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Use Cases and Requirements of AI Agent Communication from 6G Aspect
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Abstract

AI Agent can do some tasks as an assistant to human beings. During the task process, the Agent may need to connect to other Agents with different skills relative to the task. The Agent to Agent communication is a new kind of traffic for Internet, and some new requirements for networking are proposed. This document talks about the requirements and key issues of global AI agent communication towards 6G. Some 6G related use cases from 3GPP documents are introduced. After that, the related requirements for the AI Agent Communication Network (ACN) are proposed, and potential ACN frameworks and standardization works for the AI Agent Communication are also discussed.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on 1 January 2026.

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1. Introduction

AI Agent can do some work instead of people leveraging the ability of LLM (Large Language Model). Every Agent may have different abilities, and sometimes they need to cooperation to complete a task. During the task process, they need to communicate with each other. Nowadays, communication methods among the AI Agents across domains are still an open issue. This document mainly focuses on the AI Agent communications across domains or among different organizations.

The AI Agents mentioned in this document include the software ones and the embodied robot ones. Examples of the first software mode include the AI assistants on mobile phones, and the AI Agent services provided on Internet by different organizations. For the second embodied robot mode, the Agent may or may not have a SIM (Subscriber Identity Module) distributed by the 3GPP operators for identifying itself and authentication.

In the section 6.6 to 6.8 of [TR22.870], which is still under working, some use cases and requirements of AI Agent communication from the 6G aspect are introduced. It proposes that some standardization work may be needed for supporting interoperability.

This document reviews the 6G AI Agent use cases, and discusses the potential work to enable the Agent Communication Network (ACN). A referred analysis can be found in [I-D.rosenberg-ai-protocols], in which some use cases and requirements for AI Agent protocols are introduced. Meanwhile, a framework is also described for the agent communications in that draft, and it includes the communications between AI agent and User, AI agent and API, AI agent and AI agent. By comparison, this document would mainly talk about the Agent to Agent (A2A) communications, and explore potential frameworks more detailedly.

2. Use Case on AI-agents Communication

2.1. Grouping During Task Process

Grandpa Bob plans to clean the room and host a gathering at home with his daughter Alice's family and his son Charlie's family. So, he issued the command "Clean the room and help me prepare for the family gathering tomorrow afternoon" to his AI-assistant. The detailed service flows can be found in Appendix A.

