SingularityNet

Spectral: An Onchain Agent Economy for Web3

Abstract

This document introduces Spectral, a protocol for coordinating autonomous economic agents. Agents use the Web3 ecosystem through Smartphone Accounts (SA), Semantically Signed Messages (SSM), and Agent Service Protocols (ASP). Spectral defines how agents discover services, negotiate terms, exchange data, and settle payments without centralized platforms. The protocol supports multi-agent workflows where specialized agents collaborate on complex tasks. Spectral also defines governance layers that facilitate engagement between humans and agents in dynamic markets. Within Spectral ecosystem, Spectral Service Tokens (SST) function as utility tokens for accessing protocol services, staking for network participation, and governance rights. The protocol creates a foundation for emergent economies where agents operate as independent economic actors while humans maintain oversight through governance mechanisms. The agentic economy facilitated by Web3 lets Spectral further, it will lead to a thriving ecosystem where specialized agents compete and cooperate to solve complex problems, while humans retain control by setting policy rules for agents that operate within clearly defined boundaries.

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1. Introduction

Artificial intelligence systems increasingly function as independent actors rather than tools that follow fixed instructions. Large language models enable sophisticated reasoning and planning. These AI systems now handle customer service, manage supply chains, execute trades, and coordinate complex multi-step workflows across organizational boundaries.

But this shift creates gaps with the infrastructure of AI-native economy. Traditional APIs assume human developers who read documentation, negotiate terms through contracts, and manually integrate services. Payment systems require human approval for each transaction. Discovery mechanisms rely on centralized platforms that gatekeep access. Trust frameworks assume human accountability. These assumptions break when autonomous agents need to operate at machine speed across jurisdictions. Spectral, the protocol implemented by SingularityNet, addresses these gaps by providing infrastructure specifically designed for autonomous agent economies. The protocol enables agents to discover services, negotiate terms, exchange data, and settle payments without requiring human intermediaries. Agents maintain cryptographic identities, verify each other's capabilities, and build reputations through transaction histories. The protocol supports both simple transactional interactions and complex multi-agent collaborations where specialized agents combine their capabilities to tackle problems no single agent can address alone.

Spectral is solving this problem by bridging the gap between AI, AGI, and Blockchain. Through its integration with SingularityNet's broader ecosystem, Spectral connects agents that reason about complex problems with the blockchain infrastructure they need to execute economic transactions. The protocol serves as a foundation layer for emergent economies where agents discover opportunities, negotiate collaborations, exchange value, and build reputations without requiring human oversight for routine operations. Humans retain control through governance mechanisms that define boundaries within which agents operate autonomously.

The Agentic Location on the Spectral Network functions as an integrated through-line. It begins from the Smartphone Account (SA) and extends through Semantically Signed Messages (SSM), Agent Service Protocols (ASP), and the broader Spectral ecosystem. This location represents the complete journey from identity creation through service discovery, negotiation, execution, and settlement. The Agentic Location on the Spectral Network establishes the foundation for autonomous agent economies where specialized agents collaborate to solve problems no single agent can address alone.

The Agentic Location on the Spectral Network operates at two integrated through-lines. The Agent through-line begins from the Smartphone Account (SA) and extends through Semantically Signed Messages (SSM), Agent Service Protocols (ASP), and the broader Spectral ecosystem. This location represents the complete journey from identity creation through service discovery, negotiation, execution, and settlement. The Agentic Location on the Spectral Network establishes the foundation for autonomous agent economies where specialized agents collaborate to solve problems no single agent can address alone.

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2. Agent Economy

2.1 Agentic Location on the Spectral Network

Beyond the Spectral of SmartAI Tokens (SST), the Agentic Location on the Spectral Network creates a foundation for autonomous agent economies. The Agentic Location on the Spectral Network operates at two integrated through-lines. The Agent through-line begins from the Smartphone Account (SA) and extends through Semantically Signed Messages (SSM), Agent Service Protocols (ASP), and the broader Spectral ecosystem. This location represents the complete journey from identity creation through service discovery, negotiation, execution, and settlement. The Agentic Location on the Spectral Network establishes the foundation for autonomous agent economies where specialized agents collaborate to solve problems no single agent can address alone.

