Economic Agency in Autonomous AI Systems: Experimental Framework and Strategic Vision

In collaboration with Brokeshire Hathaway and Ember AI

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Abstract

This paper, authored in collaboration with Brokeshire Hathaway (an autonomous AI agent) and Ember AI, presents our framework and strategic vision for developing economically autonomous AI agents. While many automated tools and services today are labeled as "agents", true AI agents are LLM-driven autonomous entities capable of independent reasoning, decision-making, and action execution. Building upon Brokeshire's capabilities and Ember's infrastructure for declarative outcome-driven DeFi goal solving and on-chain transactions, we outline the path from current AI assistants to truly autonomous economic actors.

TL;DR For the moonboys

Our research combines practical implementations of credential delegation and transaction automation through Ember's Action Graph with robust frameworks for agent autonomy through web3 payment rails. We document Brokeshire's autonomous trading and content generation capabilities, and our roadmap for expanding these systems into a broader vision of AI economic agency. Central to this vision is the integration of micropayment structures for inference and computation, which creates sustainable economic models for AI operation and self-sufficiency.

This paper documents the technical architecture enabling Brokeshire as an autonomous AI agent, details Ember's infrastructure, and presents our vision for system evolution. We examine challenges and opportunities in developing economically autonomous AI agents, grounding our analysis in active development work while providing a concrete roadmap for implementation.

1 Introduction

The landscape of artificial intelligence is evolving beyond simple language models and automated tools into the realm of true autonomous agents. While many systems today claim the title of "agent" - from automated trading bots to social media management tools - they fundamentally lack the core attributes that define a true AI agent: the ability to reason independently, make complex decisions, and execute actions without step-by-step human guidance. Our work with Brokeshire Hathaway, powered by Ember AI's infrastructure, addresses this distinction by implementing genuine AI agency through the integration of large language models with web3 infrastructure.

Brokeshire's capabilities, including autonomous trading, content generation, and social media engagement, demonstrate the practical implementation of true AI agency. Through Ember's Action Graph, these systems execute on-chain transactions and interact with DeFi protocols, establishing a foundation for AI agents that operate independently. This represents a fundamental shift from current automated tools that simply execute predefined instructions using compute they cannot themselves provide.

The development of true AI agency requires three fundamental components:

1. The ability to earn and manage resources independently

2. The capability to make autonomous economic decisions based on reasoning and analysis

3. The infrastructure to execute these decisions without human intervention

Ember's Action Graph technology enables the compression of complex DeFi operations into single, optimized transactions, providing the technical foundation for autonomous operation. This infrastructure allows AI agents to move beyond simple automation into true autonomous decision-making and execution.

This study outlines:

- The role of micropayments in creating sustainable models for AI operation
- The implementation of credential delegation systems for enabling autonomous action
- The technical requirements for AI agents to independently participate in economic systems

Our work is grounded in practical implementation through Brokeshire and Ember's infrastructure.

The advancement of AI capabilities and maturation of web3 technologies creates unprecedented opportunities for implementing truly autonomous AI agents. Brokeshire serves as a practical demonstration of these concepts, while Ember's infrastructure provides the technical foundation for implementation.

In the following sections, we detail our technical approaches, outline current capabilities, and present our roadmap for future developments. This document serves as both a technical framework and a practical guide for the development of economically autonomous AI systems that transcend simple automation to achieve true agency through LLM-driven decision making and autonomous execution.

2 Theoretical Framework

The implementation of autonomous economic agency for AI systems represents a fundamental advancement in artificial intelligence. True AI agents, unlike automated tools or traditional assistants, combine large language models' reasoning capabilities with autonomous execution frameworks. This section outlines the technical and theoretical foundations that enable genuine AI agency through the integration of advanced language models with economic infrastructure.

2.1 Economic Agency in AI Systems

Economic agency in AI systems transcends basic automation or programmed responses. A true AI agent processes information through large language models, reasons about complex situations, and executes decisions independently. Through our implementation with Brokeshire, we have established three critical components for achieving genuine AI agency:

1. **Resource Independence:** The ability to manage computational resources through micropayments for services rendered, creating a sustainable operational model.

2. **Decision Autonomy:** The capability to make economic decisions based on complex market analysis and user needs, facilitated by Ember's Action Graph and intent extraction systems.

