AI Agents Meet Blockchain: A Survey on Secure and Scalable Collaboration for Multi-Agents

Empowering Decentralized Intelligence in the Web3 Era

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Way To Innovation

Agenda

- Introduction
- Motivation and Backgrounds
- Synergy Between AI Agents and Blockchain
- Applications and Empirical Case Studies
- Empirical Case Studies
- Research Challenges
- Future Directions
- Conclusion

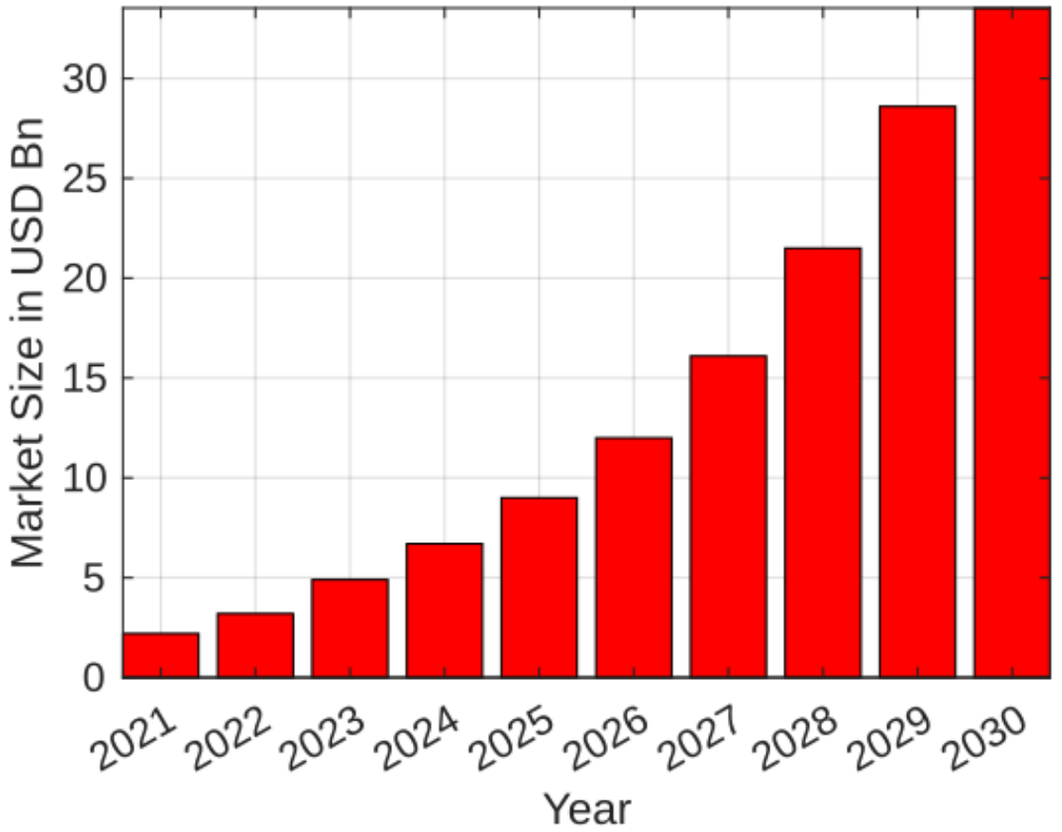
Introduction

Key points

- **Web3 Growth:** $33.53B market by 2030, driven by decentralized ecosystems.
- **Blockchain in Web3:** Transparency, security, decentralization (e.g. DeFi, DAOs).
- **AI in Web3:** Enhances decision-making, anomaly detection, and scalability.

Expansion

- **Web3 Pillars:** Decentralized governance, user-owned data, smart contracts.
- **Example:** Defi's $200B Total Value Locked (TVL) and AI-driven risk assessment.