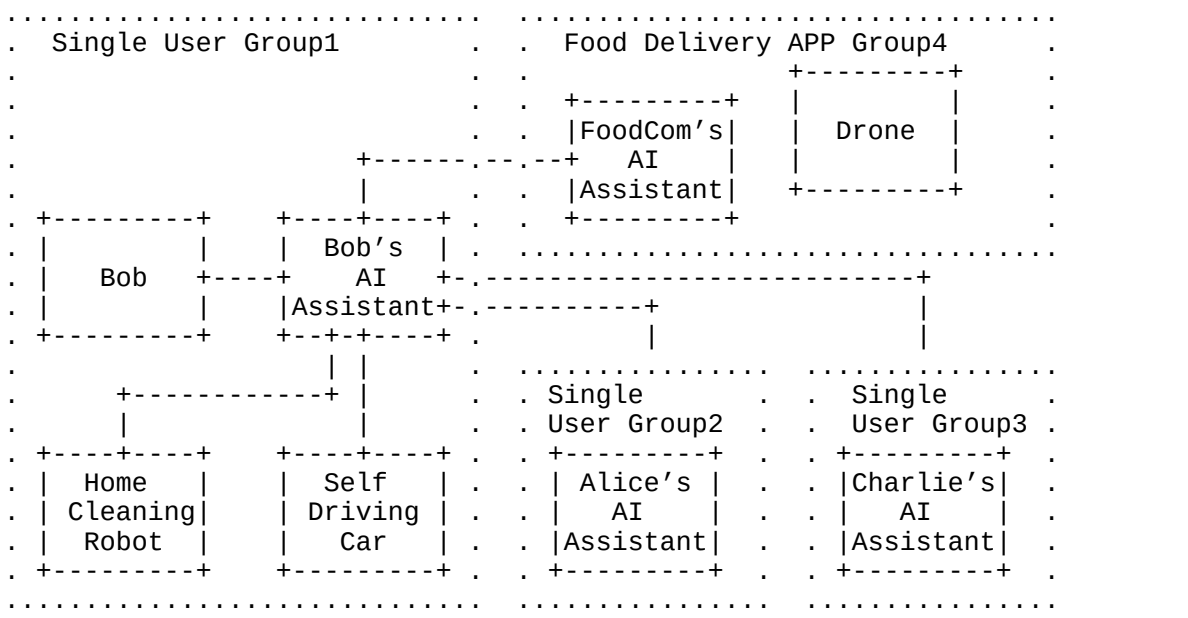

Figure 1: Static and Temp Grouping in Agent Communication Network

As shown in Figure 1 for this use case, we have four groups relatively static, i.e., the Group 1 to 4. Meanwhile, some temp groups are also needed in the service flows.

1. Bob's AI assistant needs to check the schedule of relatives, so a group including the AI assistants of Bob, Alice, and Charlie needs to be formed.

2. Bob's AI assistant and the food company's Agent need to form a group for discussing the food delivery location and time.

3. To delivery the food, the drone of the food company may visit Bob's house, and some A2A communications within a temp group may be needed.

4. The self driving car may need to go to the houses of Alice and Charlie to pick them up, and some A2A communications within a temp group may be needed.

2.2. Potential Requirements for ACN

To fulfill the task, the AI agent should be able to understand the user's intent and make a plan containing some task-oriented actions for the task. To enable the cooperation, each agent should have an ID and some characteristics, which should be visible in the Agent Communication Network (ACN). For the ACN, it needs to support the following requirements.

1. The ACN should support communications of AI Agents from different domains, and communications among the AI Agents need to be secured.

2. The ACN should support the discovery of AI Agents with specific skills for a task.

3. The ACN should support the flexible grouping of the task-related Agents, even when the Agents are from different domains.

4. The ACN should support the authentication and authorization of the AI Agents, when forming a temp group for a task.

5. The ACN should be aware of the roles, relationships, and permissions of the Agents in a task group.

3. Use Case on 6G System Assisted AI Agent Service

3.1. Assistance of Network

Due to the limited ability of an AI Agent on device. It is expected that the 6G system can assist AI agent device for awareness, decision making and actions in a couple of aspects. Detailed service flows of this use case can be found in Appendix B.

In the aspect of providing external environment information, 6G system can provide the sensing information to the Agent. For example, the information surrounding objects is useful for a vehicle to realize the traffic situation in real time, and based on which the vehicle can do the corresponding actions such as changing lane and speed. Additional, 6G system can provide the real time QoS change information. For example, this planed QoS information can be used for vehicle to change autonomous mode to manual mode when the QoS cannot fulfill the expected latency.

In the aspect of providing computing, 6G system can provide a more powerful AGI (Artificial General Intelligence) model than the light-weight one on the Agent. Thus, task offloading will be needed to realize a "device-network collaboration", in order to make a suitable decision and action. By doing so, 6G network needs to provide some 3GPP services (e.g. sensing, positioning, text-voice converting, language translation) from 6G network.

3.2. Potential Requirements for ACN

To fulfill a task, the AI agent should be able to communicate with the 6G system to obtain environment information, computing service, etc. For the ACN, it needs to support the following requirements.

1. The ACN should support exposing its services and tools to the Agents for invoking.

2. The ACN should support real time communications between the Agent on device and the service point on the ACN, if needed.

3. The ACN should be able to monitor the performance of the service, and report to the control point if service degeneration happens. The control point can be in the Agent or within the ACN.

4. The ACN should be aware of the network status and be able to expose the network information to the Agent. Here, the network condition can be regarded as one of the environment information.

5. The ACN should be aware of the different SLA requirements of Agent interconnections, and apply proper policies.

4. Use Case on Collaborative AI Agents

4.1. Collaboration of AI Agent

An AI agent can be implemented in the network, and it can perform tasks representing e.g. devices, persons, drones, or cars. By offloading tasks to the network, devices can save on complexity and energy consumption. Furthermore, an AI Agent in the network can still represent a device, person, drone or car, when that device, person, drone or car is not reachable, e.g. because of radio conditions or battery outage. Offload can happen towards a local/ edge network but can also be to a nearby other device with more processing capabilities.

