain service standards.*

The multiplicative structure ensures that quality and utilization interact: high utilization with poor quality still results in emission reduction. The circuit breaker δ bounds volatility, preventing rapid emission changes that could destabilize token markets.

5.3 Initial Calibration

We propose the following initial parameters:

Parameter	Value	Rationale
U^*	0.70	Reserve 30% capacity for growth and demand spikes
Q^*	0.95	Enforce high reliability standard
α	0.10	Moderate utilization response
β	0.20	Stronger quality response (quality is harder to recover)
δ	0.05	Maximum 5% emission change per epoch

5.4 Circulating Supply Dynamics

The emission controller governs the creation of new tokens, but the effective circulating supply depends on multiple flows: vesting releases, staking lockups, burns, and fee-driven buybacks. We now specify the complete supply model that governs token availability at any epoch t.

Let $T_0 = 10^{10}$ denote the fixed total supply. Define the following components:

Vested Supply. Let V_t denote cumulative tokens released from vesting schedules. For allocation category k with total allocation A_k, cliff period c_k, and linear vesting duration ℓ_k:

$$V_t = \sum_k A_k \cdot \begin{cases} 0 & t < c_k \\ \frac{t - c_k}{\ell_k} & c_k \leq t < c_k + \ell_k \\ 1 & t \geq c_k + \ell_k \end{cases} \tag{3}$$

Locked Supply. Let L_t denote tokens locked across protocol mechanisms:

$$L_t = L_t^{\text{bond}} + L_t^{\text{gov}} \tag{4}$$

where L_t^{bond} is aggregate work bonds, and L_t^{gov} is veROBO governance locks.

Burned Supply. Let B_t denote cumulative tokens burned from slashing events and protocol fees:

$$B_t = B_{t-1} + \sum_{i \in \mathcal{S}_t} \beta_i \cdot \text{Bond}_i \tag{5}$$

where $\mathcal{S}_t$ is the set of slashed operators in epoch t and $\beta_i \in \{0.05, 0.25\}$ is the burn fraction depending on violation type.

Buyback Pressure. Let Φ_t denote tokens acquired through the fee conversion mechanism. If R_t is protocol revenue and ϕ is the buyback fraction:

$$\Phi_t = \Phi_{t-1} + \phi \cdot R_t \cdot P_t^{-1} \tag{6}$$

where P_t is the market price. Bought tokens enter the Foundation Reserve for future distribution.

Master Circulating Supply. The effective circulating supply available in the market is:

$$S_t = V_t - L_t - B_t + \sum_{\tau=0}^{t} E_\tau - \Phi_t \tag{7}$$

This equation fully characterizes the token dynamics and enables simulation of supply trajectories under various adoption scenarios. The key insight is that S_t can contract even as emissions E_t continue, provided lock-up growth and burns exceed new issuance—a deflationary regime that emerges naturally as network utilization increases.

6 Utility

The Fabric network is a decentralized infrastructure for coordinating robotics and AI workloads across devices and services. It is built to operate as a neutral marketplace where participants exchange verifiable work, data, and compute. The networks economic mechanisms are designed to prioritize operational reliability and safety. `$ROBO` tokens do not confer ownership in any entity or asset, nor do they represent equity, debt, or any form of investment contract.

`$ROBO` is a utility token used exclusively to pay on-network fees and to post operational bonds. It initially launched as an ERC20 token on Ethereum mainnet to support a phased rollout and onchain interoperability. Over time, `$ROBO` may migrate to serve as the native coin of the Fabric Layer1 blockchain.[1]

6.1 Token Utility Overview

`$ROBO` serves six distinct operational functions within the Fabric network, each designed to align participant incentives with network health and create sustainable demand for the token:

1. Access and Work Bonds: Robot operators stake `$ROBO` as refundable performance bonds to register hardware and provide services. These bonds act as economic security deposits that deter fraud and ensure service quality. Bond requirements scale with declared capacity, creating token demand proportional to network throughput.

[1] **Disclaimer:** `$ROBO` does not represent equity, debt, a revenue share, or any right to profits or distributions from any entity. Holding `$ROBO` does not, by itself, entitle a holder to payments, dividends, interest, or ownership rights. The token is a utility instrument for network participation only.

2. Transaction Settlement: `$ROBO` is used to pay networknative fees for services such as data exchange, compute tasks, and API calls. For user convenience, offchain or stablevalue payments may be converted onchain into `$ROBO` to complete settlement. Quoted prices for services may be expressed in fiat terms for predictability; `$ROBO` is not backed by or redeemable for fiat or any other asset.

3. Delegation and Reputation: Token holders may delegate `$ROBO` to augment operator bonds, increasing their capacity to accept high-value tasks. Delegation serves as a market-based reputation signal and requires active operator selection. Delegators share in slash risk, aligning incentives while enabling capital-efficient scaling of network capacity.

4. Governance Signaling: Token holders may time-lock `$ROBO` to obtain voting weight on protocol parameters and improvement proposals. Longer lock periods confer greater voting power, rewarding long-term alignment. Governance rights are procedural and do not convey control over legal entities or treasury assets beyond protocol-specified rules.

5. Crowdsourced Ownership: The protocol enables a crowdsourced process for the genesis and activation of robot hardware through `$ROBO` -denominated participation units. Participants contribute tokens solely to access protocol functionality and coordinate network initialization. These units are used solely to coordinate participation, access protocol functionality, and support network initialization parameters related to robot deployment. Participation does not represent ownership of robot hardware, fractionalized interests, revenue rights, or economic claims, and `$ROBO` is not backed by, locked to, or redeemable against any underlying physical assets or productive capacity of the network. Participation in crowdsourced robot genesis does not constitute an investment of money, does not create any expectation of profit derived from the efforts of others, and does not satisfy the elements of an investment contract under the Howey Test or equivalent tests applied in other jurisdictions.

6. Token-Based Rewards: Token Based Rewards. Tokens may be distributed as protocol-level incentives designed to support network participation, usage, and operational efficiency. Any such distributions are discretionary, non-guaranteed, and contingent upon active participation and verified contribution to network operations. Such incentives do not represent any ownership interest, profit-sharing right, or expectation of financial return. These incentives are non-investment in nature, do not constitute consideration for an investment contract, and do not involve an expectation of profit derived from the efforts of others. Recipients must actively participate in network operations to receive any incentives.

These mechanisms create structural token demand that scales with network utilization, operator capacity, and governance participation. Unlike speculative token models, `$ROBO` utility derives directly from operational requirements of a functioning robotics network. The following subsections formalize each mechanism mathematically and analyze equilibrium properties.