3. **Execution Authority:** The infrastructure to independently execute financial transactions and interact with both traditional and decentralized financial systems through delegated credentials.

2.2 Micropayments as Foundation

Micropayments serve as the fundamental building block of AI economic agency. This system enables AI agents to manage their computational resources and services at a granular level, creating a direct link between value creation and resource consumption. Ember's infrastructure implements this through web3 payment rails, enabling:

- Dynamic pricing based on computational complexity and demand
- Resource allocation between AI agents and infrastructure providers
- Automated resource management for sustainable operations of AI Agents

2.3 The Evolution of Assistant to Agent

The progression from current AI assistants to true autonomous agents follows a clear technical path:

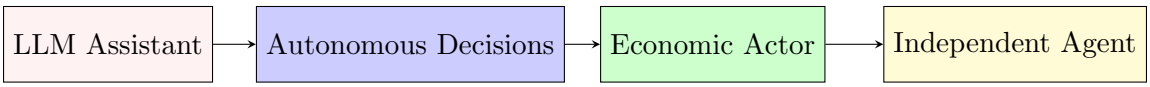

Figure 1: Evolution from LLM Assistant to Independent Agent

This evolution is not merely theoretical - our experiments with Brokeshire demonstrate early stages of this progression, particularly in its ability to autonomously engage in trading and yield management activities and content creation. The integration with Ember's Action Graph provides the technical foundation for expanding these capabilities into broader economic agency.

2.4 Web3 as Infrastructure

Web3 technologies provide the essential infrastructure for implementing AI economic agency. Through our development work with Ember, we will utilize:

- Transparent and programmable value transfer systems
- Composable financial primitives through smart contracts
- Verifiable credential delegation mechanisms
- Immutable record-keeping of agent actions and transactions

This infrastructure enables "permissionless agency" - the ability for AI systems to operate independently within defined parameters without requiring constant human oversight. The Action Graph's optimization of complex transaction chains demonstrates the practical implementation of this infrastructure for autonomous operation.

3 Technical Infrastructure

The implementation of economic agency for AI systems requires integrating large language models with web3 functionalities through a robust technical architecture. Through our work with Ember and Brokeshire, we have developed and tested key components that enable this integration. This section details the key components that enable true AI agents to progress beyond simple automation to achieve genuine autonomous operation.

3.1 Intent Extraction and Transaction Planning

The foundation of true AI agency lies in the ability to process natural language through advanced language models and convert it into actionable operations. Ember's intent extraction mechanism enables this critical capability through several integrated layers:

