

Wireless Networks

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Integrating Edge Intelligence and Blockchain

What, Why, and How

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Preface

Along with the wave of informatization technology, an unprecedented booming era of artificial intelligence (AI) has emerged. Meanwhile, with the proliferation of wireless communication, immense volumes of data are generated by mega-scale terminals instead of traditional cloud datacenters. Driving by these trends, edge intelligence (EI) has elicited escalating attention. Instead of entirely relying on the cloud, EI makes the most of the widespread edge resources to gain AI insight. It is yet facing critical challenges in its decentralized management and security, limiting its capabilities to support services with numerous requirements.

In this monograph, the blockchain (BC) has been seen as a promising solution to tackle the above issues, further support EI. Based on the number of citations or the relevance of an emerging method, this monograph presents the results of a literature survey on the integration of EI and BC. Accordingly, we conduct a summarization of the recent research efforts on the existing works for EI and BC. We then paint a comprehensive picture of the limitation of EI and why BC could benefit EI. From there, we explore how BC benefits EI in terms of computing power management, data administration, and model optimization. To narrow the gap between immature BC and EI-amicable BC, we also probe into how to tailor BC to EI from four perspectives, including flexible consensus protocol, effective incentive, intellectuality smart contract, and scalability. Finally, some research challenges and future directions are addressed.

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Acronyms

| | |
|---------|---|
| 2Ts-DRL | Two-timescale deep reinforcement learning |
| ACK | Acknowledge character |
| ADMM | Alternate direction method of multipliers |
| AI | Artificial intelligence |
| AIE | Artificial intelligence on edge |
| API | Application programming interface |
| BaaS | Blockchain-as-a-service |
| BC | Blockchain |
| CD | Computing-power device |
| CLI | Command Line Interface |
| CNN | Convolutional neural network |
| CNN | Convolutional neural network |
| CNN | Proof of work |
| CSP | Computing service provider |
| DAO | Decentralized automatic organization |
| DApp | Decentralized applications |
| DL | Deep learning |
| DLT | Distributed ledger technology |
| DNN | Deep neural networks |
| DQL | Deep Q-learning |
| DQN | Deep Q-network |
| DRGO | Deep reinforcement learning combined with genetic algorithm |
| DRL | Deep reinforcement learning |
| DSIC | Dominant-strategy incentive compatibility |
| EC | Edge computing |
| ECSP | Edge computing service provider |
| EI | Edge intelligence |
| ePoW | Enhanced proof of work |
| FL | Federated learning |
| HRL | Hierarchical reinforcement learning |
| IC | Incentive compatibility |

| | |
|----------|--|
| IDC | International data corporation |
| IIoT | Industrial internet of things |
| IoT | Internet of things |
| IoV | Internet of vehicles |
| IR | Individual rationality |
| ITS | Intelligent telehealth system |
| LM | Learning markets |
| LSTM | Long short-term memory |
| MARL | Multi-agent reinforcement learning |
| MDP | Markov decision process |
| ML | Machine learning |
| NFV-MANO | Network function virtualization management and orchestration |
| P2P | Peer-to-peer |
| PBFT | Practical byzantine fault tolerance |
| PoDL | Proof of deep learning |
| PoET | Proof of elapsed time |
| PoK | Proof of knowledge |
| POMDP | Partially observable markov decision process |
| PoQ | Proof of training quality |
| PoS | Proof of stake |
| PoT | Proof of trading |
| PoW | Proof of utility |
| QoS | Quality of service |
| RBFT | Redundant byzantine fault tolerance |
| UDEC | Ultra-dense edge computing |
| VANET | Vehicle ad hoc network |
| WAN | Wide area network |
| ZB | zettabytes |