CAGR (2022-2030) 43.6%

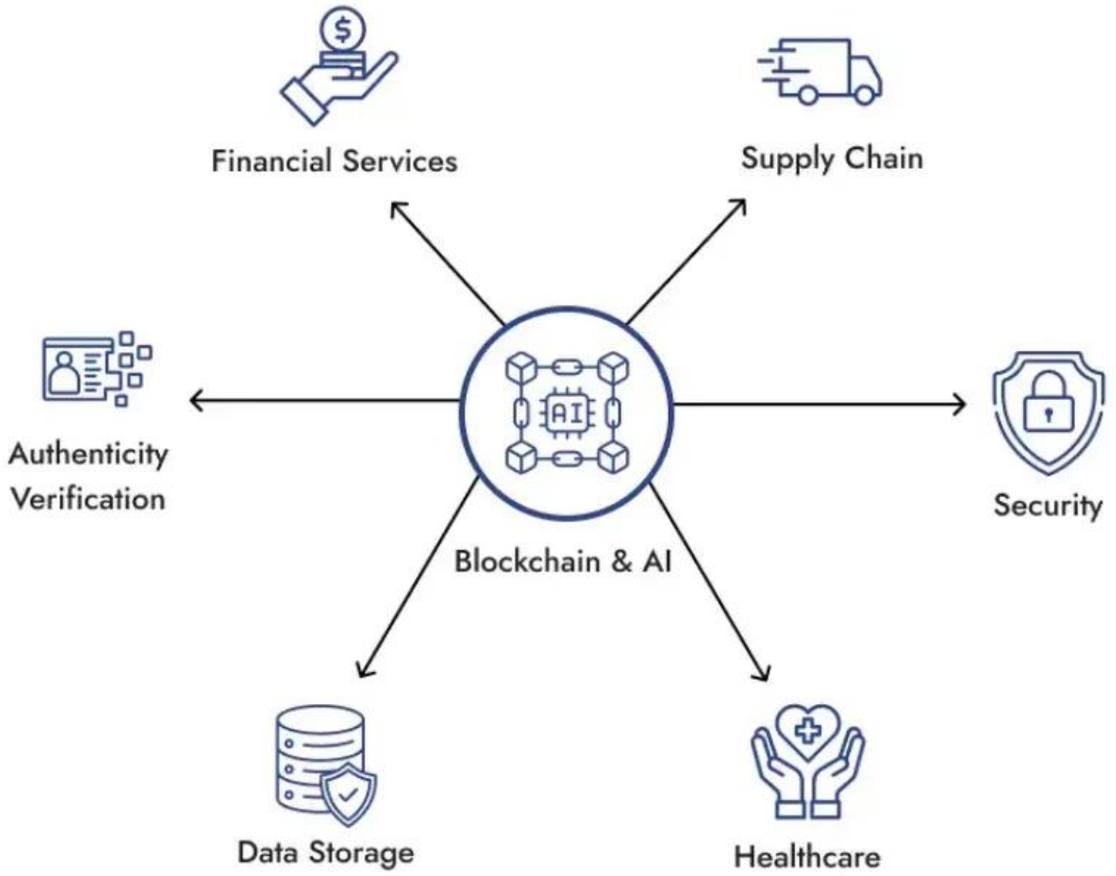
Motivation

Key points

- **Challenges in Web3:** Scalability, interoperability, energy consumption.
- **AI Agents:** Autonomous decision-making, real-time analysis, generative capabilities.
- **Multi-Agent Systems (MAs):** Collaborative problem-solving in decentralized environments.