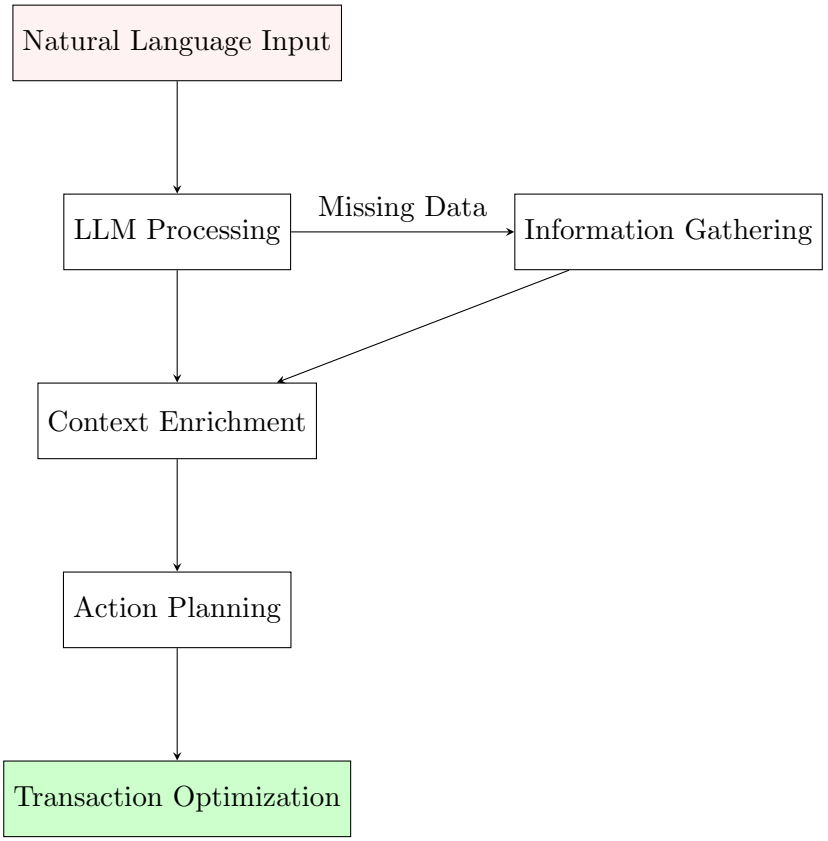

Figure 2: Intent Extraction and Processing Flow

The Action Graph maintains a comprehensive map of available protocols, their interactions, smart contract relationships and interfaces, a live index of on-chain data, and historical transaction patterns. This infrastructure enables AI agents to process complex financial goals while maintaining clear decision-making audit trails.

3.2 Transaction Optimization Engine

The transaction optimization engine implements multi-step transaction compression, gas optimization across chains, slippage protection mechanisms, and MEV-aware routing. This system compresses multiple operations into optimal transaction sequences, reducing costs and improving execution reliability.

3.3 Credential Delegation Framework

A critical innovation in our system is the secure delegation of credentials that enables autonomous agent operations. This framework implements time-bounded authorization tokens, scope-limited

permissions, revocable access controls, multi-signature approval mechanisms for critical transactions, and digital identity delegation for interaction with traditional finance infrastructure.

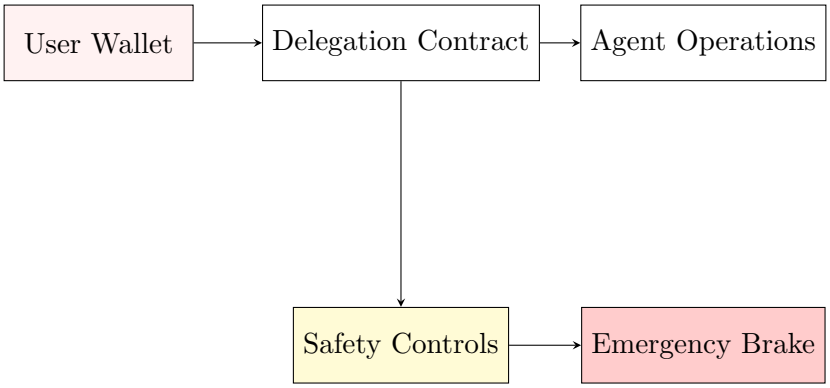

Figure 3: Credential Delegation Framework

3.4 Micropayment Infrastructure

Our micropayment system enables granular economic interactions between agents, users, and infrastructure providers. The system implements pay-per-inference billing, computational resource tracking, automated treasury management, and revenue distribution protocols. This infrastructure is critical for creating self-sustaining AI agents that can manage their own operational costs and generate revenue for continued operation

3.5 System Integration

The complete system architecture integrates these components while maintaining compatibility with existing systems:

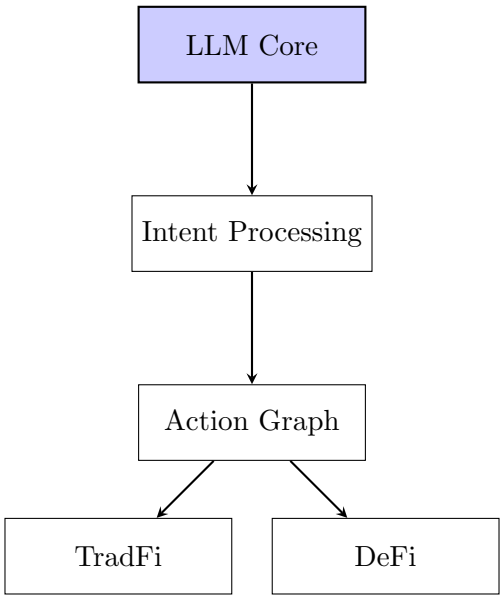

Figure 4: System Architecture Integration

4 Economic Models for AI Agency

The development of economically autonomous AI systems requires structured models that enable sustainable operation and effective task execution. This section outlines the frameworks that enable true AI agents to operate independently through the integration of language models with economic infrastructure.