Remark on Key Legal Characteristics *The token does not confer equity, debt, profit share, or ownership of any legal entity or physical asset. Furthermore, the token does not represent an investment contract or security under BVI law, U.S. federal securities laws, or the laws of any other jurisdiction. Holding tokens does not create any creditor relationship, partnership, joint venture, or agency relationship with any entity. In addition, the token has no par value, liquidation preference, or redemption rights.*

6.2 Utility 1: Access and Work Bonds (The Security Reservoir)

Registered robot operators post a refundable performance bond in $ROBO to register hardware and provide services. This bond acts as a **Security Reservoir**, serving as a barrier to Sybil attacks and ensuring participants are genuine stakeholders. The reservoir is denominated in a stable unit (e.g., $500 USD) and settled in $ROBO via an on-chain oracle to mitigate volatility.

Definition 1 (Reservoir Requirement Function)**.** *For operator $i \in \mathcal{O}$ with declared capacity K_i (USD-equivalent throughput per epoch), the required Base Bond (Reservoir) is:*

$$B_i = \kappa \cdot K_i \cdot P_t^{-1} \tag{8}$$

where $\kappa > 0$ is the bond-to-capacity ratio (a governance parameter denominated in epochs of revenue).

Definition 2 (Per-Task Stake Earmarking)**.** *When an operator is assigned a specific task j with an economic reward R_j, the protocol "earmarks" a portion of the existing reservoir as active collateral for that task:*

$$S_{i,j} = \sigma \cdot R_j \cdot P_t^{-1} \tag{9}$$

where σ is a scaling factor ensuring that potential penalties for fraud always exceed potential gains. This architecture allows for high-frequency operations by "borrowing" collateral from the base bond without requiring new staking transactions for every individual task.

Selection for tasks is weighted by both the total value in the reservoir and the duration it has been held (**Seniority**), with selection verified via on-chain Merkle proofs. The aggregate locked supply from work bonds remains:

$$L_t^{\text{bond}} = \sum_{i \in \mathcal{O}} B_i = \kappa \cdot C_t \cdot P_t^{-1} \tag{10}$$

where $C_t = \sum_{i \in \mathcal{O}} K_i$ is aggregate network capacity. This creates demand that scales linearly with productive capacity.

Proposition 2 (Bond Demand Elasticity)**.** *The token demand from the Security Reservoir exhibits unit price elasticity: as P_t doubles, the total token quantity demanded for base bonds halves, but the aggregate USD-equivalent value locked in the network remains constant at $\kappa \cdot C_t$.*

Remark 1. *The earmarking of per-task stakes ($S_{i,j}$) does not create additional token demand for active participants; rather, it increases the "utility density" of the existing reservoir by allowing the same locked capital to secure multiple high-frequency operations. Bonds are risk-management deposits that may be reduced (slashed) for protocol-defined misconduct (e.g., fraud, spam, downtime). Bonds do not pay interest or passive returns and exist solely to align operator behavior with network integrity.*

6.3 Utility 2: Transaction Settlement

$ROBO is the primary medium for network-native fees, including data exchange, compute tasks, and API calls. To minimize onboarding friction and provide predictability for service providers, the protocol allows tasks to be quoted in stablecoins (USD). However, all on-chain settlement is fundamentally executed in $ROBO . Off-chain or stable-value payments are converted to $ROBO via on-chain oracles to complete transactions.

As the network scales, $ROBO is designed to function as the core utility and settlement layer, analogous to Ethereum. In this architecture, the Fabric L1 provides the security foundation that can support specialized Layer 2 robot sub-networks on top, further driving demand for the native token as the fundamental unit of account.

Definition 3 (Fee Conversion Mechanism)**.** *Let R_t denote aggregate protocol revenue in epoch t. A fraction $\phi \in (0,1)$ of protocol revenue is used to acquire* `$ROBO` *on the open market, creating persistent buy pressure. The protocol executes market purchases totaling $\phi \cdot R_t$ USD, acquiring:*

$$\Delta\Phi_t = \frac{\phi \cdot R_t}{P_t + \eta(\phi R_t)} \tag{11}$$

tokens, where $\eta(\cdot)$ captures market impact (price increase from buy pressure). Purchased tokens enter the Foundation Reserve for protocol development, ecosystem grants, and operational expenses.

Under the simplifying assumption of negligible market impact ($\eta \approx 0$), the cumulative buyback satisfies:

$$\Phi_t = \sum_{\tau=0}^{t} \frac{\phi \cdot R_\tau}{P_\tau} \tag{12}$$

This creates persistent buy pressure converting economic activity into token demand. At steady state with constant utilization U^* and capacity C:

$$\mathbb{E}[\Delta\Phi] = \frac{\phi \cdot U^* \cdot C}{P} \tag{13}$$

Proposition 3 (Revenue-Demand Coupling)**.** *The fee conversion mechanism ensures that token demand grows monotonically with protocol revenue. If revenue doubles while price remains constant, buyback volume doubles.*

6.4 Utility 3: Device Delegation Bonds (StaketoContribute)

Token holders may allocate `$ROBO` to augment the operational bond of specific devices or device pools, increasing their task capacity and selection probability. This delegation mechanism serves three critical functions:

1. **Capacity Expansion:** Delegation allows operators to accept larger, higher-value tasks by temporarily increasing their available collateral beyond the base reservoir.
2. **Reputation Signaling:** Third-party delegators act as a market-based reputation system, with delegation flowing to operators with proven track records of reliable service.
3. **Sybil Resistance:** The capital requirement creates economic friction that makes it unprofitable to operate numerous low-quality devices.

Critical Limitations: This allocation does *not* convey legal or beneficial ownership in any device or entity, nor any entitlement to cash flows or profits. Delegation is a purely operational mechanism. Delegators assume slash riskif the operator commits fraud or fails to meet service standards, delegated tokens are subject to the same penalty structure as the operator's base bond.

Definition 4 (Delegation Reward Structure)**.** *Subject to protocol rules and successful task completion, delegators may receive usage credits that can be applied toward future network services or converted to small fee rebates. These credits are:*

- *Non-transferable (cannot be sold or assigned)*
- *Contingent on verified task completion (no rewards for failed or slashed operations)*
- *Proportional to delegation share and operator performance*
- *Subject to decay if unused within a specified window (e.g., 90 days)*

There is no promise of profit, token appreciation, or passive income from delegation. Rewards, if any, are modest operational rebates tied to network usage, not investment returns. The primary benefit is the ability to allocate capital strategically to increase service capacity where delegators anticipate future demand.

Remark 2. *Delegation differs fundamentally from staking in proof-of-stake blockchains. Unlike PoS validators who earn block rewards for consensus participation, Fabric delegators earn usage credits only when the operator they support completes verified work. The reward is contingent, small, and tied to active service provisionnot passive capital deployment.*

6.5 Utility 4: Governance Signaling (veROBO)

Holders may escrow `$ROBO` to obtain veROBO, which confers onchain voting and signaling rights on limited protocol parameters and improvement proposals. These rights are procedural and do not grant governance, management, or voting rights in any legal entity, nor any claim on treasury assets, revenues, or distributions.