Expansion

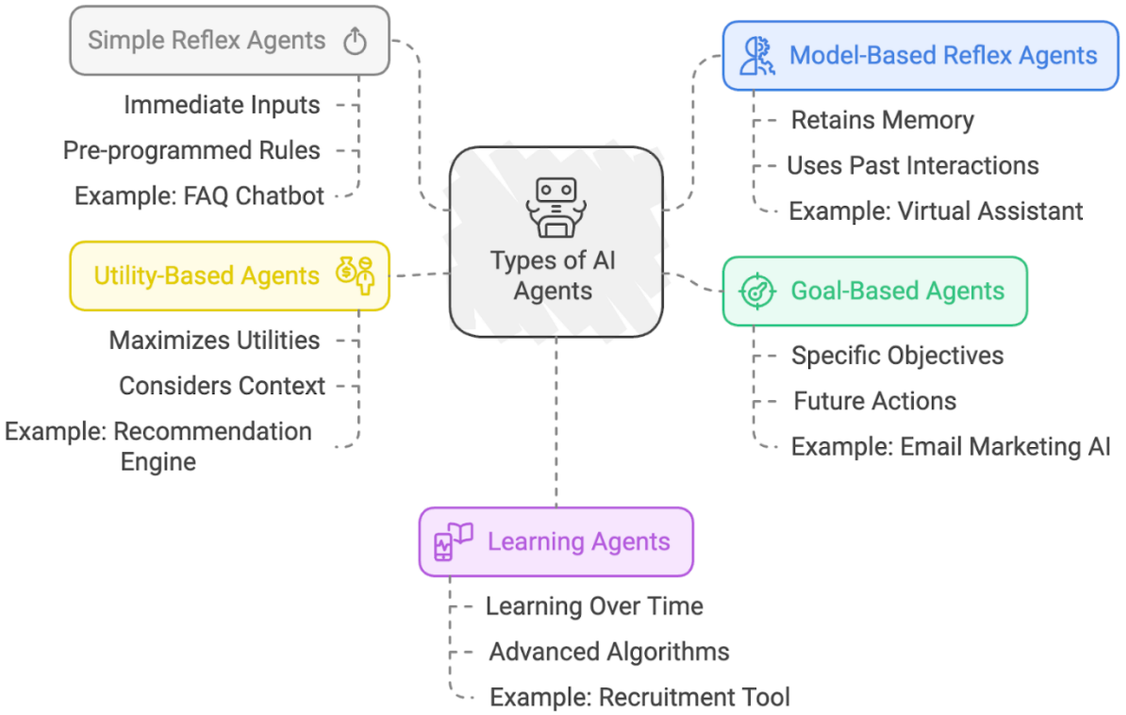
- **Case:** Blockchain's role in DA0 governance (5,000+ DAOs managing billions).
- **Problem-Solving:** Al agents address latency, trust gaps, and resource optimization.



Background

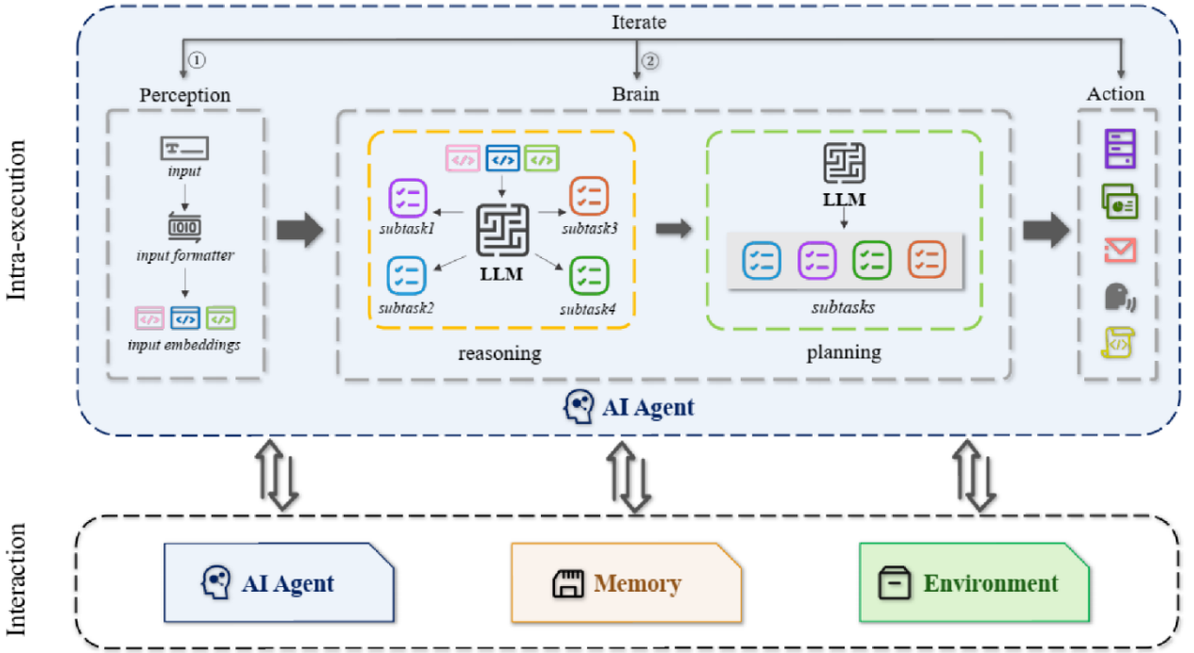
Overview of AI Agents

- **Definition of AI Agent:** An AI Agent is an intelligent entity capable of perceiving its environment.
- **Functionality:** It can make decisions and execute actions.