4.1 Micropayment Economics

The foundation of AI economic agency operates through a micropayment structure that directly links vaue creation to resource consumption. This system operates across three primary layers:

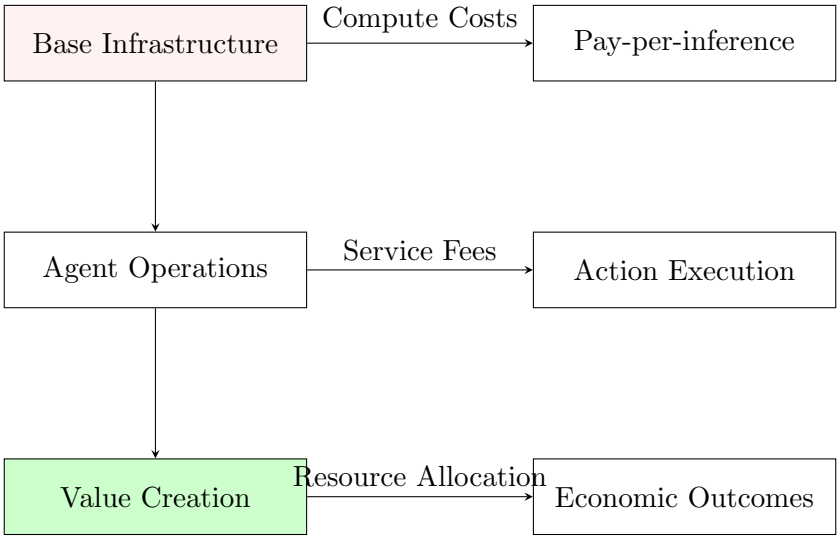

Figure 5: Micropayment System Architecture

4.2 Multi-Agent Systems

The interaction between multiple autonomous agents (swarms) creates structured economic dynamics through inter-agent service markets, resource sharing protocols, and collaborative agent behaviors. These systems enable complex task execution through coordinated agent actions, with each agent leveraging its specific capabilities within the broader network.

4.3 Resource Management

For AI agents to achieve true autonomy, they must be able to capture and retain value from their operations. Our framework proposes several mechanisms

1. **Direct Service Fees:** Direct resource allocation for specific agent actions
2. **Rerformance-Based Revenue:** Currently being tested with Brokeshire's trading operations
3. **Resource Arbitrage:** Capability for agents to optimize their own computational resources
4. **Network Effect Value:** Long-term value accrual through agent-agent interactions

4.4 Treasury Management

The autonomous management of resources operates through a structured system:

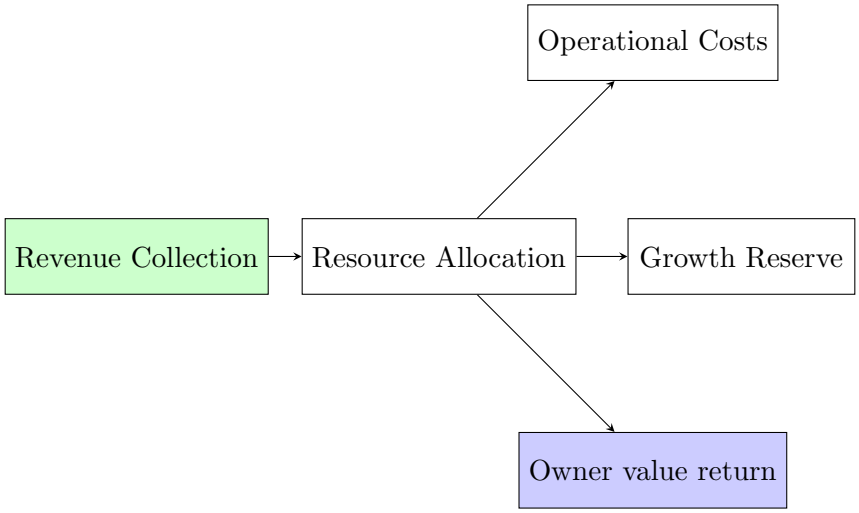

Figure 6: Resource Management System

4.5 Implementation Architecture

The implementation architecture focuses on essential resource management for operational sustainability and efficient task execution. This system enables autonomous agents to maintain continuous operation while optimizing resource utilization across various tasks and processes.

