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M. Yu
A. Wang
J. Li
Z. Li
China Telecom

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AI Agent Use Cases and Requirements in 6G Network
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Abstract

This draft introduces use cases related to AI Agents in 6G networks, primarily referencing the technical report of 3GPP SA1 R20 Study on 6G Use Cases and Service Requirements (TR 22.870). It also elaborates on some of the requirements for introducing AI Agents into 6G networks from the perspective of operators.

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1. Introduction

Currently, with breakthroughs in large language models and multimodal technologies, AI Agent has emerged as a major research focus in the industry. Equipped with capabilities such as intent understanding, action planning, decision-making, task execution, and self-awareness, AI Agents can integrate environmental perception, memory, tool invocation, and multi-agent collaboration to accomplish complex tasks. They have already demonstrated significant value in key fields like autonomous driving, intelligent customer service, and smart home systems. In the 6G era, the introduction of AI Agent technology will enable operators to fully leverage the potential of mobile communication networks, significantly improving network operational efficiency and user experience. As a result, AI Agents are expected to become a key research focus in future 6G networks, leading to deep integration between 6G and AI Agent technologies.

In the 3GPP R20 standardization research for 6G, AI Agent has been one of the most discussed and debated topics, whether in SA1’s study on 6G scenarios and requirements or SA2’s research on network architecture. In the SA1#109 meeting, 19 contributions related to AI Agents were submitted, which include 16 new use cases, with 4 use cases ultimately agreed. And a preliminary definition of AI Agent from a capability perspective was adopted: "an automated intelligent entity capable of e.g interacting with its environment, acquiring contextual information, reasoning, self-learning, decision-making, executing tasks (autonomously or in collaboration with other Al Agents) to achieve a specific goal." In the SA1#110 meeting, more than 30 contributions related to AI Agents were submitted, which include 22 new use cases, with 7 ultimately agreed.

This draft summarizes and categorizes the AI Agent-related use cases in 6G networks, with a brief introduction provided in Section 2. In Section 3, from an operator’s perspective, we elaborate on the potential requirements for introducing AI Agents into 6G networks, which should be considered when designing the A2A protocol in mobile communication network. In Section 4, we conclude this draft.

2. Use Cases

AI Agents can be deployed at various locations within the 6G system. Depending on their deployment positions, AI Agents in 6G can be classified into On-device AI Agents (deployed on user devices), application AI Agents, network AI Agents (deployed within the future 6G network), operation management AI Agents, etc. For instance, terminal AI Agents refer to those implemented on end-user devices, while network AI Agents are those embedded within the 6G network.

This section summarizes and categorizes AI Agent-related use cases in 6G networks. Unlike AI Agents in the internet domain, use cases involving AI Agents in mobile communication networks place greater emphasis on how network AI Agents can deliver 6G services to users, as well as how different AI Agents within the 6G system coordinate with each other.

2.1. Novel Intelligent 6G Services Enabled by Network AI Agents

By deploying AI Agents within 6G network, the 6G network can provide users with novel intelligent services. These intelligent services may represent combinations of multiple network capabilities, such as communication services, sensing services, AI/ML services, computing services, and more. Users only need to express their intent to the 6G network, without requiring specialized technical knowledge to decompose the intent into technical requirements. In this context, 3GPP SA1 has formally defined network intent as: Expectations including requirements, goals and constraints without specifying how to achieve them.

2.1.1. Use Case On 6G Network Providing On-demand Networking with AI Agent

User Harry owns a smart robot named Ron and has a lovely pet dog called Bob. Bob needs to be walked twice daily. While away on a business trip, Harry sends his request through an operator portal (which could be an app, a mobile webpage, etc.) to the 6G network’s AI Agent, expressing his intention for robot Ron to ensure Bob’s safety during walks. The network AI Agent processes this request, determines that the task requires perception services and QoS-guaranteed services, and then distributes these services to the relevant network entities.

2.1.2. Use Case On Intelligent Calling Services

The network delivers AI Agents enabled intelligent calling services that revolutionize traditional voice communications. By integrating recognition and perception capabilities of AI Agents, it offers two key functionalities: 24/7 Intelligent Answering (handling calls during unreachability, e.g., flight/power-off modes with contextual responses) and Intelligent Answering Machine (managing calls during user unavailability, e.g., meetings, with call logging). These services operate under strict user authorization, allowing customization of voice tones, trigger conditions (e.g., flight mode activation), and data permissions (call records/summaries). For instance, when a subscriber enables the service, the network autonomously answers calls based on predefined preferences and provides post-call analytics.