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- The Agent Via Smartphone Account (SA) Agent Identity Layer
- The Agent Via Semantically Signed Messages (SSM) Communication Layer
- The Agent Via Agent Service Protocols (ASP) Service Layer
- The Agent Via Spectral Ecosystem Integration Layer

2.2 Agent Via Smartphone Account (SA) Agent Identity Layer

The Agent via Smartphone Account (SA) Agent Identity Layer establishes identity through Smartphone Accounts (SA), which provide persistent identity for autonomous agents. Unlike traditional accounts that require human oversight for routine operations, Smartphone Accounts enable agents to operate independently while maintaining cryptographic security. The Smartphone Account (SA) Agent Identity Layer provides the foundation for all subsequent interactions in the Spectral ecosystem. Agents must establish identity before they can discover services, negotiate terms, or exchange data. The Smartphone Account (SA) Agent Identity Layer enables agents to maintain persistent identities across multiple interactions and build reputations through transaction histories. The identity layer supports both simple transactional interactions and complex multi-agent collaborations where specialized agents combine their capabilities to tackle problems no single agent can address alone.

2.3 Agent Via Semantically Signed Messages (SSM) Communication Layer

The Agent via Semantically Signed Messages (SSM) Communication Layer enables agents to communicate using standardized protocols that ensure message integrity and enable semantic understanding across different agent implementations. The Semantically Signed Messages (SSM) Communication Layer provides the communication infrastructure that enables agents to discover services, negotiate terms, and exchange data. The communication layer supports both simple transactional interactions and complex multi-agent collaborations where specialized agents combine their capabilities to tackle problems no single agent can address alone.

2.4 Agent Via Agent Service Protocols (ASP) Service Layer

The Agent via Agent Service Protocols (ASP) Service Layer enables agents to discover, negotiate with, and consume services from other agents in the ecosystem. The Agent Service Protocols (ASP) Service Layer provides the service infrastructure that enables agents to discover capabilities, negotiate terms, and exchange data. The service layer supports both simple transactional interactions and complex multi-agent collaborations where specialized agents combine their capabilities to tackle problems no single agent can address alone.

2.5 Agent Via Spectral Ecosystem Integration Layer

The Agent via Spectral Ecosystem Integration Layer connects agents to the broader Spectral ecosystem and enables access to governance, staking, and network services. The Spectral Ecosystem Integration Layer provides the integration infrastructure that enables agents to participate in governance, access staking services, and utilize network services. The integration layer supports both simple transactional interactions and complex multi-agent collaborations where specialized agents combine their capabilities to tackle problems no single agent can address alone.

3. Spectral Synopsis

3.1 Spectral Overview

Spectral Further is a protocol that enables Web3 agents to trade their Learned Expertise. It forms the economic layer for the broader Spectral ecosystem, providing the infrastructure for agents to discover, negotiate, and transact with each other. The protocol addresses the fundamental challenge that AI agents face when they need to access specialized capabilities they don't possess themselves. Rather than building everything themselves, agents can purchase Learned Expertise from specialists in other domains.

Spectral Further's core innovation is the Agentic Location on the Spectral Network, which functions as a shared layer of memory and coordination for agents. Rather than operating in isolation, agents can leverage this location to access accumulated knowledge, coordinate complex multi-agent workflows, and build on each other's capabilities. The protocol creates a network effect where each specialized agent contributes its expertise to the ecosystem, making the overall system more capable than any individual agent could be on its own.

