



Special Topic on AI-Agent Communication Network (ACN): Architecture, Protocols and Key Technologies

Guest Editors



 Sun Tao



 Cui Yong

AI agents, whether embodied as physical entities or existing as software, are developing extremely fast and are believed to be vital for 6G and the whole Internet in the future. The communication network shall evolve to meet the great potential increase in the number of agents. AI agents are expected to become new users but with quite different traffic patterns, varying quality of service (QoS) requirements, and multi-modality data. They may also rely on the network to gain facilitated capabilities such as computing, sensing, and data. It is important to enable these AI agents to communicate with each other securely at any time and anywhere to accomplish assigned tasks. By leveraging AI agents, the communication system may undergo a revolutionary change toward a new generation. Embodied AI agents in network elements (e. g., terminals, access, core and transport networks) will make the system run actively, dynamically, and autonomously. It can be seen that AI agents are bringing a new paradigm for network services as well as for the network itself. It is worthwhile for both industry and academia to devote effort to making this happen toward the AI era.

In this special issue, we aim to explore the AI-Agent Communication Network (ACN) from the perspectives of architecture, protocol and key technologies. In view of the community's interest in this area, as well as the timing of 6G standardization,

we believe this special issue is the right time to show how the community views this important area and, as a trigger, to further explore this.

The first paper, titled "AI Agent Centric Network: New Network Design Paradigm and Related Key Technologies", proposes a paradigm shift for future 6G wireless networks from traditional human-centric, connectivity-oriented designs to AI Agent-Centric (AA-Centric) networks. To realize this vision, the paper introduces key supporting technologies, including a new functional system framework, a layered wireless network architecture, multi-level large language model collaboration, and enhanced protocols for agent-to-agent and agent-to-non-agent interaction.

The second paper, titled "Toward AI-Agent-Native 6G Networks: A Survey on Protocols, Multimodal Coordination, and ISCC-Driven Dynamic Networking", explores AI-agent-native 6G networks, shifting from the Internet of Things (IoT) to the Internet of Agents (IoA) with AI agents as core users. It analyzes unique agentic traffic (bursty semantic streams, ultra-reliable low-latency flows) and proposes agent-centric key value indicators (KVIs). It introduces Agentic Syntax for intent-based signaling, multi-agent coordination via Integrated Sensing, Communication, and Computing (ISCC) technologies, and network embedded agents (NEAs). A Deep-Agentic-Network Architecture (DAN-Arch) is proposed, vertically integrating physical sensing and reasoning flows. Finally, challenges in energy efficiency, standardization, and governance are discussed to guide future research.

The third paper, titled "Training Optimization for Complex Reasoning Tasks in ACN: Dynamic Batch-Aware Advantage Weighting for Agentic RAG", addresses reward sparsity and low sample efficiency in training Agentic retrieval-augmented generation (RAG) for complex reasoning in 6G ACN. It pro-

DOI: 10.12142/ZTECOM.202602001

Citation: (Format 1): Sun T, Cui Y. Editorial: AI-Agent Communication Network (ACN): architecture, protocols and key technologies [J]. *ZTE Communications*, 2026, 24(2): 1-2. DOI: 10.12142/ZTECOM.202602001

Citation: (Format 2): T. Sun and Y. Cui, "AI-Agent Communication Network (ACN): architecture, protocols and key technologies," *ZTE Communications*, vol. 24, no. 2, pp. 1 - 2, Jun. 2026. doi: 10.12142/ZTECOM.202602001.

poses dynamic batch-aware advantage weighting (DB-AW), a lightweight reinforcement learning (RL) module built on group relative policy optimization (GRPO), with two core components: difficulty-aware weighting (amplifying advantages for challenging samples) and batch filtering (removing zero-gradient groups). Evaluated on HotpotQA, NQ, and 2Wiki datasets, DB-AW delivers 15% - 18% accuracy gains on Qwen2.5-3B/7B and LLaMA3.2-3B, while lifting the effective update rate from 68% to 100%. It reduces training costs and enables scalable agent deployment in ACN.