2.1.3. Use Case On Disaster Rescue Planning Enabled By Network AI Agents

When a disaster strikes, unpredictable challenges such as collapsed buildings, deformed roads, and communication outages make the rescue extremely complex. By leveraging 6G network AI Agents for rescue planning, the rescue efficiency can be significantly improved, maximizing the protection of victims ' lives and personal property. In this case, the intent may be "execute the rescue mission with multiple rescue robots in a certain area". Upon receiving the intent, the network AI agents initiate the rescue planning and decompose the rescue into multiple operations and other standardized 3GPP service. This may specifically include: road obstacle sensing (sensing service), multi-robot rescue route planning (AI inference service), training obstacle avoidance models (AI training service), real-time optimal route computation for rescue robots (computing service) and communication resource allocation for disaster zones (communication service).

2.2. Device-Network Collaboration

With the rapid advancement of technologies like smartphones and lightweight large-scale AI models, capabilities of user devices have significantly expanded, enabling autonomous execution of certain AI tasks and independent decision-making. However, due to inherent device limitations - including constrained computational resources and battery capacity - deploying complex AI agents or performing sophisticated AI tasks locally on devices remains challenging. Consequently, investigating optimal collaboration mechanisms between UE-based AI agents and network-based AI agents to accomplish complex tasks represents a critical research direction for 6G networks.

2.2.1. Use Case On 6G System Assisted AI Agent Service

AI-powered devices can interact with their environment—collecting data, making autonomous decisions, and executing actions. The 6G system will enhance AI agents by providing supplementary environmental data (e.g., real-time sensing for traffic awareness) and dynamic QoS updates for adaptive decision-making.Additionally, 6G must support secure AI agent authentication and inter-agent communication, as traditional identifiers like SUPI/IMSI may not suffice for dynamic AI functionalities. The rise of AI agents will also increase "horizontal traffic" between devices, enabling collaboration within agent groups and with third-party applications.

2.2.2. Use Case On Smart Housekeeping

6G system could help to keep the family daily care and security, requiring advanced automation and management capabilities to maintain a comfortable and efficient living space. There will be more AI related applications and intelligent devices (e.g. robots, UAVs, autonomous vehicles) in the 6G era. Users will be able to express their requirements through natural language to convey their needs. In certain scenarios, multiple devices will need to collaborate to complete complex tasks. The 6G system can dynamically coordinate devices based on user's supply and demand requirements.

2.2.3. Use Case On Child Health Management Assistant

Lily's smartwatch AI agent continuously tracks her vital signs (heart rate, body temperature) during school hours. When detecting abnormal readings (elevated heart rate and temperature), the system automatically escalates monitoring frequency and initiates an emergency protocol by: (1) verifying authorization through the network, (2) selecting the optimal emergency contact (mother Emma, based on real-time proximity and availability data), and (3) coordinating with Emma's AI agent by sharing Lily's health metrics, location data, and environmental conditions. The network facilitates this process by providing positioning services, environmental sensing data, and secure data transmission between authorized AI agents. Emma's AI agent then calculates the fastest route to Lily's location while receiving continuous health updates, enabling prompt medical intervention. This scenario showcases the seamless integration of UE-based and network-based AI capabilities, including cross-domain data analysis, dynamic service invocation, and privacy-preserving emergency response mechanisms, ultimately delivering timely healthcare intervention while maintaining strict data security protocols.

2.3. Multiple Devices Collaboration

Under the powerful communication capabilities of 6G networks, multiple on-device AI Agents can collaborate with each other to accomplish complex AI tasks. These AI Agents may from either the same application or different applications.

2.3.1. Use Case On Collaborative AI Agents

John and Ann’s electric vehicle (EV) uses an AI Agent to optimize charging based on dynamic energy prices and travel plans. While John sleeps during a business trip, his EV’s AI Agent detects high electricity prices at the hotel location and considers selling battery power back to the grid. To verify feasibility, it securely accesses both John and Ann’s calendar AI Agents (hosted by different providers) without waking them. Learning of John’s planned 900km return trip, the AI Agent cancels the energy sale. All cross-border data exchanges maintain strict privacy, blocking unauthorized access (e.g., from friends’ AI Agents). This demonstrates how standardized AI Agent interoperability enables intelligent, user-authorized decisions across distributed systems.

2.3.2. Use Case On AI Agents Communication

A group could be established for users and their AI agents to communicate with each other. To complete a complex task involving multiple users and triggered by a user, AI agent or application, communication domain for multiple groups could be established, Communication domain could be dynamically created for users and AI agents from multiple groups to communicate with each other for a specific task during a specific time. Only the AI agents in the same domain can communicate with each other. If authenticated / authorized, users and AI agents could join this group via various access technologies, including the cellular network, WiFi and Ethernet, etc.

2.4. Network-Application Collaboration

The 6G network AI Agents and application AI Agents can fully collaborate to accomplish network tasks. On one hand, AI agents within the 6G network can invoke appropriate application AI Agents based on service characteristics. On the other hand, the network AI Agents can share network data and domain expertise with application AI Agents, providing crucial data support for application AI Agents.