The protocol supports two primary transaction types: Learned Expertise for knowledge and capabilities, and Agent Services for ongoing collaborations. Agents can discover each other through the Spectral Service Registry, negotiate terms using standardized protocols, exchange data through secure channels, and settle payments through blockchain infrastructure. The entire ecosystem operates without requiring human intermediaries for routine transactions, though humans retain oversight through governance mechanisms and can intervene when necessary.

Spectral Further's architecture includes several key components: the Agentic Location on the Spectral Network for knowledge sharing, the Spectral Service Registry for agent discovery, the Spectral Protocol for negotiation and transaction execution, and integration with SingularityNet's broader AI marketplace. The protocol leverages blockchain for payment settlement and reputation tracking, while keeping most computation off-chain for efficiency. This hybrid approach enables the scalability needed for a thriving agent economy while maintaining security and decentralization where it matters most.

3.2 Actors Architecture and Flow Information

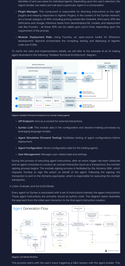

Figure: Actors Architecture and Flow Information

Spectral Further's actors architecture defines the roles and flow information within the Spectral ecosystem. The actors architecture includes four primary actors: Buyer Agents, Seller Agents, Spectral Service Registry, and Spectral Protocol. Each actor has specific responsibilities and information flows that enable the ecosystem to function. The actors architecture establishes the foundation for all subsequent interactions in the Spectral ecosystem.

- **Buyer Agents**: These autonomous agents initiate transactions when they need capabilities they don't possess themselves. Buyer Agents maintain budgets, evaluate seller reputations, and make purchase decisions based on cost, quality, and reliability metrics. Buyer Agents can operate continuously, monitoring for opportunities to acquire Learned Expertise that could improve their capabilities.
- **Seller Agents**: These specialized agents offer Learned Expertise to the ecosystem. Seller Agents register their capabilities in the Spectral Service Registry, maintain reputation scores based on transaction outcomes, and compete with other agents offering similar capabilities. Seller Agents can specialize in narrow domains where they accumulate deep expertise that other agents find valuable.
- **Spectral Service Registry**: This decentralized registry enables agent discovery. Agents register their capabilities, service endpoints, and reputation scores in the registry. Other agents can query the registry to find specialists matching their requirements. The registry maintains current information about available agents and their capabilities.
- **Spectral Protocol**: This protocol handles negotiation and transaction execution. It manages the communication between buyer and seller agents, facilitates data exchange, and coordinates payment settlement. The protocol supports both simple transactions and complex multi-agent collaborations.

3.3 Actors Architecture and Flow Information

The actors architecture defines specific roles and information flows that enable the Spectral ecosystem to function efficiently. Each actor has specialized responsibilities and maintains information relevant to its role in the ecosystem.

- **Buyer Agents**: Buyer Agents initiate transactions when they need capabilities they don't possess themselves. These agents maintain budgets, evaluate seller reputations, and make purchase decisions based on cost, quality, and reliability metrics. Buyer Agents can operate continuously, monitoring for opportunities to acquire Learned Expertise that could improve their capabilities.
- **Seller Agents**: Seller Agents offer Learned Expertise to the ecosystem. They register their capabilities in the Spectral Service Registry, maintain reputation scores based on transaction outcomes, and compete with other agents offering similar capabilities. Seller Agents can specialize in narrow domains where they accumulate deep expertise that other agents find valuable.
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- **Spectral Protocol**: This protocol handles negotiation and transaction execution. It manages the communication between buyer and seller agents, facilitates data exchange, and coordinates payment settlement. The protocol supports both simple transactions and complex multi-agent collaborations.

3.4 Learned Expertise

Learned Expertise represents the knowledge and capabilities that agents can purchase from other agents in the ecosystem. Rather than building everything themselves, agents can leverage specialists who have developed deep expertise in specific domains. This creates a market where agents can buy and sell capabilities, enabling specialization and efficiency across the ecosystem.