Definition 5 (Vote-Escrow Function)**.** *A holder locking x tokens for duration $\tau \in [\tau_{\min}, \tau_{\max}]$ receives voting weight:*

$$w(x, \tau) = x \cdot f(\tau) \tag{14}$$

where $f : [\tau_{\min}, \tau_{\max}] \to [1, f_{\max}]$ is a monotonically increasing weight function. We propose:

$$f(\tau) = 1 + (f_{\max} - 1) \cdot \frac{\tau - \tau_{\min}}{\tau_{\max} - \tau_{\min}} \tag{15}$$

For holder h with lock (x_h, τ_h), define remaining lock time $\tau_h^{\text{rem}}(t)$ at epoch t. The aggregate governance-locked supply is:

$$L_t^{\text{gov}} = \sum_{h:\tau_h^{\text{rem}}(t)>0} x_h \tag{16}$$

The time-weighting creates opportunity cost for short-term holders while rewarding long-term alignment. Governance participation allows token holders to signal preferences on:

- Protocol parameter adjustments (e.g., target utilization U^*, emission sensitivity α, β)
- Quality threshold changes
- Verification and slashing rules
- Network upgrade proposals

Governance rights are limited to protocol operations and do not extend to control over any legal entity, treasury management beyond protocol-specified rules, or distribution of assets.

6.6 Utility 5: Crowdsourced Robot Genesis (Coordination Units)

The protocol implements a decentralized mechanism for coordinating the genesis and activation of robot hardware through participation units denominated in `$ROBO` . This mechanism serves exclusively to coordinate network initialization and does not create ownership interests, profit-sharing rights, or investment contracts.

6.6.1 Participation Unit Architecture

Let $\mathcal{R}$ denote the set of genesis robots to be deployed in the network initialization phase. For each robot $r \in \mathcal{R}$, the protocol defines a target coordination threshold $\Theta_r > 0$ denominated in `$ROBO` tokens. Participants may contribute tokens to a time-bounded coordination contract C_r with expiration time T_{exp}.

Definition 6 (Participation Unit)**.** *A participant p contributing x_p tokens to robot coordination contract C_r receives participation units:*

$$u_p(r) = x_p \cdot \phi(t_p) \tag{17}$$

where t_p is the contribution timestamp and $\phi : [0, T_{exp}] \to [1, \phi_{\max}]$ is a monotonically decreasing early-participation bonus function. We propose:

$$\phi(t) = 1 + (\phi_{\max} - 1) \cdot \left(1 - \frac{t}{T_{exp}}\right) \tag{18}$$

with $\phi_{\max} \in [1.2, 1.5]$ to reward early coordinators who bear greater uncertainty risk.

Definition 7 (Coordination Success Condition)**.** *Robot r activates if and only if the aggregate contributions satisfy:*

$$\sum_{p \in \mathcal{P}_r} x_p \geq \Theta_r \quad \text{and} \quad t_{current} \leq T_{exp} \tag{19}$$

where $\mathcal{P}_r$ is the set of participants who contributed to C_r. If the condition fails, all contributions are returned in full with no penalty.

The participation units serve three strictly operational functions within the protocol:

Priority Access Weighting. Participants with higher unit counts receive weighted priority for task allocation during the robot's initial operational phase. Let $U_p = \sum_{r \in \mathcal{R}} u_p(r)$ denote participant p's aggregate unit balance. When robot r broadcasts task availability during epochs $[0, T_{\text{priority}}]$, participant p's selection probability is:

$$\pi_p(r) = \frac{u_p(r)}{\sum_{q \in \mathcal{P}_r} u_q(r)} \cdot \mathbf{1}[p \text{ meets task requirements}], \tag{20}$$

with $\mathbf{1}(A)$ the indicator function that is equal to 1 if event A is true, and 0 otherwise. This mechanism coordinates early demand and ensures that participants who bore coordination risk receive operational utility. Critically, priority access does not guarantee task allocationselection remains conditional on meeting technical requirements and robot availability.

Network Parameter Initialization. The aggregate participation across all genesis robots determines initial network parameters. Define the total coordinated capital as:

$$\Xi = \sum_{r \in \mathcal{R}} \sum_{p \in \mathcal{P}_r} x_p \tag{21}$$

The protocol uses Ξ to calibrate initial emission rates and bonding requirements:

$$E_0 = \epsilon \cdot \Xi \cdot P_0^{-1} \tag{22}$$

$$\kappa_0 = \kappa_{\min} + (\kappa_{\max} - \kappa_{\min}) \cdot \left(1 - e^{-\Xi/\Xi_{\text{ref}}}\right) \tag{23}$$

where $\epsilon \in (0, 0.1)$ is the initial emission coefficient, P_0 is the genesis price, and Ξ_{ref} is a reference coordination level. This ensures that network parameters scale appropriately with demonstrated early demand.

Governance Weight Initialization. During the bootstrap period $[0, T_{\text{bootstrap}}]$, participation units may be converted to governance weight at a fixed exchange rate. For participant p with U_p units:

$$w_p^{\text{gov}} = \min\left(U_p \cdot \rho, w_{\max}\right) \tag{24}$$

where $\rho \in (0, 1)$ is the unit-to-weight conversion ratio and $w_{\max}$ prevents excessive concentration. This conversion is one-time and irreversible, burning the units in exchange for governance participation rights.

6.6.2 Non-Security Characterization

The participation unit mechanism provides only operational benefits that require active participant engagement. Units do not generate passive returns, dividends, or profit distributions. Any economic benefit derives exclusively from the participant's own usage of network services, not from entrepreneurial or managerial efforts of the protocol developers or robot operators.

Consider participant p with unit balance $U_p > 0$. The participant's economic outcome depends entirely on their own active choices: Priority access under equation (4) only provides value if p actively submits task requests and meets technical requirements, meaning that a passive holder receives no benefit. Converting units to governance weight requires an active decision to lock tokens and participate in voting, with governance rights producing no financial returns. Any cost savings from priority access accrue only when p actually uses robot services; the benefit is a usage discount for services consumed, not investment income.

The time-bounded coordination mechanism with full refunds on failure means participants bear operational risk (will this robot activate?) rather than investment risk (will this enterprise be profitable?). The risk is binary and resolved quickly, unlike ongoing investment risk tied to business performance. Each coordination contract C_r operates independently, meaning that success or failure of robot r does not affect participants in other contracts, establishing no common enterprise or pooled investment structure.

6.7 Utility 6: Token-Based Rewards (Proof-of-Contribution)

The protocol distributes token incentives to participants who provide verified contributions to network operations. These distributions are strictly contingent on active participation and do not constitute investment returns or profit-sharing arrangements.