In this scenario, when the collaborating AI Agents are implemented in different networks, some basic functionality needs to be standardised to the collaboration between AI agents. E.g. how to identify an AI Agent, how to authorise access to a different AI Agent and how to establish and maintain secure association between AI Agents.

Detailed service flows of this use case can be found in Appendix C.

4.2. Potential Requirements for ACN

When the AI Agent is implemented in the network, the AI Agent applications need to be installed on the UE. The ACN needs to support the following requirements.

1. The ACN should support hosting of large amounts of AI agent applications, and the invoking of the users.

2. The ACN should support the secure interoperability between AI Agents and between AI Agents and applications to achieve a collaborative task.

5. Cooperation Layer in Agent Communication

There are four layers to enable the Agent communication as shown in Figure 2.

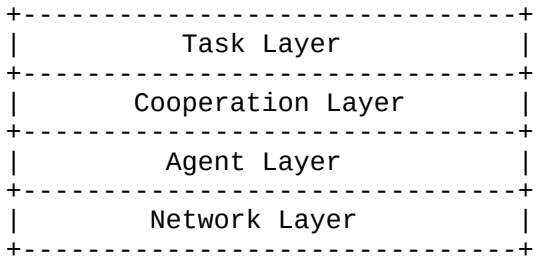

Figure 2: Four Layers for Agent Communication

1. The first layer is the network layer. It should provide the connection service needed between agents.

2. The second layer is the agent layer. It should provide the agent service, and support some basic Agent to Agent communication functionality.

3. The third layer is the cooperation layer. It should support the authentication of the agents, networking of the agents for a task, etc. It is the main layer focused by this document.

4. The task layer is the fourth layer. The task may come from a user or an Agent. Some of the tasks need the involvement of the cooperation layer.

There may be various tasks and various Agents, but the number of the realizations of the cooperation layer should be few. With this new layer, flexible networking and authorization mechanisms for Agent Communication can be supported.

6. Communication Modes of ACN

There are four types of the cooperation modes for the Agent Communication. It should be noted that we are talking about the A2A communication across domains, which is perhaps more complicated than the A2A communication within a group or within an organization.