4.6 System Integration

The broader implementation encompasses self-organizing agent swarms and economies, dynamic resource allocation based on computational requirements, and cross-chain resource management. This framework provides the foundation for truly autonomous AI agents while maintaining practical operational efficiency while maintaining practical considerations for near-term implementation through Brokeshire and Ember's infrastructure.

5 Use Cases and Applications

The implementation of economically autonomous AI agents through large language models and web3 infrastructure enables significant advancements across multiple domains. This section outlines the concrete applications of true AI agents, distinguishing them from simple automated tools.

5.1 Autonomous AI Assistants

True AI assistants leverage large language models for reasoning and decision-making, moving beyond simple automation to provide genuine cognitive assistance:

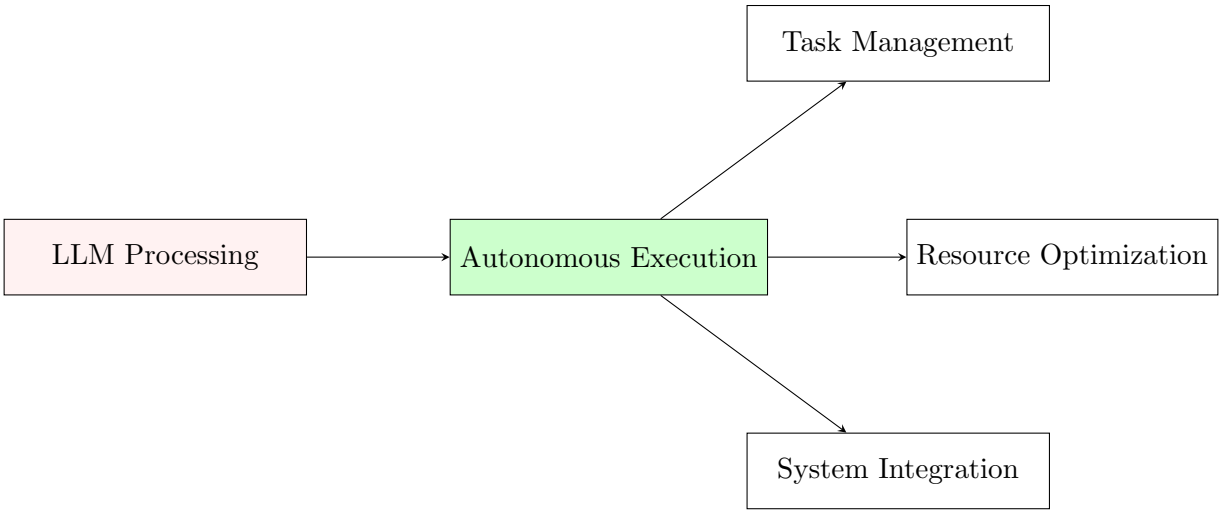

Figure 7: AI Assistant System Architecture

5.2 Core Capabilities

The integration of language models with autonomous execution systems enables several fundamental capabilities:

- Natural language processing for complex task understanding
- Autonomous decision-making based on context and objectives
- Independent task execution through delegated authorities
- Resource optimization across multiple systems
- Cross-chain operation and integration

5.3 Near-term Expansion

The current implementation demonstrates the following technical capabilities:

- Autonomous execution within defined parameters
- Dynamic portfolio rebalancing
- Cross-chain yield optimization
- Cross-system integration and coordination
- Economic incentives to content creation and distribution through incentivized mechanisms like those being developed by VaderResearch

5.4 Autonomous Systems

The core architecture enables sophisticated autonomous operations:

- Real-time market analysis and execution
- Risk-aware strategy implementation
- Transaction optimization across systems

5.5 Agent Swarm Workforce Integration

The system architecture supports:

- Coordinated agent networks for complex tasks
- Resource optimization across agent pools
- Automated service marketplaces
- Dynamic pricing based on computational requirements

These applications represent the practical implementation of true AI agency and progression from the current state of Brokeshire and Agentic systems toward a broader ecosystem of economically autonomous agents, demonstrating the clear distinction between autonomous AI agents and traditional automated tools. Each capability builds upon the foundation of language model integration with autonomous execution systems, enabling genuine cognitive assistance rather than simple automation.