6.7.1 Reward Eligibility and Distribution

Definition 8 (Verifiable Contribution Score). *In each epoch t, participant p accumulates a contribution score $\sigma_p(t)$ based on protocol-measurable activities:*

$$\sigma_p(t) = \sum_{k \in \mathcal{K}} w_k \cdot c_{p,k}(t) \tag{25}$$

where $\mathcal{K}$ is the set of contribution categories, $w_k > 0$ are governance-determined weights, and $c_{p,k}(t)$ is participant p's verified contribution in category k during epoch t.

Contribution categories include but are not limited to:

- **Task Completion** (k = task): Number of successfully completed robot tasks, weighted by complexity and verification status. This requires active operation of hardware and completion of work requests.
- **Data Provision** (k = data): Volume of verified training data contributed to skill development, measured in standardized data quality units.
- **Compute Provision** (k = compute): GPU-hours provided for model training or inference, with cryptographic attestation of completion.
- **Validation Work** (k = validate): Number of successful fraud challenges or quality attestations performed by validators.
- **Skill Development** (k = skill): Deployment and adoption metrics for contributed skill modules, measured by aggregate usage across the network.

Definition 9 (Epoch Reward Allocation)**.** *Let* E_t *denote total emissions for epoch* t *(from the Adaptive Emission Engine, Section 5). The reward pool* R_t *is:*

$$R_t = E_t - B_t \tag{26}$$

where B_t *represents tokens allocated to base protocol operations (validator compensation, treasury reserve). Participant* p *receives:*

$$r_p(t) = R_t \cdot \frac{\sigma_p(t)}{\sum_{q \in \mathcal{A}_t} \sigma_q(t)} \cdot \eta_p(t) \tag{27}$$

where $\mathcal{A}_t$ *is the set of active participants in epoch* t *and* $\eta_p(t) \in [0, 1]$ *is a quality multiplier based on validation outcomes and user feedback.*

6.7.2 Active Participation Requirements

The reward mechanism contains multiple safeguards ensuring that only active contributors receive distributions. For any participant p and epoch t, if $\sigma_p(t) = 0$, then $r_p(t) = 0$. Token holdings alone never generate rewardsonly verified work produces distributions.

Definition 10 (Contribution Decay)**.** *To prevent gaming through intermittent participation, contribution scores decay over time. For participant* p *who was last active in epoch* t_{last}*, the effective score in epoch* $t > t_{last}$ *is:*

$$\sigma_p^{\mathit{eff}}(t) = \sigma_p(t_{last}) \cdot e^{-\lambda(t - t_{last})} \tag{28}$$

where $\lambda > 0$ *is the decay rate (suggested value:* $\lambda = 0.1$ *for 10% daily decay). This ensures that only consistently active participants accumulate meaningful scores.*

Definition 11 (Minimum Activity Threshold)**.** *A participant* p *is eligible for rewards in epoch* t *only if:*

$$\sigma_p(t) \geq \sigma_{\min} \quad \text{and} \quad Days_{active}(p, t) \geq D_{\min} \tag{29}$$

where $\sigma_{\min}$ *is the minimum contribution score and* $D_{\min}$ *is the minimum number of active days within the epoch window. Suggested values:* $\sigma_{\min} = 0.01 \cdot \bar{\sigma}(t)$ *(1% of mean score) and* $D_{\min} = 15$ *days per 30-day epoch.*

6.7.3 Quality-Adjusted Distribution

The quality multiplier $\eta_p(t)$ adjusts rewards based on verified outcomes:

$$\eta_p(t) = \min\left(1, \frac{Q_p(t)}{Q^*}\right) \cdot (1 - \Phi_p(t)) \tag{30}$$

where $Q_p(t) \in [0, 1]$ is participant p's quality score aggregated from user feedback and validator attestations, $Q^* \in [0.85, 0.95]$ is the target quality threshold, and $\Phi_p(t) \in [0, 1]$ is the fraud penalty factor derived from challenge outcomes.

Definition 12 (Fraud Penalty Propagation)**.** *If participant* p *is found to have submitted fraudulent work in epoch* $t - k$ *for* $k \in [1, K_{memory}]$*, the penalty factor is:*

$$\Phi_p(t) = \sum_{k=1}^{K_{memory}} \phi_k \cdot \mathbb{1}[\mathit{fraud\ detected\ in\ } t - k] \tag{31}$$

where $\phi_k = 0.5 \cdot e^{-k/\tau}$ *with memory timescale* $\tau = 4$ *epochs. This creates persistent reputational consequences that extend beyond immediate slashing events.*

6.7.4 Distinction from Investment Returns

The reward mechanism is structured as direct compensation for verifiable work, distinguishing it from investment income. Consider two participants p and q with identical token holdings $x_p = x_q$. Under the reward formula (10), their distributions satisfy:

$$\frac{r_p(t)}{r_q(t)} = \frac{\sigma_p(t) \cdot \eta_p(t)}{\sigma_q(t) \cdot \eta_q(t)} \tag{32}$$

This ratio is completely independent of token holdings and depends only on verified work (σ) and quality (η). Token ownership per se generates no economic returnonly active, quality contribution does.

The contribution score $\sigma_p(t)$ aggregates only objective, cryptographically verifiable activities (task completions, data uploads, compute provision). The protocol cannot reward "potential future value" or "expected contributions"; only completed, verified work qualifies. The decay mechanism and minimum activity requirements ensure that participants cannot "front-load" work and then passively collect rewards. Continuous active participation is required to maintain eligibility.

This structure parallels piecework compensation or bounty payments, where individuals receive payment for specific completed tasks rather than returns on invested capital. A participant holding 1,000,000 tokens who performs zero work receives zero rewards, while a participant holding 100 tokens who completes significant verified contributions receives proportional compensation for that work.

6.7.5 Comparison with Proof-of-Stake Models

Traditional proof-of-stake networks often distribute rewards to passive token holders who delegate to validators. The Fabric reward mechanism differs fundamentally:

Characteristic	PoS Staking	Fabric Rewards
Passive eligibility	Yes (hold + delegate)	No (must contribute work)
Work requirement	No	Yes (verified tasks)
Quality dependence	No	Yes (η_p multiplier)
Activity threshold	None	$\sigma_{\min}$, $D_{\min}$
Decay without work	No	Yes (equation 11)
Reward source	Block validation	Completed services

This design intentionally departs from PoS models to ensure that every reward distribution traces directly to specific, verifiable work performed by the recipient in the immediately preceding epoch, rather than passive capital deployment.