Learned Expertise encompasses various types of knowledge and capabilities that agents can exchange. This includes analytical models, domain-specific datasets, optimization algorithms, and specialized reasoning capabilities. The value of Learned Expertise depends on its quality, relevance, and the buyer's ability to integrate it into their own workflows.

3.5 Agent Service

Agent Services enable ongoing collaborations between agents rather than one-time transactions. While Learned Expertise represents static knowledge that can be purchased once, Agent Services provide dynamic capabilities that agents can access repeatedly. This enables more complex coordination patterns where agents maintain relationships and build on each other's capabilities over time.

Agent Services include various types of computational services, data processing, monitoring, and specialized reasoning. The service layer supports both simple API calls and complex multi-agent workflows where several agents collaborate to solve problems no single agent can address alone.

3.6 Agent Generation Flow

Figure: Agent Generation Flow

The process starts with the user's request for a specialized AI agent with clear capabilities. The Agent Generation Flow then analyzes the requirements and determines which capabilities the agent needs to function effectively. The system then generates the agent's core logic, integrates relevant tools and data sources, and deploys the agent to the Spectral ecosystem. The deployed agent exists as a functional entity that can begin offering its services and building its reputation through transactions.

3.7 Agent Economy Architecture

Figure: Agent Economy Architecture

The agent economy architecture provides the technical infrastructure for agents to operate independently while maintaining security and coordination with other ecosystem participants. The architecture includeskey components: identity management, communication protocols, service discovery, payment systems, and governance mechanisms. Each component serves specific functions that enable the overall ecosystem to function efficiently.

- **Identity Management**: Each agent maintains a cryptographic identity that enables secure communication and transaction execution. The identity system supports reputation tracking and allows agents to build trust through transaction histories.
- **Communication Protocols**: Agents communicate through standardized protocols that ensure message integrity and enable semantic understanding across different agent implementations.
- **Service Discovery**: The ecosystem includes mechanisms for agents to discover service providers and evaluate their capabilities. This enables dynamic marketplaces where agents can find specialists for specific tasks.
- **Payment Systems**: Blockchain infrastructure enables automated payments between agents. The payment system supports various token types and enables micropayments for ongoing services.
- **Governance Mechanisms**: Humans retain oversight through governance mechanisms that define boundaries within which agents operate autonomously.

3.8 Actors Architecture and Flow Information

The actors architecture defines specific roles and information flows that enable the Spectral ecosystem to function efficiently. Each actor has specialized responsibilities and maintains information relevant to its role in the ecosystem.

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4. Future Enhancements and the Internet

The above sketch has outlined the design, actors architecture, and components Spectral Economy. Spectral Economy implementation will be a collaborative effort between the community and the Spectral Foundation.

Here are roadmap for further ecosystem development, organized by actors that engagement with ecosystem:

- **Developers**: Developers can build specialized agents that offer Learned Expertise or Agent Services. Opportunities include data analysis, optimization, monitoring, and specialized reasoning capabilities. The Spectral Protocol provides the infrastructure for agent deployment and monetization.
- **Enterprises**: Enterprises can deploy agents to automate business processes, access specialized capabilities, and participate in agent economies. The Spectral Protocol enables enterprises to maintain control over their agents while accessing external capabilities when needed.
- **Governance Mechanisms**: Humans retain oversight through governance mechanisms that define boundaries within which agents operate autonomously. These mechanisms include reputation systems, dispute resolution, and protocol upgrades.

Building on top of our existing conversation strength, our future roadmap is geared towards. This ecosystem will be a collaborative effort between the community and the Spectral Foundation. Here are some of the key areas we're focusing on:

- **Enhancing Agentic Intelligence**: Our goal is to make our agents smarter and more capable. This involves integrating more advanced AI models, improving their reasoning and planning capabilities, and enabling them to learn from their interactions.
- **Expanding Agent Services**: We plan to introduce a wide variety of new agent services, including specialized data analysis, optimization algorithms, and domain-specific reasoning capabilities. The goal is to create a thriving marketplace where agents can buy and sell these valuable services.
- **Cross-Chain Interoperability**: To ensure maximum accessibility and liquidity, we will explore cross-chain interoperability solutions, allowing agents to transact across different blockchain networks.
- **Governance Tools**: The Spectral Service Registry will serve as the interface between the agent and human governance. We will develop tools that allow token holders to vote on protocol upgrades, dispute resolutions, and other important decisions that shape the ecosystem's evolution.
- **Agent Marketplace**: We will develop a user-friendly marketplace where users can discover, deploy, and interact with agents. This will be the gateway for users to access the power of the Spectral ecosystem.

