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Considerations for AI Agent Communication and Networking in Enterprise
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Abstract

This document focuses on enterprise scenarios, investigating key technologies including agent identification and registration, capability discovery, efficient communication, and secure collaboration. It proposes an agent identifier and semantic routing mechanism to achieve trusted access and efficient collaboration among heterogeneous agents, providing a technical path for campus-level multi-agent cooperation.

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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1. Introduction

1.1. Overview

Artificial intelligence is evolving from a model-dominated stage toward autonomous and collaborative agents. Constructing network infrastructure that supports efficient and secure agent collaboration has become critical. To address the core challenges of large-scale multi-agent collaboration in enterprise digital transformation, this paper focuses on enterprise and campus scenarios and proposes an agent private network architecture centered on the Agent Gateway as the core device. It investigates a key technical system covering agent identification and registration, capability discovery, efficient communication, and secure collaboration, and innovatively proposes an IPv6 address-based agent identifier and semantic routing mechanism. Based on the Agent Gateway, this architecture achieves

trusted access, capability discovery, and efficient collaboration among heterogeneous agents through synergy between network-layer and application-layer capabilities, providing a technical reference and practical approach for enterprise and campus-level agent collaboration.

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.

3. Problem Statement

3.1. AI Agent Protocol heterogeneity and interoperability barriers

There are various types of devices, platforms, and applications within the AI agents. Different agents vary in resources and supported protocols (e.g., ACP, A2A, ANP, etc.)., so adaptation and protocol conversion are required for agents’ communication.

3.2. Massive Agent Connection and Addressing

The number of agents in the enterprise (including robots, sensors, digital humans, edge AI units, etc.) can reach the million-level scale. Traditional IP addressing and service discovery mechanisms (such as DNS and static configuration) are unable to support dynamic registration, real-time discovery, and high-concurrency connections, which leads to low addressing accuracy and high communication latency.

3.3. Performance, Reliability and QoS Guarantee

AI agent services (such as real-time control, video analysis, and emergency response) have stringent requirements for low latency, high reliability, and deterministic QoS. However, the best-effort transmission mode of traditional networks fails to meet these strict demands, which easily gives rise to issues such as transmission delay, jitter, packet loss, and congestion collapse.

3.4. Trustworthy Access and Permission Control

During the cross-domain or cross-system communication of agents, there is a lack of unified identity authentication, fine-grained permission control, and behavior auditing mechanisms. This brings about potential security risks.

4. Requirements of Agent Communication and Networking in Enterprise

4.1. Requirements for AI Agent

Agent Identity Identification & Discovery: Distinguish agents from real users, integrate semantic understanding and addressing to match business needs with corresponding agents. Heterogeneous Compatibility: Different agents vary in resources and supported protocols, so adaptation and protocol conversion are required for agents communication.

4.2. Requirements for Network

Efficient Agent Communication: For agent interaction, consider network reachability, QoS guarantee, and differentiated SLA services. Due to high pressure in peer-to-peer collaboration among multiple agents, convergence is needed to enable hierarchical communication. Agent Scheduling & Management: Realize agent scheduling within and across enterprise campus; unify orchestration of network resources and agent services to align network and business. Security & Privacy: Implement access management and permission control to enhance security.

4.3. Requirements for Agent Gateway

As the core device of the enterprise agent private network, the agent gateway integrates the reliable transmission capability of communication gateways and the cognitive decision-making characteristics of agents. It acts as the connection center, policy enforcer, and security guardian, supporting trusted access, efficient communication, and collaborative operations among agents.

[I-D.han-rtgwg-agent-gateway-intercomm-framework] proposes the Agent Gateway Intercommunication Framework, with Application Service Layer, Orchestration & Control Layer, Agent Connectivity Layer, Network Communication Layer.

5. Potential Key Technologies for Network Infrastructure

This section proposes several potential technologies, which are mainly used for agent communication and networking in enterprise scenarios.

5.1. Agent Service Awareness

Agent Service Type Identification: Identifies services including real-time control, video analysis, semantic interaction, data synchronization, and emergency commands. QoS Requirement Awareness: Recognizes differentiated service demands for latency, reliability, and throughput, and automatically matches appropriate network scheduling policies. Traffic Feature and Behavior Awareness: Perceives agent communication patterns such as request-response, publish-subscribe, multicast, broadcast, and continuous streaming to optimize forwarding paths and resource allocation.

5.2. Agent Service Bearer

Deterministic Forwarding and Low-Latency Transmission: Provides deterministic transmission with bandwidth reservation, low jitter, and low packet loss for real-time control and emergency agent services, guaranteeing SLAs for critical services. High-Concurrency Connection Bearer: Supports concurrent access of massive agents, long connection keepalive, and lightweight signaling interaction, solving resource bottlenecks associated with million-scale agent access.

5.3. Agent ID and Skill Identification

Globally Unique Agent Identifier: Defines a unified, routable, and cross-domain interoperable Agent ID to replace traditional IP addresses as the core identity of agents. Standardized Description of Capabilities/Skills: Performs structured and parsable skill modeling for functions provided by agents, including perception, reasoning, execution, collaboration, and scheduling. ID and Skill Registration and Publication: Supports automatic registration of an agent’s ID, attributes, skills, location, and status, forming a global directory service.

5.4. Token/Agent-aware Routing

Token-aware Routing: Forwards the first token and critical tokens with high priority to reduce first-packet latency. Combined with token importance classification, differentiated QoS is achieved. Agent-aware Routing: Performs routing based on Agent ID, Skill, and intent; automatically selects the optimal service provider according to task objectives, capability requirements, and load status; supports cross-domain, cross-gateway, and cross-enterprise agent addressing. It realizes routing by capability, forwarding by intent and supports automatic collaboration among multiple agents.

6. Potential Key Technologies for AI Agent

TBD.

7. Potential Key Technologies for AI Agent Gateway

TBD.

8. Security Considerations

TBD.

9. IANA Considerations

TBD.

10. Informative References

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