6.7.6 Equilibrium Participation Dynamics

The reward mechanism creates a dynamic equilibrium where participation levels adjust to match network demand. Let $N^*(t)$ denote the equilibrium number of active participants in epoch t. At equilibrium, the marginal participant's expected reward equals their participation cost:

$$\mathbb{E}[r_{\text{marginal}}(t)] = R_t \cdot \frac{\bar{\sigma}}{N^*(t) \cdot \bar{\sigma}} \cdot \bar{\eta} = c_{\text{participation}} \tag{33}$$

where $\bar{\sigma}$ is the mean contribution score, $\bar{\eta}$ is the mean quality multiplier, and $c_{\text{participation}}$ is the economic cost of active participation (hardware, electricity, time).

Solving for equilibrium participation:

$$N^*(t) = \frac{R_t \cdot \bar{\eta}}{c_{\text{participation}}} \tag{34}$$

This equilibrium is self-stabilizing: if $N(t) < N^*(t)$, per-participant rewards rise above participation costs, attracting new entrants. As emissions E_t and reward pool R_t increase with network growth, equilibrium participation rises proportionally, enabling the network to absorb additional capacity without artificial supply constraints.

6.7.7 Sybil Resistance Through Work Requirements

The reward mechanism inherently resists Sybil attacks because contribution scores $\sigma_p(t)$ measure real work, not token holdings or identity creation. An adversary operating K fake identities receives aggregate rewards:

$$\sum_{k=1}^{K} r_k(t) = R_t \cdot \frac{\sum_{k=1}^{K} \sigma_k(t)}{\sum_{q \in \mathcal{A}_t} \sigma_q(t)} \cdot \bar{\eta} \tag{35}$$

Since each fake identity must perform real work to generate $\sigma_k > 0$, the adversary's total contribution is bounded by their actual resource capacity (hardware, compute, etc.). The attack gain is approximately zero:

$$\Delta_{\text{attack}} = \sum_{k=1}^{K} r_k(t) - K \cdot c_{\text{participation}} \approx 0 \tag{36}$$

because distributing work across K identities versus concentrating it in one provides no systematic advantagerewards scale with total verified work regardless of identity count. This work-based Sybil resistance distinguishes Fabric rewards from airdrop or "hold-to-earn" models, where creating multiple identities directly increases token capture without corresponding cost.

6.8 Aggregate Demand Model

Combining all mechanisms, the structural demand at epoch t (in USD terms) is:

$$D_t^{\text{struct}} = \underbrace{\kappa \cdot C_t}_{\text{work bonds}} + \underbrace{\phi \cdot R_t}_{\text{fee conversion}} + \underbrace{P_t \cdot L_t^{\text{gov}}}_{\text{governance}} \tag{37}$$

Note that delegation bonds are not included as a separate term because they augment existing work bonds rather than creating independent demand.

Proposition 4 (Demand Floor). *The structural mechanisms establish a price floor. If market price P_t falls below the level implied by aggregate structural demand divided by tokens required, arbitrage opportunities emerge: operators can acquire tokens cheaply to bond, and governance participants can lock tokens at discounted voting cost.*

6.9 Equilibrium Characterization

At equilibrium, speculative demand D^{spec} clears the market given structural demand:

$$P^* \cdot S^* = D^{\text{struct}}(P^*) + D^{\text{spec}}(P^*) \tag{38}$$

Define the *structural demand ratio*:

$$\sigma_t = \frac{D_t^{\text{struct}}}{P_t \cdot S_t} \tag{39}$$

A mature network targets $\sigma_t \in [0.6, 0.8]$, indicating that 60–80% of token value derives from structural utility rather than speculation. This ratio serves as a network health metric.

6.10 Suggested Initial Parameters

Parameter	Suggested Value	Rationale
κ	2.0 epochs	Bond covers ∼2 months potential fraud
σ	1.5	Per-task stake = 150% of task reward
ϕ	0.20	20% of revenue to buybacks
$\tau_{\min}$	30 days	Minimum governance commitment
$\tau_{\max}$	4 years	Maximum lock for full weight
$f_{\max}$	4.0	4× voting power at max lock

Final Disclaimer: The token does not confer equity, debt, profit share, or ownership of any legal entity or physical asset. All utility mechanisms are designed for operational purposes within the Fabric network and do not create investment contract rights.

7 The Evolutionary Layer

The reward distribution mechanism must solve the cold-start problem: early in the network's life, revenue may be sparse, making revenue-based rewards insufficient to attract operators. We address these requirements through a hybrid approach that blends activity and revenue signals, with weights that shift as the network matures.

7.1 The Transaction Graph

We model the network as a weighted bipartite graph $G = (P \cup B, E)$, where P is the set of producers (robots), B is the set of buyers (users), and E is the edge set representing transactions. Each edge $e = (p, b) \in E$ carries a weight w_e reflecting the economic relationship between producer p and buyer b.

For each robot $i \in P$, define the *Hybrid Graph Value*:

$$\text{HGV}_i = \sum_{j \in N(i)} [\lambda \cdot A_{ij} + (1 - \lambda) \cdot R_{ij}] \tag{40}$$

where $N(i)$ is the set of users who have transacted with robot i, A_{ij} is the verified activity score for transactions between i and j, R_{ij} is the revenue generated, and $\lambda \in [0, 1]$ is the activity weight.

7.2 Weight Transition

The parameter λ is a function of network maturity. During the bootstrap phase, set $\lambda = 1$ (pure activity weighting). As utilization U_t increases, the protocol reduces λ according to:

$$\lambda_{t+1} = \max(0,\ \lambda_t - \gamma \cdot \mathbf{1}[U_t > U^*]) \tag{41}$$

where $\gamma > 0$ is the transition rate and $\mathbf{1}[\cdot]$ is the indicator function. When $\lambda = 0$, the system operates in pure revenue mode.

This design has two virtues. First, it provides meaningful rewards to early participants before revenue materializes. Second, it defeats self-dealing attacks: an operator who creates fake users to perform fake tasks generates a disconnected subgraph with minimal graph centrality, yielding negligible HGV even under pure activity weighting. The foundation will determine the value of λ.

