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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 agent communication related 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. Intent-based 6G Services Enabled by Network AI Agents

By deploying AI Agents within 6G network, the 6G network can provide users with intent-based 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 QoSguaranteed 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).

2.1.4. Use Case On AI Agent For Network Performance Assurance

AI agents are artificial entities that can perceive environments, make decisions, and act. The AI Agents have evolved to LLM-based versions, leveraging LLMs’ strengths in knowledge acquisition, reasoning, and planning to decompose complex tasks into collaborative sub-tasks via perception, intent understanding, and plan reflection (with feedback and human interaction for robustness). In 6G network, multi-agent systems address strict network demands of big events (e.g., national games with millions of participants over 15 days), where Operator A deploys AI agents for performance assurance. The workflow involves organizers submitting intent-based requirements (e.g., bandwidth, VIP service), AI agents decomposing tasks into network configuration, resource allocation, and real-time monitoring, service agents creating and refining action plans through reflection, and action agents executing via tools. During the event, agents collaborate to ensure VIP QoE, monitor KPIs, and auto-adjust networks upon warnings. This multi-agent collaboration fulfills 6G’ s big-event needs while reducing labor, surpassing 5G’ s limitations in real-time dynamic planning, frequent KPI collection, and plan reflection.

2.1.5. Use Case On Customized Service Provisioning Based On AI Agents

With telecom industries prioritizing personalized services, AI agents integrate with 6G network to boost efficiency and innovation. This use case involves Bob (a 6G user), who needs high-quality 6G network support for a 2 pm online meeting during his tomorrow’ s Beijing-Chengdu train trip (departing 9 am). Assume that Operator A’ s 6G-deployed AI agent enabling intent-based services, user-agent interaction, and third-party resource access via tool invocations. Bob sends his intent; the AI agent validates the intent, and fetches third-party data (e.g., train schedules) if needed, identifies possible routes and covering base stations, predicts meeting QoE, and pushes fee-included assurance packages. After Bob’ s selection, the agent pre-configures the network, ensuring his optimal meeting experience during the journey.

2.1.6. Use Case On Network-based Intelligent Assistance (e.g. for autonomous driving) By a Network-native AI Agent

The rapidly growing market for AI-driven traffic navigation/ assistance (e.g., ADAS, autonomous vehicles) presents significant opportunities for 3GPP operators. 3GPP networks offer unique advantages: access to exclusive wide-area environmental/network data, distributed AI capabilities, low latency via edge computing, and the integration of communication-AI-sensing. They provide three service categories: Category 1 (local inferencing with vehicle/network data, low cost), Category 2 (added network sensing, moderate cost), and Category 3 (external data integration, comprehensive assistance). Core components include the AI Toolbox (pre-trained models/ algorithms), network-based intelligent assistant (AI Agent interpreting intents and orchestrating services), and UE-side Intelligent Assistance Application Entity. The service flow involves UE registration, subscriber intent submission (e.g., safe navigation), AI Agent recommending customized services, subscriber selection, and real-time network service activation/monitoring to fulfill the intent (e.g., safe travel to destination).

2.1.7. Use Case On AI-optimized Smart Call Assistance For Telecom Networks

A telecom operator integrates an AI-powered smart call assistance service into 6G network, leveraging in-network AI Agents to dynamically optimize voice/video call quality based on real-time network conditions, user intent, and historical data. Assume that the network AI capabilities (e.g., AI Agents), UE (smartphones/VoIP devices) with AI for real-time call condition/QoE monitoring, privacy-compliant user data sharing, and pre-trained AI models are deployed. The service flow starts with a user initiating a call; the UE’s AI monitors metrics like jitter and packet loss, requesting network adjustments if quality degrades. The 6G AI Agent generates optimizations (e.g., codec adjustments, bandwidth allocation) and validates effects (e.g., via digital twin). The UE provides QoE feedback, and the AI Agent continuously analyzes aggregated data, updating models if persistent issues (affecting single/multiple users) arise.

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.

2.2.4. Use Case On Flexible UE-Network Coordination Through AI Agent(s)

6G aims to support diverse terminals (cars, AR glasses, etc.) with advanced services beyond connectivity, but current service interaction faces fragmentation and reliance on user pre-knowledge of available services. To address this, Operator O deploys AI agents in its 6G network for generic UE-network coordination. When user A drives into city X, the service access AI Agent proactively recommends a regional sensing service to enhance driving safety, which A accepts—receiving beyond-line-of-sight sensing data. After checking into a hotel, A’s connected AR glasses are notified of a regional computing service; with A’s permission, the AI agent coordinates application offloading/acceleration. The AI agent dynamically adjusts: warning of potential downgrades in poor network areas (advising local app execution) and providing communication quality maps/path recommendations in crowded spots, plus optional VIP QoS prioritization.

2.2.5. Use Case On Proactive AI Agent For Personal Safety

This use case presents a network-hosted personal safety AI agent in 6G network, dedicated to proactively safeguarding users by integrating real-time data (location, wearable biometrics like heart rate/accelerometer, calendar) and environmental data (e.g., area crime statistics) to build user risk profiles. Assume that Alex has subscribed to the service, granting explicit data access consent, configuring safety policies (emergency contacts, distress triggers), and 6G ensuring secure, low-latency agent hosting. When Alex walks through an unfamiliar, high-crime area after dark, the agent monitors his data, detects a sudden spike in heart rate and sprinting, and activates a high-alert state. It sends Alex a safety confirmation prompt and alerts his emergency contact Chloe. Unresponsive after 30 seconds, the agent auto-contacts emergency services with Alex’s real-time location and context.