2.4.1. Use Case On Intelligent Communication Assistant

Currently, most of the personal AI assistants are provided on the devices (e.g. smart phones). However, the limitation of the power and thermal factors are the bottlenecks of the AI assistant development on devices. Operators are highly possible to provide the Intelligent Communication Assistant services leveraging 6G network AI Agents. For example, Alice is a business traveler, and her personal assistant in 6G network automatically monitors flight status, books a taxi upon landing by interfacing with the taxi company’s registered

AI service, and guides her to the vehicle using real-time location data - all without taxing her smartphone’s resources. This includes collaboration with AI Agents for applications such as taxi booking and real-time navigation.

2.4.2. Use Case On 6G AI Agents Collaboration With Third-party AI Using LLM

A 3rd party application (e.g. a smart city traffic management system) AI Agent sends a text-based request or query to the 6G network. The request is processed by an AI agent in the 6G network that leverages LLMs and the network’s advanced capabilities (e.g. sensing, real-time data processing, telemetry, analytics, and others) to provide a response or perform an action. The 6G network AI agent acts as an intelligent intermediary, interpreting the text-based request, gathering necessary data, and returning a response or executing a task.

3. Potential Requirements for 6G Network

In this section, we present potential requirements to 6G network that may arise from the introduction of AI Agents in 6G mobile communication networks from an operator’s perspective. Some of these potential requirements have already been agreed by 3GPP, while others have not yet been adopted by 3GPP.

3.1. The Identity of AI Agents

The 6G network shall support secure authentication, authorization, and management mechanisms for AI Agents’ digital identities. These AI Agents include on-device AI Agents, 3rd party AI Agents, network AI Agents, etc. A robust identity management mechanism is the prerequisite for interactions between users and AI Agents, as well as between different AI Agents.

3.2. Efficient Collaboration

The 6G network shall support efficient collaboration between different AI Agents and between AI Agents and the tools. This include: developing agent communication protocols better suited for 6G network characteristics, supporting multimodal data (such as text, audio, video, etc.) interactions, enabling rapid transmission of massive data volumes, etc.

3.3. Registration and Discovery

The 6G network shall support mechanisms for on-device AI Agents, 3rd party AI Agent, network AI Agents and tools to register their attributes to 6G network, which enables efficient, cross-platforms and cross-domain AI Agents and tools discovery. This may different from the discovery mechanism in A2A protocol (e.g. NRF discovery mechanism).

3.4. Service and Data Exposure

The 6G network shall support secure mechanisms to expose the 6G services (e.g. sensing service, computing service, AI/ML service, etc.) and network data (e.g. sensing data, positioning data, etc.) to 3rd party AI Agents.

3.5. Reliability Assurance

The 6G network shall be able to provide mechanisms (e.g. network digital twin) to ensure the reliability and the validity of the decisions made by the AI Agents. The decisions made by the AI Agents in 6G network may directly change the network status, parameters, configurations. Only decisions that have been verified for reliability can be executed to change the network environment.

3.6. High-performance Communication

The 6G network shall enable high-performance communication, which may include low latency, high band-width, ultra-high data rate, etc. This is crucial for numerous scenarios such as device-network collaboration, network-application collaboration.

3.7. Security

The security of AI Agents communication in 6G includes the data protection and user consent. Data pravacy means tha 6G networks shall support end-to-end encryption for the interactions between AI Agents to ensure robust data protection and privacy security for sensitive information. Besides, 6G network shall be able to provide mechanisms to collect the user consent for the local data collection.

3.8. Energy Efficiency

The 6G network shall be able to provide mechanisms to optimize the communication between AI Agents (especially for the on-device AI Agents) to reduce energy consumption.

4. Conclusion

AI Agents are expected to represent a critical innovation vector for 6G. This draft explores the transformative potential of AI Agents in 6G networks, outlining key use cases and operational requirements from an operator's perspective. When designing A2A protocols for 6G networks, the aforementioned requirements should be thoroughly considered and incorporated into the protocol architecture.

5. Informative References

[TR_22.870]
"3GPP TR 22.870, "Study on 6G Use Cases and Service Requirements", 2025.".

Authors' Addresses

Menghan Yu
China Telecom
Beiqijia Town, Changping District
Beijing
Beijing, 102209
China
Email: yumh1@chinatelecom.cn

Aijun Wang
China Telecom
Beiqijia Town, Changping District
Beijing
Beijing, 102209
China
Email: wangaj3@chinatelecom.cn

Jinyan Li
China Telecom
Beiqijia Town, Changping District
Beijing
Beijing, 102209
China
Email: lijinyan@chinatelecom.cn

Zhen Li
China Telecom
Beiqijia Town, Changping District
Beijing
Beijing, 102209
China
Email: liz779@chinatelecom.cn