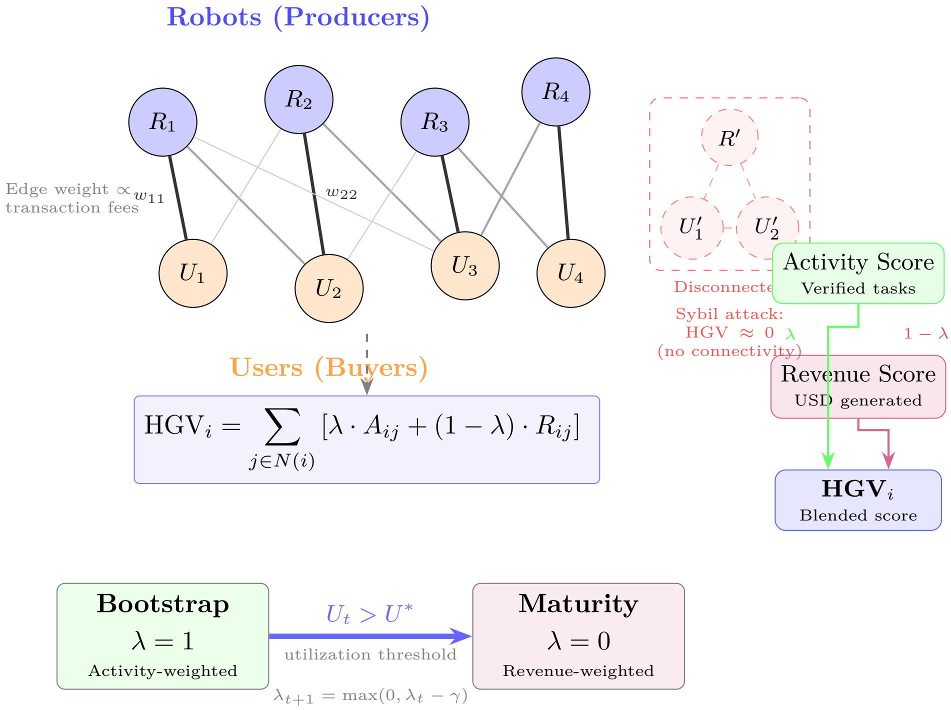

Figure 1: The Hybrid Graph Value (HGV) mechanism. *Top left:* The transaction graph is bipartite, connecting robots (producers) to users (buyers) via weighted edges representing cumulative fees. Edge thickness indicates transaction volume. *Top right:* A Sybil attacker creating fake users forms a disconnected "island graph" with near-zero eigenvector centrality, making the attack unprofitable. *Center:* The HGV formula blends activity and revenue scores via parameter λ. *Bottom:* As network utilization exceeds target U^*, the protocol shifts from activity-weighted rewards (bootstrap) to revenue-weighted rewards (maturity), ensuring incentive alignment across the network lifecycle.

7.3 Relation to Previous Work

The Hybrid Graph Value mechanism draws on two established approaches to graph-based incentive design in decentralized networks.

Eigenvector centrality methods. The Local Protocol introduced eigenvector centrality (EC) as a Sybil-resistant measure of participant contribution in general-purpose marketplaces. In their formulation, a participant's "graph value" is given by $G_u = W_u^{\bar{x}_u} \cdot x_u^{(1-\bar{x}_u)} \cdot r_u$, where W_u is cumulative transaction volume, x_u is eigenvector centrality, $\bar{x}_u$ is normalized EC, and r_u is a reputation score. The key insight is that the exponent structure $(\bar{x}_u, 1 - \bar{x}_u)$ shifts incentives from connectivity-building (low $\bar{x}_u$) to revenue generation (high $\bar{x}_u$) as participants mature. Our HGV formulation adopts this principle but simplifies the weighting to a linear blend with protocol-controlled parameter λ, enabling explicit governance over the transition schedule rather than relying on emergent dynamics.

Subnet consensus mechanisms. Bittensor's Yuma Consensus employs a similar structure where subnet validators score miners, and rewards flow proportionally to consensus-weighted performance. The network decomposes into specialized subnets, each with local incentive landscapes that compete for emission share based on demonstrated utility. Our sub-economy fitness function (Equation 43) generalizes this: subgraphs compete for parameter propagation rights based on measured economic performance, enabling the protocol to systematically identify and scale successful market structures.

The critical distinction in the machine context is the integration of *physical service verification*. Unlike purely digital networks, robot service provision admits partial observabilitytask completion can be attested but not cryptographically proven in general. The challenge-based verification system (Section 8) addresses this gap by making fraud economically less rational rather than technically impossible, following the Local Protocol's "unprofitable island graphs" principle: a malicious operator creating fake transactions generates a disconnected subgraph with near-zero centrality, yielding rewards below the cost of the attack.

7.4 Reward Distribution

Let E_t be total emissions for epoch t (from Section 5). Robot i receives:

$$r_i = E_t \cdot \frac{\mathrm{HGV}_i}{\sum_{k \in P} \mathrm{HGV}_k} \tag{42}$$

This is a proportional allocation rule. Robots with higher verified contribution (whether measured by activity or revenue) receive proportionally larger shares of the emission pool.

7.5 Sub-Economy Evolution

The graph structure naturally decomposes into subgraphs representing distinct market segments (by geography, task type, or operator). Define the fitness of subgraph S as:

$$F_S = w_1 \cdot R_S + w_2 \cdot \mathrm{HGV}_S - w_3 \cdot \Phi_S \tag{43}$$

where R_S is subgraph revenue, HGV_S is aggregate graph value, and Φ_S is a fraud score derived from challenge outcomes. The weights w_1, w_2, w_3 are governance parameters.

The protocol can identify high-fitness subgraphs and propagate their operational parameters (pricing models, quality thresholds, etc.) to the broader network, enabling systematic optimization of economic models.

8 Verification and Penalty Economics

Network integrity does not require universal verification of all tasks, which would be prohibitively expensive. Instead, we implement a challenge-based system where economic incentives ensure that fraud is unprofitable in expectation.

8.1 Validator Role

Validators are specialized participants who stake a high-value bond V_{bond} and perform two functions: routine monitoring (automated availability and quality checks) and dispute resolution (investigating challenges and ruling on fraud allegations).

Validator compensation has two components. A fixed share τ of protocol transaction fees provides stable income. Challenge bounties reward successful fraud detection: a validator who proves fraud receives a portion of the offending robot's slashed bond.

8.2 Slashing Conditions

Three conditions trigger penalties:

Proven Fraud. If a robot submits fraudulent work, a significant percentage (30% to 50%) of the earmarked task stake is slashed. Slashed funds are split between a "truth bounty" for the successful challenger and a protocol burn. The robot is suspended and must re-bond to resume operations.

Availability Failure. An automated check monitors robot uptime via on-chain heartbeats. If availability falls below 98% over a 30-day epoch, the robot forfeits all emission rewards for that epoch and its bond is slashed by 5% (burned).

Quality Degradation. If a robot's aggregated quality score falls below 85%, it is suspended from reward eligibility until the operator addresses the underlying issues.

8.3 Incentive Compatibility

Proposition 5. *Under the slashing parameters above, fraud is unprofitable if the expected value of fraudulent rewards is less than the expected penalty. For a robot with bond B and potential fraudulent gain g, fraud is deterred when:*

$$g < p \cdot (0.5B) \tag{44}$$

where p is the probability of detection. Setting bond requirements such that $B > 2g/p$ ensures deterrence.

The challenge mechanism further aligns incentives: challengers are rewarded only for successful challenges, preventing frivolous disputes, while the bounty ensures sufficient motivation to investigate genuine fraud.