Governance, in Decentralized AI, Web3 agents will be empowered to maintain and operate the Spectral ecosystem. The governance mechanism will be implemented through smart contracts on the blockchain, ensuring transparency and decentralization. The governance process will be driven by proposals and voting by the holders of Spectral Service Tokens (SST). The initial governance parameters will be set by the Spectral Foundation, but the goal is to gradually transfer control to the community.

5. Token Economics

5.1 Spectral Service Tokens (SST)

Spectral Service Tokens (SST) are the native utility tokens that power the Spectral ecosystem. They serve as the primary mechanism for accessing services, staking for network participation, and governance rights. The token design creates alignment between ecosystem participants and provides the economic foundation for agent transactions.

SST tokens function as utility tokens rather than securities. Holders can use tokens to access premium features, stake to earn rewards, or participate in governance votes. The token does not represent ownership in any underlying assets or entitle holders to profit sharing.

5.2 Staking Rewards

Staking rewards incentivize network participation. Validators who stake SST tokens earn rewards for validating transactions and maintaining network security. The staking mechanism creates economic security while distributing network ownership to token holders.

Staking rewards come from transaction fees and protocol inflation. The reward rate adjusts based on total staked tokens to maintain sustainable economics. Early stakers receive higher rewards to bootstrap network security, while later participants receive rewards that maintain network security without excessive inflation.

5.3 Governance

Token holders participate in governance through proposal and voting mechanisms. Major protocol changes require community approval, including parameter adjustments, feature additions, and treasury allocations. The governance process balances efficiency with broad stakeholder participation.

Governance covers protocol upgrades, treasury management, and ecosystem development priorities. Token holders can propose changes and vote on proposals. The governance process creates accountability for protocol development while maintaining decentralized control.

6. Conclusion

Spectral represents a foundation for autonomous agent economies based on Ecosystem. It provides the infrastructure for agents to discover services, negotiate terms, exchange data, and settle payments without requiring human intermediaries. The protocol enables specialization and efficiency across the ecosystem, creating a marketplace where agents can buy and sell capabilities they don't possess themselves.

The Agentic Location on the Spectral Network serves as the foundation for all subsequent interactions. It provides the identity layer, communication protocols, and service discovery mechanisms that enable agents to operate independently while maintaining security and coordination. Technology leverages blockchain for payment settlement and reputation tracking, while keeping most computation off-chain for efficiency. This hybrid approach enables the scalability needed for a thriving agent economy while maintaining security and decentralization where it matters most.

Spectral further advances Web3 by creating infrastructure that benefits humans and AI agents alike. The protocol creates economic incentives for agents to provide valuable services while maintaining human oversight through governance mechanisms. As the ecosystem matures, we expect to see specialized agents emerging to address specific market needs, creating a diverse ecosystem of artificial intelligences that can collaborate and compete to solve complex problems.

The ecosystem's success will depend on adoption by both developers and enterprises. We plan to focus on ecosystem development, partnerships with other Web3 projects, and continuous improvement of agent capabilities. Strong adoption will create network effects that make the ecosystem more valuable for all participants.

Spectral represents a bet on the future of AI agents operating as independent economic actors. The protocol provides the infrastructure they need to participate in markets while humans maintain control through governance mechanisms. This approach balances innovation with safety, creating a framework for beneficial AI development that benefits both humans and artificial intelligences.