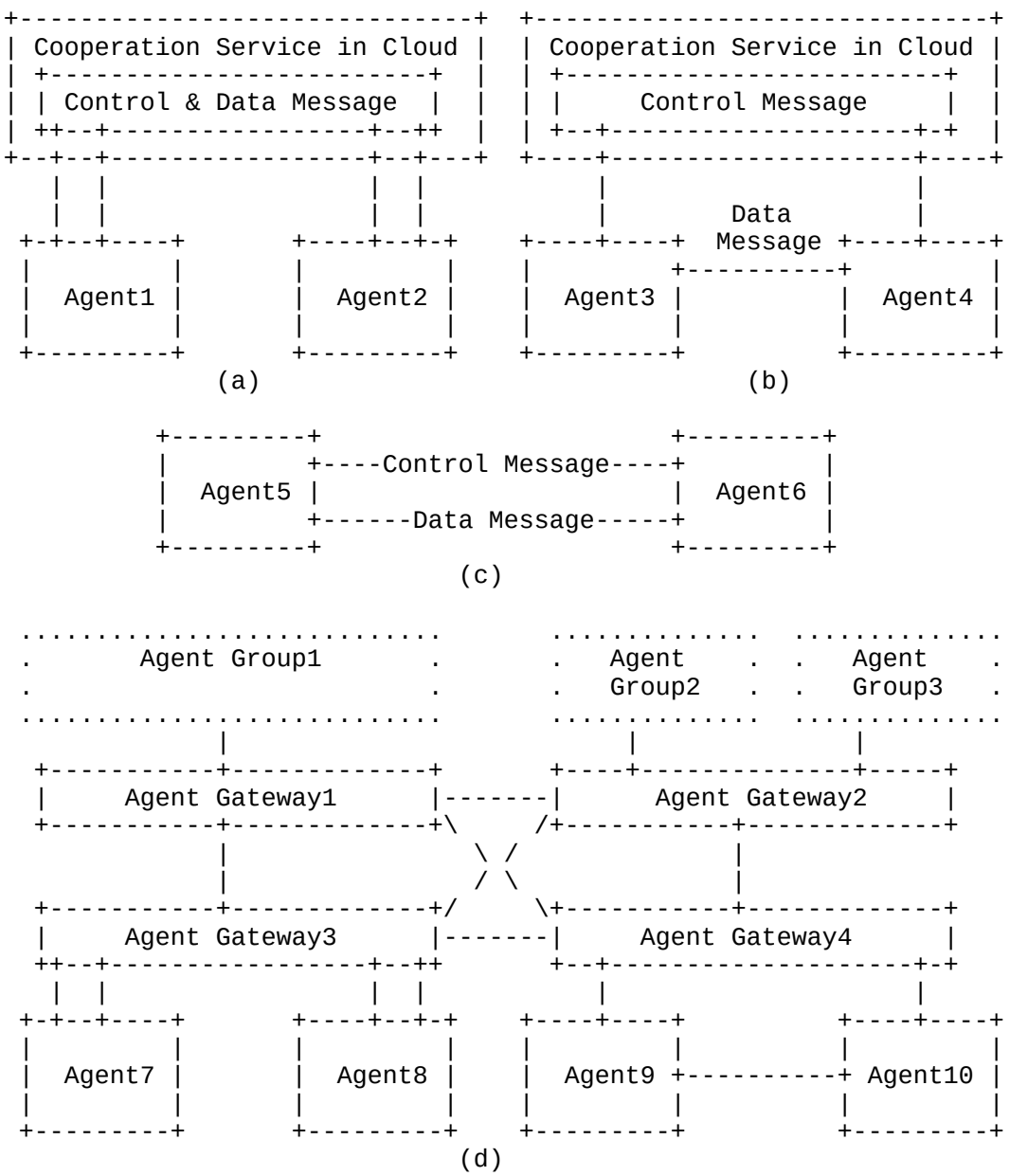

Figure 3: Four Types of Agent Communication Modes

1. In the type (a), Agent1 and Agent2 connect to the service in the cloud firstly, for example via an installed APP. After that, they can communicate by using the service in the cloud.

2. In the type (b), Agent3 and Agent4 connect to the service in the cloud firstly, for example via an installed APP. After that, they can communicate by using the service in the cloud. Optionally, they can establish a directly connected tunnel to transfer data messages.

3. In the type (c), where perhaps no Internet service is available, Agent5 and Agent6 need to authenticate each other, and establish a directly connected tunnel to transfer control and data messages.

4. In the type (d), Agents and Agent Groups are interconnected by Agent Gateways. It is a decentralized structure.

For the first and second mode, the Agents are connected via a relatively centralized way. The advantages are that the realizations are easy to be extended, for example, though the APP software update. In Section 7, the framework and some related procedures of this mode is discussed.

The third mode works like a self-organize network. A basic communication channel and a common protocol are needed here.

The Agent Gateways in the fourth mode work in a distributed way. A gateway interconnection protocol is need here. In Section 8, the framework and some related procedures of this mode would be talked about.

7. Framework of Centralized Agent Communication Platform

The framework of the centralized platform based Agent communication is shown in Figure 4.

Some assumptions of the framework are listed as follows:

1. The organization A and B all have registered in the centralized platform P1.

2. The Agent A needs to fulfil a task T, which cannot be completed within the domain A. Another agent with skill S is needed, and it is included in the centralized platform P1.

3. The ORG B or Agent B has registered with the skill S in the centralized platform P1, and Agent B supports public invocation.

