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Problem Statement and Gap Analysis for Agent-enabled Mobile Core Network
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Abstract

This document provides the problem statement and gap analysis of agent-enabled mobile core network.

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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Table of Contents

1. Introduction

With the development of AI technology, AI Agent, as advanced form of AI capability, is rapidly becoming an important evolutionary direction. While traditional AI (such as ChatGPT) mainly relies on user input commands, the Agent can independently think, make decisions, and perform complex tasks, just like an AI assistant, capable of independently completing multi-step operations. The development of Agent has directly brought about profound changes in terminal form and business content. Besides, it will also profoundly change the traditional mobile network architecture and business model.

Agent communication is an important reference and connotation of 6G mobile network evolution. The emergence of Agent brings new communication terminal forms and business scenarios, which brings new demands to the transmission protocols and network capabilities of mobile networks, and 6G needs to evolve and enhance new capabilities as a communication bridge for next-generation Agent services and terminals. Also, 6G can improve its own level of intelligence by taking advantage of the perception and decision-making of the Agent.

From the document of 3GPP Technical Report (TR) 22.870 [TR22.870], the AI Agent is defined as 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. The current content of the report already provides some use cases for AI Agent communication. The use cases are mainly focused on Networt for AI Agent, including scenarios such as connected cars, takeaway booking, child care, and earthquake rescue. There are fewer use cases in AI Agent for Network, focusing on network operation and maintenance.

2. Conventions and Definitions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 RFC2119 [RFC8174] when, and only when, they appear in all capitals, as shown here. Abbreviations and definitions used in this document: *AI: Artificial Intelligence. *NF: Network Function.

3. Problem statement

The AI Agent brings changes to the network in terms of interaction content, interaction object and interaction protocol.

3.1. Changes in Interaction Content

The traditional communication content is mainly singlemodality such as text, video/image, and voice for the transmission of transparent media. The AI Agent integrate physical and virtual world, driving the evolution of communication interaction content to multimodality data, such as the perception and transmission of multimodality data of actions, states/emotions, space, and haptics.

3.2. Changes in Interaction Entity

AI Agent extend the scope of traditional interaction entities, which are no longer limited to simple dialogs between human-machine-objects and enabling based on fixed processes. Instead, it extends to multi-entity interactions within AI Agent(such as tools), between AI Agents, and between AI Agent and current network objects (such as network elements, application systems, IoT devices). The extension of interaction entities not only enhances the autonomous collaboration capability, but also promotes more complex and intelligent task collaboration and decision-making modes.

3.3. Changes in Interaction Protocol

AI Agent can autonomous decision-making, semantic understanding, and learning-evolution capabilities, and interact with users in a more natural and flexible way. In AI Agent communication, the traditional protocol paradigm based on fixed syntax and static layering is broken. A transmission protocol with semantic understanding, dynamic negotiation, and autonomous collaboration is required. Also, the new protocol can support multimodality data transfer and transformation.

4. Use Cases

4.1. Network for Agent Communication

TBD.

4.2. Agent-based Network Enhancement

TBD.

5. Gap Analysis

5.1. GAP analysis of service capabilities

5.1.1. User-Driven Service Mechanism

The current communication network is mainly a user-driven service model, in which the user initiates a communication request, and the network passively responds and establishes a connection to provide communication services. For AI Agent communication, it is not only a simple data transmission, but also an interactive behavior with the goal of completing a specific task. The network needs to analyze and understand the task and behavior. And perceive the task context state, so as to better optimize the allocation of resources to meet the user’s needs. The network needs to sense and understand the tasks and behaviors of, as well as perceive the task context state, so as to better optimize the resource allocation and guarantee that tasks are completed on demand.

5.1.2. Communication Dumb Pipeline Model

The traditional mobile network serves as a ’dumb pipeline’, providing undifferentiated basic bit stream transmission services, mainly guaranteeing communication indexes such as bandwidth and delay. In AI Agent communication, the traffic often presents multimodality, upstream and downstream peer-to-peer, and short bursts, etc. The network require the capability to support dynamic, semantic, and multimodality communication traffic demand brought by AI Agent

communication.

5.2. GAP analysis of foundational capabilities

5.2.1. Fixed NF and Processes

The current mobile core network is characterized by precise definition, serial processing and linkage impact. Events trigger the serial processing of multiple NFs. NFs and processes are basically fixed, and the linkage impact will be produced when the functions are changed.

5.2.2. Network Intelligence

Although the intelligence technology has been introduced into the current mobile network, it is mainly realized through optimization and transformation at the existing architectural level, which is still a ’plug-in’ intelligence and can only provide single intelligence or local enhancement capability. For example, the 5GC NWDAF has the ability of intelligent sensing and analyzing, it cannot make autonomous decision scheduling based on the analysis results. For AI Agent communication, mobile networks should consider endogenous intelligence at the early stage of design and build AI-native network capabilities.

5.2.3. Network Programmability

The current network provides services through the collaboration of NFs and deployed services, it is difficult to realize network-level update, and the network programmability is insufficient. In capability opening, the closed operation of NFs brings about a lack of openness to external capabilities. In addition, the network also lacks the capabilities to call and respond to external capabilities.

6. Security Considerations

TBD

7. IANA Considerations

TBD

8. 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>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

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