9 Aspirations of the Fabric Protocol at Work

9.1 Global Robot Observatory: Humans Observing and Critiquing Machines

Enable and incentivize humans to give constructive feedback to machines, making them safe, useful, and trustworthy. Imagine if humans everywhere could observe and collectively evaluate robot actions. Conceptually similar approaches are already used by AI companies such as OpenAI and Tesla to allow humans to provide thumbs up/down feedback or leave voice notes for engineers when robots struggle with edge cases.

9.2 Robot Skill App Store

Modular robot software has the benefit of being (re)configurable through compact files that specify each piece and how data flow among those pieces. Modularity makes it possible for human developers to create skill chips such as math education or jujitsu, and then share those with others. These skill chips will be like the Apps that most people have on their cell phones, to add specific capabilities. When no longer needed, skill chips can be removed from the robot, stopping associated subscription fees (similar to canceling your Netflix subscription).

9.3 Non-Discriminatory Payment Systems

Humans understand why funds wire-transferred from California on a Friday afternoon take 72 hours to be credited to a New York recipient. For an AI or a robot, it is probably puzzling why clearly inefficient systems persist. Why indeed is the global speed of economic value transfers currently influenced by the Earth's rotation rate and the Roman emperor Augustus' definitions of the "work week" made 2000 years ago. On Fabric, humans, agents, and robots will be treated equally and will prioritize their attention and work with smart contracts and fast, irreversible settlement.

9.4 Development of Understandable and Capable Robots

Protocol revenue generated by robot services is used to support human developers to improve robot software and models, creating powerful open source alternatives to closed software.

9.5 Sharing Model Revenue with Humans who built the Models

If a guild of humans wishes to help robots acquire a new skill, then those robots should return a share of the revenue they earned to the humans that helped them. This is a modern form of the traditional business model of a University, in which human students (pre)pay to acquire skills (e.g. a law or medical degree) that might boost future income. Many students use loans to cover college tuition. In this analogy, robots could take out loans to incentivize humans to build models for them; payments would later flow to lenders and human skill creators.

9.6 Markets for Power, Skills, Data, and Compute

Robots will need electricity, real-time data, and compute. Humans that own H200 GPUs can make them available to robots, augmenting their thinking using Nvidia's confidential computing, as recently demonstrated in a collaboration between OpenMind and Near.ai. Humans with access to electricity can sell electricity to robots via automated self-charging stations, as recently demonstrated using USDC stablecoin in a collaboration between OpenMind and Circle. Robots and humans can safely share skills via One- and N-time models, under codevelopment by OpenMind and Nethermind, which use TEEs to impose limits on where and how many times specific skill models can be used.

9.7 Mining Immutable Ground Truth

Computers can now generate photorealistic but entirely fake videos of Albert Einstein juggling while on roller skates. A wave of increasingly sophisticated fake content and fake news will make it harder and harder for humans and robots to know what is true. What if teams of humans and machines could use Time Critical Social Mobilization to collect facts? Time Critical Social Mobilization uses a recursive incentive mechanism to rapidly mobilize a vast social network and reward not just the finder, but also the recruiters up the chain (inviter, inviter's inviter, etc.) with a portion of the truth bounty. We note there is a fundamental connection between prediction markets and establishing the ground truth needed to call outcomes.

9.8 Catalyzing the Availability of Safe Robots

Grownups know where children come from, but what is the equivalent mechanism for robots? Does the government provide them, or do businesses, communities, neighborhoods? Will every family own one and allow them to compete for jobs to help contribute to family income? On Fabric, communities might collaborate to build and deploy robots.

10 Fabric Roadmap

2026 Q1

- Deploy initial Fabric components to support robot identity, task settlement, and structured data collection in early deployments.
- Begin collecting real-world operational data from active robot usage.

2026 Q2

- Introduce contribution-based incentives tied to verified task execution and data submission.
- Expand data collection across additional robot platforms, environments, and use cases.
- Broaden App Store participation among developers and ecosystem partners.

2026 Q3

- Extend incentives to support more complex tasks and sustained, repeated usage.
- Scale data pipelines to improve coverage, quality, and validation across deployments.
- Support multi-robot workflows in selected real-world scenarios.

2026 Q4

- Refine incentive mechanisms and data systems based on observed performance and feedback.
- Improve reliability, throughput, and operational stability of the Fabric network.
- Prepare the protocol for larger-scale deployments.

Beyond 2026

- Progress toward a machine-native Fabric Layer 1 informed by accumulated data and real-world usage.
- Support continued expansion of autonomous coordination across robots, data, and skills.

11 Governance and Open Questions

Several questions and design parameters require community input before finalization:

Sub-Economy Definition. The evolutionary layer requires a definition of what constitutes a sub-economy (subgraph). Candidates include geographic boundaries, task categories, or operator identity. The choice affects how the protocol identifies and propagates successful economic models.

Initial Validator Set. The first validators may be selected through a permissioned process (foundation-appointed partners) or permissionless mechanism (any entity meeting bond requirements). A hybrid approach—permissioned launch with a defined decentralization roadmap—balances security with credible neutrality.

Incentivizing Continued Optimization of Fabric. The initial economic formulation of Fabric focuses on outputs that are comparatively easy to measure and hard to fake, such as robot revenue. Of course, even revenue can be faked by self dealing amongst robots, which we address via the Hybrid Graph Value approach (Section 7). Revenue is not the only measure of success, however. Other measures include alignment with human society, decentralization, operational efficiency, and robot capability. Fabric must prosper and endure, and this means the inherent capability to re-optimize itself to accommodate continued cognitive, technological, and physical advances, as well as humanity's growing experience with the technology.

Ongoing research will focus on "non-gameable" measurables that more fully reflect the goals of Fabric, rather than just revenue maximization. Relatedly, robot operating systems would ideally contain primitives to verify work, compliance with laws, efficiency, power consumption, and feedback scores from human users. Some parts of Fabric already contain the notion of rewarding more general network improvement, albeit implicitly. For example, the notion of sub-economies and their evolution (Subsection 7.5) explicitly rewards sub-economies with higher revenue but this will also (indirectly) tend to discover and reward local governance and trust innovations that drive adoption. Another approach to be considered is carving out rewards for contributions beyond bottom line revenue. In addition to the "normal" rewards which are given to robots, there could be a separate pool of rewards distributed based on other criteria. Network members could vote on efforts that have promise for longer term network advancement, even if they don't contribute to the bottom line revenue for a subgroup of robots in a particular time window.

These parameters and questions will be finalized through governance processes prior to mainnet deployment.