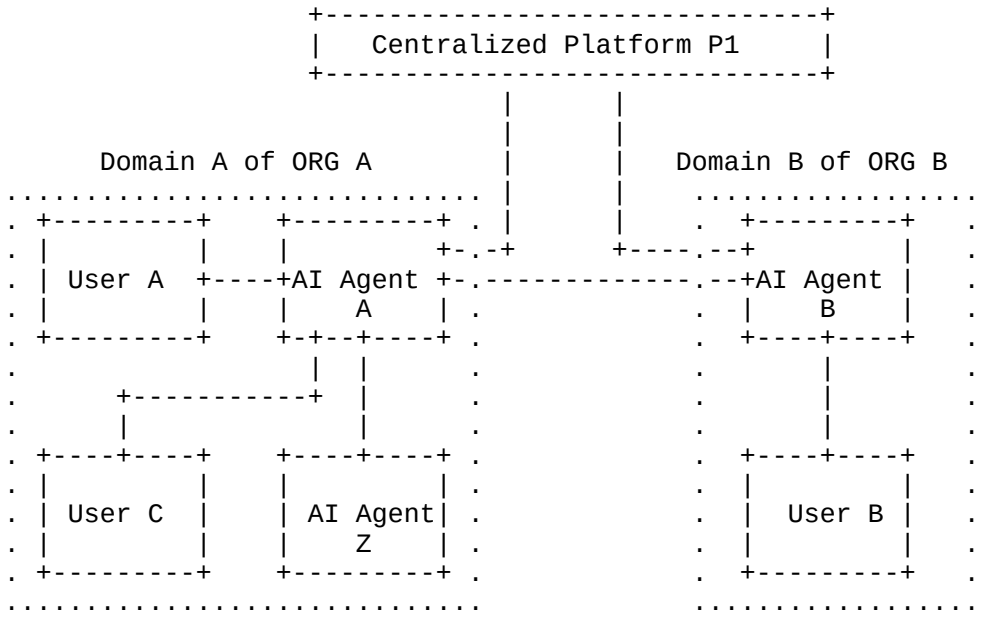

Figure 4: Centralized Platform based A2A Communication Framework

A general procedure of the cooperation method is described as follows:

1. Agent A logs in the centralized platform P1, and searches for an Agent with skill S. Agent B is found.

2. Platform P1 triggers the ORG B to notify the Agent B to log in the platform P1.

3. To complete the task T, Agent A and Agent B form a group to enable the communications between them.

4. After the task T is completed, Agent A can evaluate the service of Agent B, and the group may be deleted in the platform P1.

Alternatively, after the trust relationship is established on the platform P1, Agent A and Agent B can also communicate directly. Or, they can use the two paths for different kinds of data delivery. For example, to transfer some files, they can use the directly connected tunnel, and to transfer some simple messages, they can use the overlay platform P1.

Figure 4 has shown a simple case with only two Agents to form a group. If more agents are needed for the task T, a more complicated networking mechanism on the platform P1 can be supported. Even the Agent A can delete or add some agents on the task process.

8. Framework of Decentralized Agent Cooperation

The framework of the gateway-based Agent communication is shown in Figure 5.

Some assumptions of the framework are listed as follows:

1. The organization A has registered in the Gateway G1, and the organization B has registered in the Gateway G2. Gateway G1 and G2 are in the same Agent Federation F1, which contains many agent gateways.

2. The Agent A needs to fulfil a task T, which cannot be completed within the domain A. Another agent with skill S is needed, and it is included in the decentralized Agent Federation F1.

3. The ORG B or Agent B has registered with the skill S in the Agent Federation F1, and Agent B supports public invocation.