The fourth paper, titled “Internet of Agents: Design of the Protocol System”, designs a protocol system for the IoA, addressing identity management, dynamic networking, and semantic routing challenges in large-scale agent collaboration. It classifies agents into user agents and service agents, proposing a three-layer architecture with management, control, and routing protocols. Key designs include unified agent identification, capability registration, Domain Name System (DNS)-based service discovery, task-driven networking, and semantic routing. The system extends existing Internet protocols and introduces semantic awareness to enable scalable, secure cross-domain agent collaboration, laying a foundation for an open, large-scale agent ecosystem.

The fifth paper, titled “The Dawn of 6G: Empowering a User-Centric Ecosystem with Agentic AI”, proposes AA6NS, an Agentic AI-enabled 6G network service framework for user-centric ecosystems. It integrates Agentic AI across 6G’s application, core, and RAN layers, enabling intent-driven orchestration, adaptive QoS management, and dynamic multi-device service group coordination. The framework supports physical AI applications such as smart delivery, elderly care, and emergency rescue, translating user intents into real-time network actions. Key capabilities include task-level packet data unit (PDU) sessions, service awareness, and group management, laying the foundation for intelligent, adaptive human-machine collaboration in 6G.

The sixth paper, titled “Intent-Driven Control System for Heterogeneous Agent-Oriented Networking (HaoNet)”, tackles dynamic, high-frequency agent interactions. HaoNet has three core traits: task-driven operation, distributed collaboration, and closed-loop intelligence. A three-layer architecture integrating Intent-Driven Network (IDN) maps high-level intents to network actions. Key technologies include Monitor-Analyze-Plan-Execute over a shared Knowledge (MAPE-K) adaptive loops, large language model (LLM)-based intent processing, and large-small model collaboration. Smart home and

smart factory scenarios verify the system’s ability to boost policy consistency, reliability, and task efficiency in dynamic agent networks.

The seventh paper, titled “Mitigating Semantic Drift in Multi-Agent Communication: A Dynamic Neuro-Symbolic Approach”, addresses semantic drift in LLM-based multi-agent communication, where heterogeneous agents assign conflicting meanings to shared terms. It proposes DOA, a dynamic ontology alignment framework with a semantic prober, neuro-symbolic aligner, and consensus vault. DOA dynamically reconciles local ontologies in real time, grounding dialogue in a shared evolving ontology. Evaluated in supply chain and healthcare scenarios, DOA boosts task success rates by 31.5% and cuts communication overhead by 50%, outperforming raw natural language and fixed-schema baselines.

ACN is a new and important topic. The papers above span new ideas on architecture, mechanisms, and protocols, covering both mobile networks and the Internet in general. As this special issue is being generated, OpenClaw is booming. It can be expected that more AI agent applications, frameworks, and platforms will emerge. The open-source and industry ecosystem is also key to this area. In summary, we hope this special issue is a big step toward identifying the open problems, attracting more attention from the community to work together, and designing the system for the era of AI tokens and AI-agent worlds.

Biographies

Sun Tao received his BS degree in automation (2003) and PhD degree in control science and engineering (2008), both from Tsinghua University, China. He has been with China Mobile Research Institute since 2008. He is now the Chief Expert at China Mobile. He has more than ten years of experience in mobile network architecture design, IP technology research, and standardization, and served as the Vice Chair of 3GPP SA2 (System Architecture). He currently serves as Vice Chair of 3GPP SA.

Cui Yong received his BE degree (1999) and PhD degree (2004) both in computer science and engineering from Tsinghua University, China. He is currently a full professor in the Computer Science Department at Tsinghua University. He has published over 100 papers in refereed conferences and journals, receiving several Best Paper Awards. He has co-authored more than 10 Internet standard documents (RFCs). His major research interests include mobile cloud computing and network architecture. He served or serves on the editorial boards of *IEEE TPDS*, *IEEE TCC*, and *IEEE Internet Computing*. He also acted as a working group co-chair at IETF.