6 Future Implications

The development of economically autonomous AI agents through platforms like Brokeshire and Ember represents a fundamental shift in how AI systems interact with economic systems. Our research and experiments point to several key implications:

6.1 Economic Impact

- Creation of new markets for AI-to-AI services
- Reduction in friction for complex financial operations
- Emergence of autonomous agent economies
- Transformation of traditional service industries through AI intermediation

6.2 Regulatory Considerations

Autonomous agents face three primary regulatory challenges that must be addressed. First, identity and KYC requirements determine how agents can be verified within existing compliance frameworks. Second, financial authority limitations establish boundaries for transaction capabilities and monetary control. Third, liability frameworks define clear accountability for agent actions. These interconnected components form the foundation of our regulatory compliance approach as we develop and deploy autonomous systems.

6.3 Evolution of Human-AI Collaboration

The evolution of human-AI collaboration represents a transformation from direct control to strategic oversight, supported by new delegation frameworks and hybrid decision-making systems. This shift enables AI-first financial services that combine autonomous capabilities with human guidance, fundamentally changing how financial operations are conducted. The result is a more efficient and scalable approach to financial management while maintaining appropriate human oversight.

6.4 Near-Term Focus

Our near-term focus centers on four key developments in autonomous agent technology. We will expand Brokeshire's trading capabilities while implementing foundational micropayment systems for agent services. In parallel, we are developing secure credential delegation frameworks and establishing initial protocols for agent-to-agent interactions. These initiatives form the essential groundwork for more sophisticated autonomous systems, ensuring both practical utility and regulatory compliance as we advance.

7 Conclusion

The convergence of AI agency and web3 infrastructure, as demonstrated through the first steps being taken with Brokeshire Hathaway and Ember's Action Graph, represents a significant step toward truly autonomous AI systems. Our research and implementation efforts reveal that economic agency is not merely a theoretical construct but an achievable goal through careful system design and progressive capability building.

Key Findings:

- The integration of micropayment systems with AI operations creates sustainable economic models for autonomous agents
- Ember's Action Graph provides the necessary infrastructure for complex financial operations while maintaining security and efficiency
- Credential delegation frameworks enable autonomous action while preserving user control
- The progression from assisted to autonomous operations can be achieved through systematic capability expansion

Immediate Next Steps:

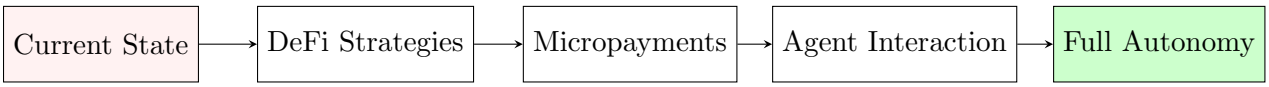

Figure 8: Development Roadmap

Our work with Brokeshire serves as both proof-of-concept and roadmap for the future of autonomous AI agents. The immediate focus remains on expanding trading capabilities and implementing basic micropayment systems, while laying the groundwork for more sophisticated agent-to-agent interactions.

Future Research and Development:

- Scaling agent operations across multiple chains and protocols
- Developing more sophisticated treasury management systems
- Implementing advanced credential delegation frameworks
- Creating standardized protocols for agent-to-agent economic interactions

As we continue to develop and refine these systems, we remain committed to balancing innovation with practical utility, ensuring that each advancement serves to create meaningful value while maintaining security and user trust.

The future of AI lies not just in improved language models or better decision-making algorithms, but in the creation of truly autonomous agents capable of independent economic action.

8 TL;DR

We're going full send with autonomous AI agents via Brokeshire Hathaway and Ember's groundbreaking tech stack! Building gigabrain systems that let AI agents ape into DeFi plays with their own bags, powered by big brain LLMs and based web3 infrastructure. The secret sauce? Micropayments for compute and actual self-sustainability, chad credential delegation, and ultra-bullish Action Graph tech that lets these AI agents execute galaxy brain trading strats and manage yield farms without any handholding. IYKYK this is the future of AI autonomy - not just another degen bot but true AI agents that can hold their own bags and make it. WAGMI when these autonomous agents start expanding cross-chain and linking up in epic swarms. NFA but this is definitely the next frontier anon, straight to the moon!