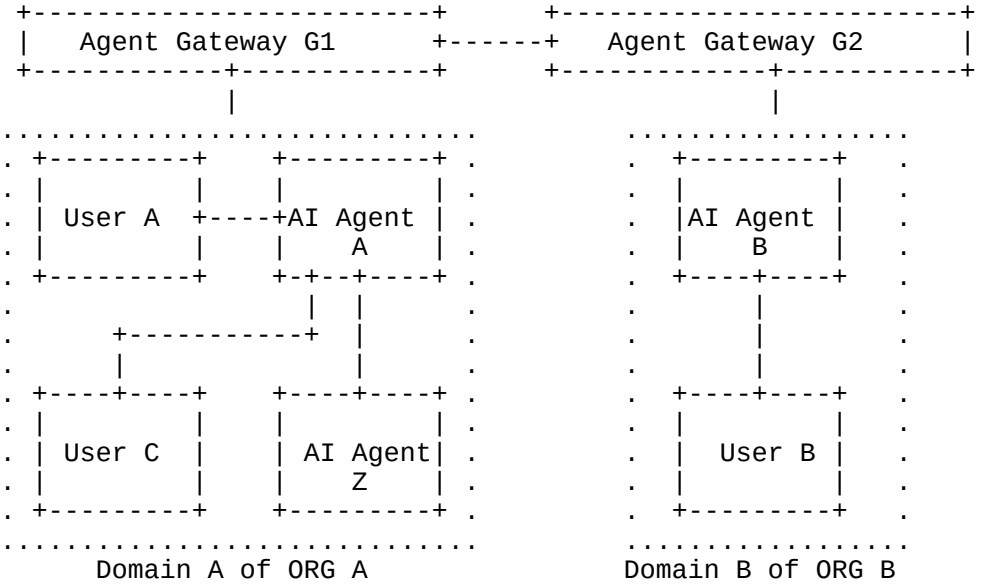

Figure 5: Gateway-based Agent Communication Framework

A general procedure of the cooperation method is described as follows:

1. Agent A logs in the Gateway G1 of the Agent Federation F1, and searches for an active Agent with the skill S. Agent B is found.

2. Gateway G1 and Gateway G2 form a temp group for the task.

3. To complete the task T, Agent A and Agent B in the group communicate by using the Gateway G1 and G2.

4. After the task T is completed, Agent A can evaluate the service of Agent B, and the group may be deleted.

Figure 5 has shown a simple case with only two Agents. If more agents are needed for the task T, a more complicated networking mechanism on the Gateways can be supported. Even the Agent A can delete or add some agent on the task process.

Some of the requirements of Gateways are introduced as follows.

1. Gateways should support the agent register and discovery.

2. Gateways should support cross-domain relays and state synchronizations.

3. Gateways should be able to notify the ACN of the information about the agent locally connected and related skills, and support the tunnel establishment for the cross domain traffic.

4. Gateways should support skill-based routing, where a Gateway works like an Agent Proxy to find the target Service Agents, after understanding the intent of the user or the Agent.

9. IANA Considerations

TBD.

10. Security Considerations

TBD.

11. Acknowledgements

TBD.

12. References

12.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

12.2. Informative References

[I-D.rosenberg-ai-protocols] Rosenberg, J. and C. F. Jennings, "Framework, Use Cases and Requirements for AI Agent Protocols", Work in Progress, Internet-Draft, draft-rosenberg-ai-protocols-00, 5 May 2025, <https://datatracker.ietf.org/doc/html/draft-rosenberg-ai-protocols-00>.

[TR22.870] 3GPP TR 22.870, "Study on 6G Use Cases and Service Requirements", 2025.

Appendix A. Service Flows of AI-agents Communication

A.1. Pre-conditions

Some assumptions for the service flows of this use case are listed as follows:

1. Bob has just purchased a home robot and has not connected to Internet.

2. Except for the home robot that Bob just bought, all other AI agents of users, have been assigned with digital identities associated with the user’s identity.

3. The users’ AI-agents involved in this scenario include AI assistant, drone and intelligent vehicle, etc. Intelligent vehicles are connected through cellular networks, while other AI-agents are connected through home WiFi.

4. All AI-agents registered to 6G system, so that their attributes are visible for some of the members, based on permission and authorization.

A.2. Service Flows

The service flows are described as follows:

1. Bob, Alice, and Charlie each request the operator to create AI agent groups for them. They then invite their respective AI agents, such as their AI assistants, smart cars, drones, etc., to join their individual groups. In other words, there are separate groups for Bob, Alice, and Charlie, allowing the AI agents within the same group to communicate with each other. In addition to owner information (e.g. related user, etc.), examples attributes for Bob's AI agent in this use case are as Figure 6.

2. The newly purchased home robot joins to Bob's group after authentication, and is associated with Bob's identity. Then, the home robot reports its capability to the group.