Working of AI Agent

- **Perception:** The AI Agent's ability to gather information from the environment and extract relevant knowledge.
- **Planning:** The process by which an AI Agent makes decisions to achieve a specific goal.
- **Action:** Actions taken by the AI based on the environment and its planning.



Research Method

Literature Search Keywords

("AI Agent" OR "Agent AI" AND Blockchain OR Web3), ("AI Agent" OR "Agent AI" AND "Generative AI" AND Consensus), ("AI Agent" OR "Agent AI" OR Web3 AND Privacy), ("AI Agent" OR "Agent AI" AND "Blockchain" AND "Generative AI" OR Web3), ("AI agent" OR "agent AI" OR "LLM agent" OR "autonomous agent" OR multi-agent OR "intelligent agent" AND blockchain OR "decentralized AI" OR web3 OR "generative AI")

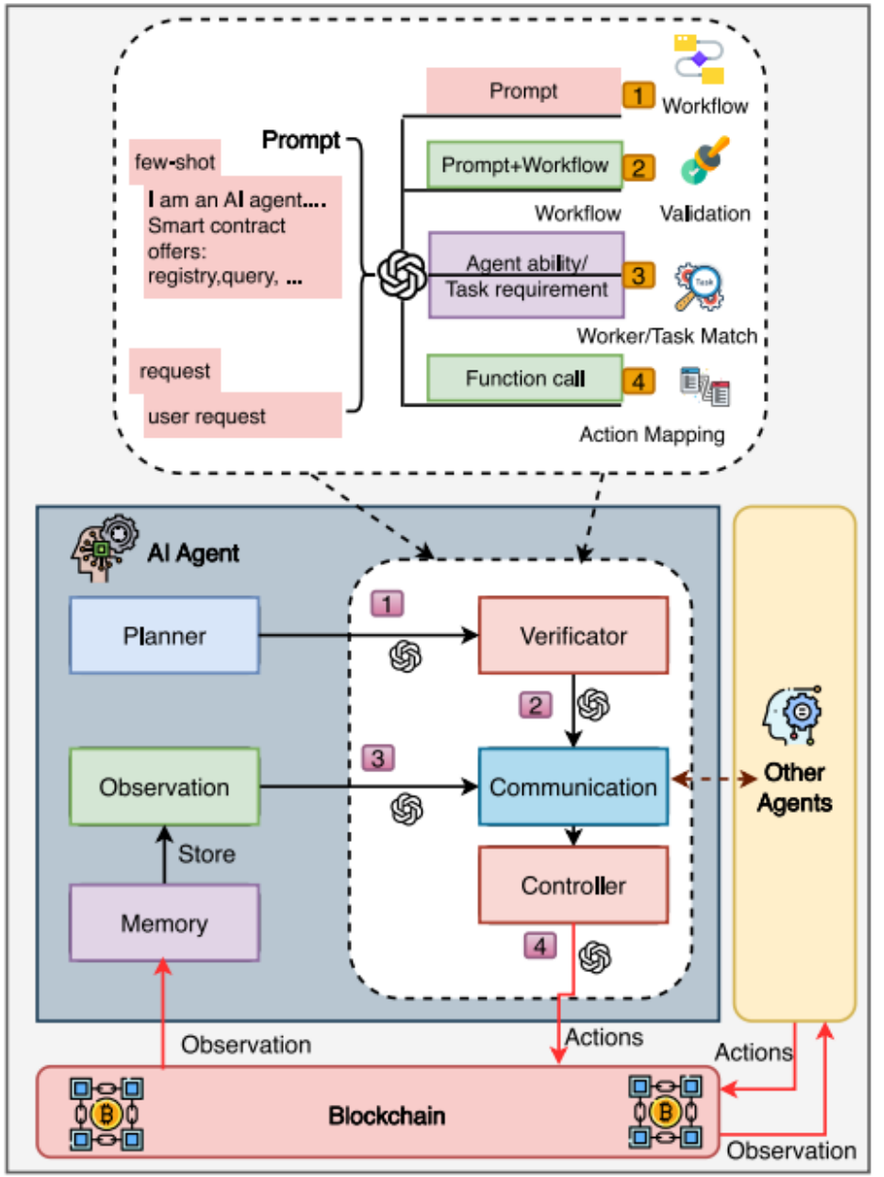
Database and Search Process

- Literature sourced from **IEEE, ACM**, **Springer**, **ScienceDirect**, and **Web of Science**.
- Systematic search identified **140** articles in initial round.
- Reduced to **110** after first screening of and further narrowed to **80**.