2.2.6. Use Case On Shared Embodied AI Agents

A future shared embodied AI agent model will emerge, with entities like humanoid robots, robot dogs, and Automated Guided Vehicles (AGVs) deployed across cities for rental. This boosts their utilization and makes AI tech more accessible, requiring 6G’s high-speed, low-latency network for real-time status reporting, location sharing, and interactions. Assume that ShareRobot deploys such agents (with IDs, communication modules) registered to Operator A. Bob’s (AGV) Sam (registered to Operator B) can’t carry a mattress, so he rents a ShareRobot shared AGV via QR code— logging in, authorizing access to Sam, and binding them. The two AGVs connect, share attributes, and collaborate to move the mattress. Finally, Bob successfully transports the mattress, returns the shared AGV, pays for usage; ShareRobot pays Operator B for data traffic and related services.

2.3. Multiple Devices Collaboration

Under the powerful communication capabilities of 6G network, 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.

2.3.3. Use Case On Authentication And Authorization For AI Agents

The security risks (malicious intent, intent misinterpretation) of AI Agents are critical. Thus, authentication (verifying AI agent/user identity) and authorization (limiting access to subscribed services) are essential, with distinct policies for UEs and on-device AI agents. A case in point: an invite-only AR exhibition, where authorized AI agents in smart glasses enable personalized AR content via the operator’ s ultra-low-latency, high-bandwidth network. Alice and Bob (invited, registered) and Cindy (impersonating Dale via his glasses) launched the AR app. The network authenticated all AI agents but failed Cindy’ s user authentication; only Alice and Bob got approved, accessing dedicated data paths for real-time AR rendering. Cindy was rejected, and the network mitigated threats through dual authentication/authorization.

2.3.4. Use Case On Smart Support For Data Collection And Fusion In Multi-agent Scenarios

This use case describes a smart collaboration scenario where several robots (UEs) with data collection and processing capabilities and direct/indirect network access collaboratively build an information set via data/sensor fusion. Emphasizing energy, resource efficiency, and situation-aware communication, the robots generate diverse, dynamically changing AI traffic with varying QoS requirements. They share real-time traffic demands with the 6G network and a fusion center; an AS (trusted third party) centrally coordinates, e.g., instructing pre-processing or task splitting. The 6G network adapts to dynamic traffic changes (e.g., robot/object distance) to ensure reliable communication.

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.

2.4.3. Use Case On Network Knowledge As Part of Retrieval Augmented Generation For Generative AI

Generative AI (including LLMs and multi-modal models) combined with Retrieval Augmented Generation (RAG)—which retrieves external knowledge to augment prompts before generation—enhances output quality with up-to-date information while reducing model retraining energy costs. In 6G, MNOs deploy diverse network knowledge sources (static/dynamic data like roaming conditions, coverage, performance predictions) to support RAG-powered services such as XR city sightseeing. Subscribed user Alice invoke XR apps, prompting Generative AI to use RAG for accessing relevant network knowledge. The app selects suitable knowledge sources, retrieves data, and generates optimized outputs (e.g., XR previews adapting to roaming/coverage constraints). Benefits include improved user experience, energy savings, and digital inclusion, though retrieval may introduce delays. Existing 5G lacks full RAG support, making 6G’s timely multi-source knowledge provision critical.

2.4.4. Use Case On AI Agent Management

To address global elderly care challenges amid aging populations, 6G network enable cross-ecosystem collaboration of third-party AI agents on smart devices (e.g., cameras, bracelets, TVs) via operator-managed registration and invocation mechanisms. Operator A provides AI agent management for 70-year-old Mary, whose devices register capabilities (fall detection, heartbeat monitoring, video call) to the 6G network. When Mary’s smart camera detects a fall, it triggers emergency services directly or via the network. The emergency center requests real-time data; the 6G network invokes her bracelet’s AI agent for heartbeat monitoring and the camera’s agent for live video (with consent). It further activates the TV’s AI agent for a video call—featuring volume amplification, dialect translation, and instructional videos—to guide Mary. Finally, Mary handles injuries correctly while awaiting paramedics. Existing 5G features partially support this, but 6G’s cross-ecosystem coordination are critical.

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 network 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. Cross-Domain Collaboration

Future AI agents will be ubiquitous, forming a device-network-industry end-to-end ecosystem. 6G network shall support the cross-domain collaboration of AI agents, including the device domain, RAN domain, core network domain, operation and management domain, application domain, etc.

3.4. 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 existing agent communication related protocol (e.g. NRF discovery mechanism).

3.5. 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.

3.6. 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.

3.7. 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.

3.8. Security

The security of AI Agents communication in 6G includes the data protection and user consent. Data pravacy means tha 6G network 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.

3.9. 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 network, outlining key use cases and operational requirements from an operator’s perspective. When designing agent communication related protocols for 6G network, 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.".

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