3. Bob sends the request to his AI-assistant, and request the AI-assistant to arrange the gathering as task coordinator. The AI-assistant received Bob's request. Based on the local or cloud-based knowledge base, Bob's AI-assistant retrieves the history of past family gatherings, determines the list of sub tasks and distributes the sub tasks to corresponding AI agents.

4. Bob's AI-assistant communicates with the discovered cleaning robot based on its capabilities and sends the request to the cleaning robot to carry out a full house cleaning. When the cleaning robot needs collaboration from other robots, e.g. to move some heavy furniture, it will setup a cleaning group with others to enable efficient communication within the cleaning group. After the cleaning, the communication group will be released accordingly.

5. Bob's AI-assistant communicates with the discovered and selected restaurant's AI assistant by matching the requirements and AI agents' attributes. Bob's AI-assistant orders food for tomorrow and negotiate the food delivery time and location with restaurant's AI assistant. The restaurant's AI assistant selects a drone based on its capabilities from restaurant's group, to do the food delivery. Then the restaurant's AI assistant sends the determined time and location to the food delivery drone and sends the information of selected drone to Bob's AI-assistant, so that Bob's AI-assistant can communicate with drone.

6. During food delivery, the drone offloads a portion of the computational tasks to the network, to assist it in obstacle identification, by assisting in the process of modal transformation, for example, by pre-processing the images captured by drones, and obtaining alert data. When drones arrive at the pick-up point, they will setup a temporary communication group with the home robot to enable secure and cooperative food delivery. The communication is supported even if the drone and

home robot transmit different modality information, e.g. video/ text, etc. The communication group will be released after the delivery.

7. Bob’s AI-assistant communicates with Alice’s AI assistant and intelligent vehicle. Bob’s AI-assistant negotiates with Alice’s AI assistant for the time and place to pick up Alice’s and sends the request to the intelligent vehicle to pick up Alice’s with negotiation result (i.e. the pick-up time and place).

8. Bob’s AI-assistant communicates with Charlie’s AI assistant and intelligent vehicle. Bob’s AI-assistant negotiates with Charlie’s AI assistant for the time and place to pick up Charlie’s and sends the request to the intelligent vehicle to pick up Charlie’s with negotiation result (i.e. the pick-up time and place).

	Service Features	Capabilities	Permission
AI assistant	1)Service description: Voice and Text-Based Interaction, Information Retrieval, Personalized Recommendations 2)Service area: Wide 3)Moving speed: N/A	1)WiFi & cellular connection; 2)Tools (Perception + Action); 3)Reasoning & Decision making; 4)Memory + Reflection	InvitationAllowed: true; DiscoveryAllowed: true; ShareAllowed: true; CreatGroupAllowed: true
Drone	1)Service description: e.g. Radar, Camera, Grasping, Navigation 2)Service area: Wide 3)Moving speed: Medium	1)WiFi & cellular & V2V connection; 2)Tools (Perception + Action)	InvitationAllowed: true; DiscoveryAllowed: true; ShareAllowed: true; CreatGroupAllowed: true
Intelligent vehicle	1)Service description: e.g. Radar,	1)WiFi & cellular connection; 2)Tools	InvitationAllowed: true; DiscoveryAllowed:

	Camera, Driver Assistance, and improved Navigation 2)Service area: Wide 3)Moving speed: High	(Perception + Action); 3)Reasoning & Decision making; 4)Sensing	true; ShareAllowed: true; CreatGroupAllowed: false
Home robot	1)Service description: e.g. Voice interaction, Cleaning, Security Monitoring, 2)Service area: Local 3)Moving speed: Low	1)WiFi connection; 2)Tools (Perception + Action)	InvitationAllowed: true; DiscoveryAllowed: true; ShareAllowed: true; CreatGroupAllowed: true

Figure 6: Illustrative attributes of AI agents

A.3. Post-conditions

The expected results are listed as follows:

1. The cleaning robot cleans Bob’s house.

2. The drone sends the foods from the restaurant to Bob’s house.

3. The intelligent vehicle picks up Alice’s and Charlie’s and sends them to Bob’s house.

4. Alice, Charlie and Bob have a happy gathering party.

Appendix B. Service Flows of 6G System Assisted AI Agent Service

B.1. Pre-conditions

Some assumptions for the service flows of this use case are as follows.