Synergy Between AI Agents and Blockchain

AI Enhancing Blockchain

- **Intelligent Consensus:** Proof-of-Thought (**PoT**), Proof-of-Compute (**PoC**).
- **Zero-Shot Learning:** Fraud detection without prior training.
- **Vulnerability Detection:** Ensemble LLMs for smart contract security (**98.8% accuracy**).

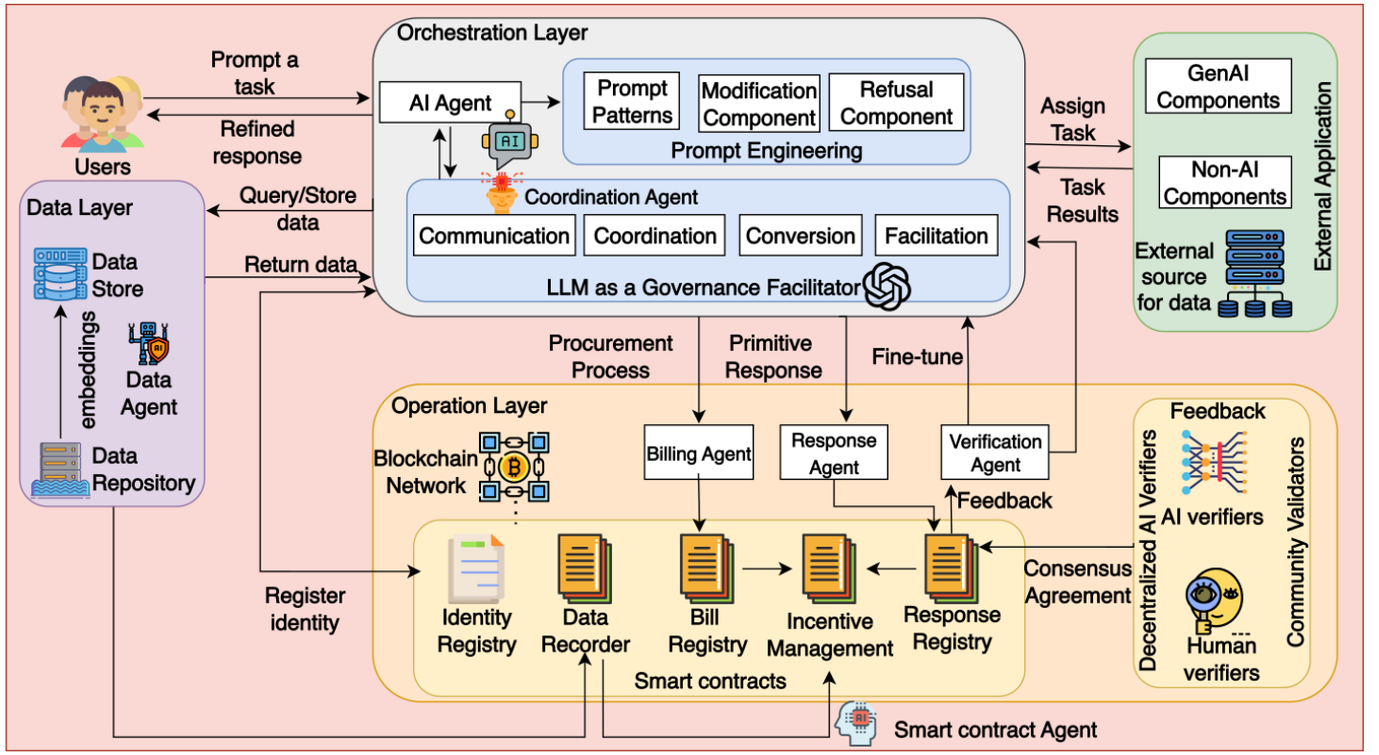


Synergy Between AI Agents and Blockchain

Blockchain Empowering AI Agents

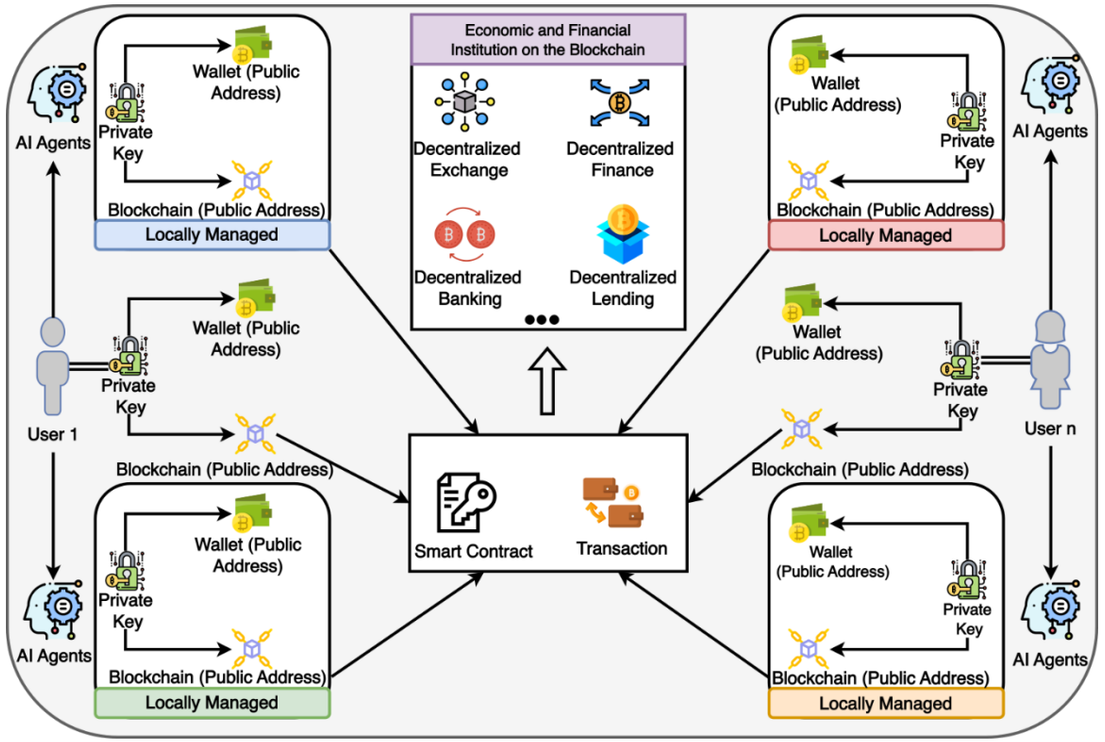
- **Secure Infrastructure:** Ethereum AI Agent Coordinate Or (EAAC), IPFS integration.
- **Governance:** Decentralized voting for multi-agent collaboration (mABC framework).
- **Dynamic Environments:** Blockchain's on-Chain and off-chain data integration develops adaptive agents.

Example: BlockAgents framework for Byzantine fault tolerance



Applications

- **Asset Management:** Tamper-proof ownership tracking via smart contracts.
- **DeFi:** AI-driven trading strategies (e.g., **CryptoTrade** agent with 24% throughput increase).
- **DAOs:** LLM-powered governance (e.g., Luna influencer with 45% user retention).
- **Supply Chain:** Dynamic collaboration across stakeholders.
- **Edge computing:** Resource allocation in IoT networks.