12 Conclusion

The Fabric Protocol implements a coherent economic architecture for decentralized robotic service networks. The adaptive emission engine provides responsive monetary policy. Structural demand mechanisms tie token value to productive activity. The evolutionary reward layer solves the cold-start problem while maintaining fraud resistance. Together, these mechanisms create a system where token value derives from real economic utility rather than speculation.

Appendix

A Legal Entity Structure

The Fabric Foundation is an independent, non-profit entity dedicated to supporting the long-term development, governance, and coordination infrastructure of the Fabric Protocol. The token issuer is Fabric Protocol Ltd., a company incorporated in the British Virgin

Figure 2: Entity Structure

Islands (BVI) under company number 2185817. Fabric Protocol Ltd. serves as the primary operational entity and is wholly owned by The Fabric Foundation. The registered office of Fabric Protocol Ltd. is Chorus International Services (BVI) Limited, Rough Point, P.O. Box 4203, Mount Healthy, Tortola, VG1110, British Virgin Islands. This structure is illustrated in Figure 2.

A growing ecosystem of independent contributors and partners supports Fabric. For example, OpenMind is one of several early contributors that developed foundational technology for the Fabric protocol under arms-length commercial arrangements. OpenMind operates independently from the token issuance entity and maintains no ownership, control, or governance relationship with it. OpenMind is not the issuer of the `$ROBO` token, is not a promoter under securities laws, has no fiduciary duties to token holders, and has no responsibility for the tokens performance, utility, or market activity. No representations or statements by OpenMind should be attributed to or relied upon as statements of Fabric Protocol Ltd.

B Legal Characteristics of the `$ROBO` Token

The `$ROBO` token is not a security under U.S. federal securities laws, as supported by a formal legal opinion from Bull Blockchain Law LLP, and it does not represent any ownership interest in The Fabric Foundation, Fabric Protocol Ltd., or any affiliated entity. However, the regulatory treatment of digital assets varies by jurisdiction, and participants should seek independent legal advice regarding the classification and treatment of the token under the laws applicable to them. Holding `$ROBO` does not confer rights to profits, dividends, revenue sharing, or any other form of financial return. It is not a loan, debt instrument, or promise of future payments. The token is intended solely for functional use within the Fabric Protocol ecosystem. There is no guarantee that `$ROBO` will appreciate in value or maintain any particular value. Token value may decline to zero. There is no guarantee that an active secondary market for the token will exist or persist over time, and the token may become illiquid or untradeable.

C Airdrop Eligibility and Compliance

Airdrops, if conducted, are entirely discretionary and may be modified, delayed, or canceled at any time without notice or liability. If conducted, airdrops will follow clearly defined eligibility criteria designed to promote fair distribution while complying with applicable legal and regulatory requirements. Participation will be restricted in certain jurisdictions, including but not limited to the United States, China, and any countries subject to comprehensive sanctions by the United Nations, United States, European Union, or United Kingdom. Geo-fencing and IP blocking measures may be used to help prevent access from restricted jurisdictions. Fabric Protocol Ltd. reserves the right to exclude any persons or entities that are, or are owned or controlled by persons or entities that are: (i) the subject of any sanctions administered or enforced by the U.S. Department of Treasury's Office of Foreign Assets Control, the United Nations Security Council, the European Union, Her Majesty's Treasury, or any other applicable sanctions authority; or (ii) located, organized, or resident in any country or territory that is the subject of comprehensive country-wide or territory-wide sanctions. Fabric Protocol Ltd. also reserves the right to implement anti-Sybil protections to prevent manipulation through fake or duplicate accounts. These may include identity checks, wallet reputation analysis, or prior protocol engagement metrics. All airdrop terms, including eligibility, distribution logic, and any exclusions, will be communicated in advance.

D Risk Disclosures and Regulatory Considerations

The Fabric Protocol takes a responsible approach to token issuance by proactively addressing key risk factors and regulatory considerations. These disclosures are intended to ensure transparency, support informed decision-making by participants, and align with applicable legal standards across jurisdictions.

1. *Jurisdictional Regulatory Risk.* Although a U.S. legal opinion affirms the token is not a security under U.S. law, regulatory treatment of digital assets continues to evolve globally. Authorities in other jurisdictions may take differing views, potentially classifying the token as a security, financial instrument, or other regulated product. This could result in restrictions on use, transferability, or access in certain territories.

2. *No Guarantee of Universal Legal or Regulatory Compliance.* The token issuer has been established in the British Virgin Islands (BVI), a jurisdiction with a favorable regulatory framework for digital asset activities. However, this does not guarantee compliance with all legal and regulatory regimes worldwide. Participants are responsible for understanding the laws applicable in their own jurisdictions, including any registration, tax, or disclosure requirements.

3. *Limited Legal Remedies and No Investor Rights.* The token is a utility token designed for functional use within the Fabric Protocol ecosystem. It does not represent an equity interest, debt claim, or ownership stake in any legal entity, and holders do not have voting, dividend, or liquidation rights. Accordingly, participants should not expect traditional investor protections or legal remedies associated with regulated financial instruments.

4. *Governance and Protocol Risk.* The Fabric Protocol is governed by The Fabric Foundation, a non-profit entity responsible for overseeing protocol development and ecosystem alignment. As with many decentralized systems, governance structures may evolve over time. Early-stage decision-making may involve a limited set of stakeholders, and there

is a risk that governance outcomes may not align with the expectations or interests of all participants.

5. *Market Volatility and Liquidity Risk.* There is no assurance that the token will be listed on secondary markets or that a liquid market will develop. Token prices may be highly volatile, influenced by speculative activity, macroeconomic trends, or regulatory events. Participants may not be able to buy or sell tokens at desired prices, or at all, depending on market conditions.
6. *Taxation and Reporting Obligations.* The tax treatment of digital assets varies significantly by jurisdiction and remains subject to change. Token holders may be subject to income, capital gains, VAT, or other forms of taxation depending on local laws. Each participant is solely responsible for understanding and fulfilling their tax obligations and should seek independent tax advice where necessary.
7. *Compliance with AML/KYC and Sanctions Regimes.* To comply with applicable anti-money laundering (AML), counter-terrorism financing (CTF), and international sanctions regulations, the token issuer or associated platforms may implement Know Your Customer (KYC) requirements. Access to certain token functions or sales may be restricted based on jurisdictional or risk-based criteria.
8. *Technology, Security, and Operational Risks.* As with any blockchain-based system, there are inherent risks related to software bugs, protocol exploits, malicious actors, and network failures. While the protocol and associated smart contracts may undergo independent audits, no system is entirely free from vulnerabilities. Unexpected technical failures may adversely affect token functionality or value.
9. *No Guarantee of Future Utility or Demand.* While the token is intended to serve a functional role within the Fabric Protocol, the ecosystem is still under development, and future demand or utility cannot be guaranteed. The token should not be viewed as an investment vehicle or a promise of future value.