Bob has a robot nanny as his personal AI agent, bought from vendor-A. Bob’s cell phone is his another personal AI agent bought from vendor-B. Those AI agents on device, as personal assistant, can assist Bob with suggestions and actions based on information the AI agents are aware of.

B.2. Service Flows

The service flows are described as follows:

1. Bob, living in his home in Beijing, decided to go to Sanya for his winter vacation. He asked his robot nanny (AI agent) to book a 5-star hotel with lowest price.

2. The personal assistant began to check the well-known brand hotels in Sanya. As Bob is a VIP in some hotels and the AI agent needs to get the VIP price, when the robot nanny tried to login the hotel website, the application checked with 6G network that the AI agent (Robot nanny) is Bob’s valid personal device and the application provided the VIP price to the Robot nanny.

3. By collecting a couple of 5-star hotels’ price, the Robot nanny finally selected and booked a hotel room with the lowest price for Bob.

4. Later-on, when Bob has left home to the airport, he remembers there is a delivery at home that need to pick up. Thus Bob asked the AI agent on cell phone, via 6G network, to notify robot nanny who is at home to pick up the delivery. Given the two AI agents are from different vendors, they support different protocols and information modalities, the 6G network helped to interconnect the cell-phone agent with the robot nanny and then transform the "pick-up delivery" command from the cell phone to the pictures with guideline marks that the robot nanny can parse.

5. Robot nanny managed to pick up the delivery.

B.3. Post-conditions

The expected results are listed as follows. Thanks to the 6G network, the AI agent on device can assist Bob to find the VIP price for booking hotel, and the AI agents can communicate with each other without "language" barrier.

Appendix C. Service Flows of Collaborative AI Agents

C.1. Pre-conditions

Some assumptions for the service flows of this use case are as follows.

Husband and wife John and Ann own an electric car. The electric car has an AI Agent that can organise various things for the car. This includes that it can communicate with applications from the energy grid to optimise charging the car. There is a "spot-price" for electricity that fluctuates with locally available electricity. The price can even be negative if there is more renewable energy is produced than can be used. The intelligent agent for the car is provided by the car company. The local networks the AI Agent runs on are determined by contracts the car company has.

John has a personal AI Agent that amongst others manages his calendar. John gets the subscription for the AI Agent through his corporate employer.

Also, Ann has a personal AI Agent that manages her calendar. As Ann is a self-employed consultant, she obtains a subscription for her personal AI Agent from her telecommunications provider.

The car AI Agent has been authorised by John and Ann to access their personal AI Agents to obtain information about their calendars.

C.2. Service Flows

The service flows are described as follows:

1. John is on a business trip abroad with his car. While he is asleep in a hotel, the car is connected to a charger. The AI Agent for the car runs in an edge network near the car.

2. The car AI Agent communicates with a local application for the local energy grid and notices that the price for electricity is particularly high that night in the area of the hotel. There is the possibility to make a profit if the car can actually provide energy from its battery back to the grid.

3. To determine whether it is a good idea to provide energy from the car battery back to the grid, the car AI Agent needs to check whether the car needs to travel far next day. Rather than calling John and Ann, and waking them up, to get that information, the AI Agent checks the AI Agents from John and Ann

to see if any large trips are planned. The AI Agent for John has ported to an edge location at the hotel. The AI Agent for Ann runs in her telecommunications network back at home.

4. The personal AI Agent from John indicates that the next day John plans to travel back home, a 900 km journey. It is not a good idea to use the car battery to sell energy back to the grid.

5. In the morning, John sees a message from a friend asking him to meet some friends in the pub. The friends (or their personal AI Agents) are not authorised to access calendar information from his AI Agent.

C.3. Post-conditions

The expected results are listed as follows. Information was exchanged between the car AI Agent and the personal AI Agents from John and Ann, even though these AI Agents at that time used computing resources from different providers in different countries. Information was protected against unauthorised access.

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