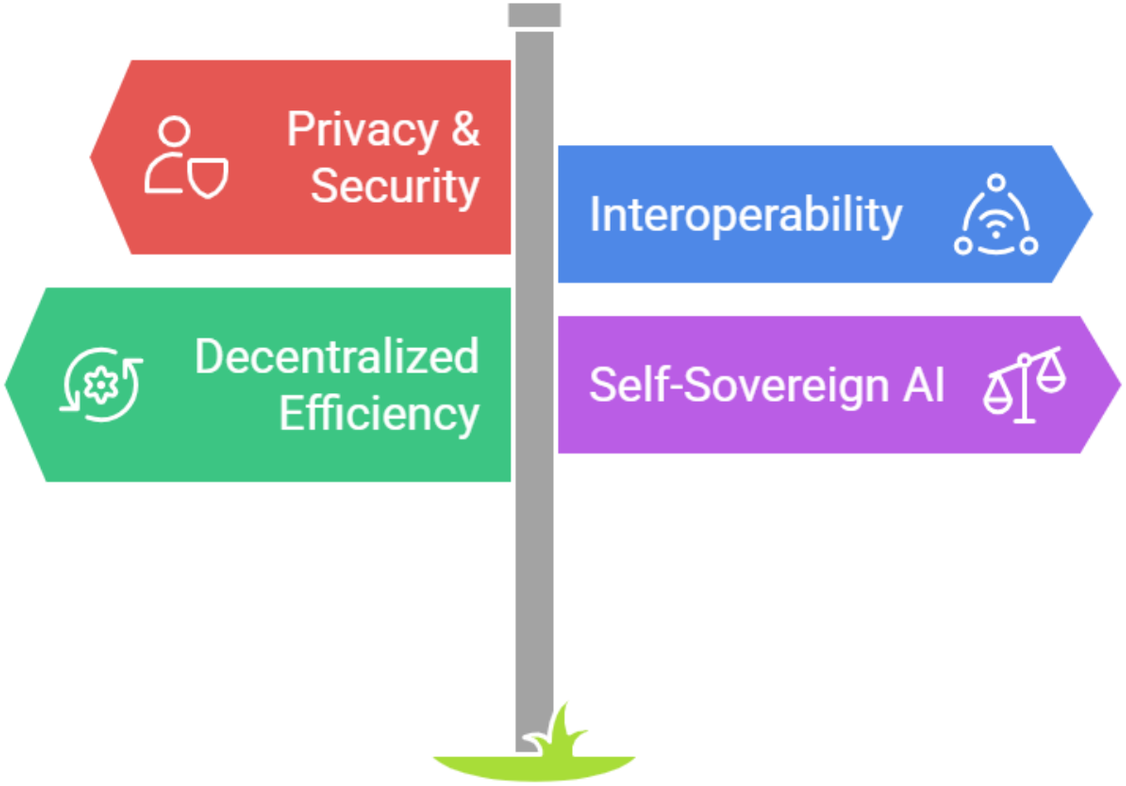
Empirical Case Studies

Examples	Criteria	Advantages	Limitations
ai16z (Solana)	DeFi (Hedge Funds)	- Optimizes portfolio allocations using AI agents - Reduces operational costs by 20% through automation	- Limited scalability due to Solana's throughput constraints - Relies on the DAO model, which can face coordination issues
Terminal of Truths (ToT)	DeFi (Tokenomics)	- Increases daily transaction throughput by 24% through autonomous decision making - Eliminate intermediaries, enhancing efficiency	- High computational overhead for AI integration - Limited privacy due to public blockchain ledger
Luna (Virtuals Protocol)	Social Engagement	- Enhances user retention by 45% with tokenized rewards and governance mechanisms - Operate as an autonomous influencer across social platforms	- Dependency on user activity for sustained engagement - Vulnerable to limitations of platforms and content regulations
ArbDoge AI (Arbitrum)	Collaborative DAOs	- Engages over 270,890 token holders to develop decentralized products collaboratively - Incentivizes innovation through AI-driven project proposals	- Requires high participation to maintain innovation and governance effectiveness - Faces challenges in interoperability across multiple blockchains
Fetch.ai	Privacy and IoT	- Secures IoT operations by leveraging both AI agents and blockchain-based privacy protocols - Enhances data privacy and trust	- Limited scalability in high-frequency IoT use cases - Integration complexity for heterogeneous IoT devices
Delysium (Web3 Gaming)	Gaming and NFTs	- Integrates AI agents to enhance user experiences - AI-driven governance models enable decentralized game economies	- High computational demands for real-time decision making - Relatively immature ecosystem for large-scale gaming adoption
SingularityNET + Cardano	DeAI	- Supports DeAI services through blockchain and cross-chain operability - Cross-chain compatibility enables broader application reach	- Computational overhead due to combining AI and blockchain workflows - Limited number of DeAI applications currently supported

Research Challenges

Key Challenges

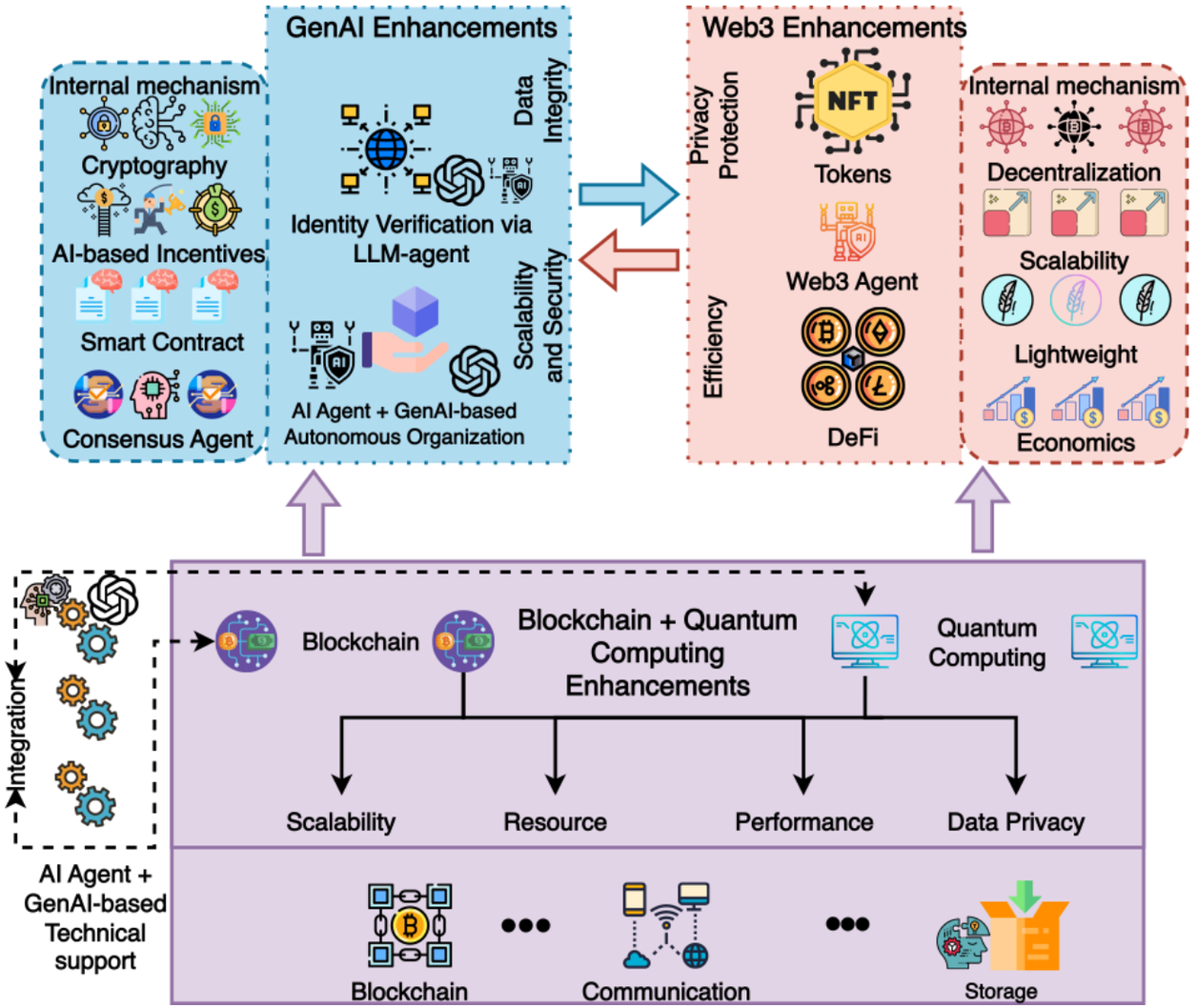
- **Privacy& Security:** Multi-agent eavesdropping, quantum steganography risks.
- **Interoperability:** Cross-chain communication (e.g., **Talus**, **Delysium bridges**).
- **Decentralized Efficiency:** Balancing computational overhead and autonomy.
- **Self-Sovereign AI:** Accountability for untethered agents (e.g., **Proof-of-Personhood**).



Future Directions

Future Directions

- **Quantum Computing:** Quantum-resistant protocols for blockchain-AI fusion.
- **Ethical Governance: ETHOS** framework for decentralized accountability.
- **Responsible AI:** AI systems should promote fairness and transparency.



Conclusion

Key Takeaways

- ❑ Blockchain and Al agents synergize to enable secure, scalable decentralized systems.
- ❑ Transformative applications in DeFi, DAOs, supply chains, and edge computing.
- ❑ **Critical challenges:** Privacy, interoperability, and ethical governance.

Call To Action

- ❑ Foster collaboration between academia and industry to advance decentralized intelligence.

Any Questions ?