DMSC Working Group
Internet-Draft
Intended status: Standards Track
Expires: 31 October 2026

S. Sun
ICT, CAS
X. Zhang
CNIC, CAS
Q. Gao
Huawei Technologies
M. Liu
Y. Wang
ICT, CAS

April 2026

Intent-based Agent Interconnection Protocol at Agent Gateway
draft-sz-dmsc-iaip-01

Abstract

This document specifies the Intent-based Agent Interconnection Protocol (IAIP) operating at the Agent Gateways (AG), which defines the interaction mechanisms between AI Agents (at the Agent Domain) and the AG (at the Interconnection Services Domain). This specification focuses on dynamic interconnection among agents based on semantic intent, rather than static network addressing alone. This protocols defines the mechanisms for agent registration via capability advertisement, Gateway Validation, Intent Resolution and Matching, Routing Decisions and Forwarding, enabling the discovery, selection and dispatching of intent queries based on agent capabilities and task requirements at AG.

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 3 October 2026.

Table of Contents

1. Introduction

The emergence of agentic networks marks a fundamental shift from static, address-based networking to semantic, intent-driven interactions. Autonomous agents powered by advanced artificial intelligence models are capable of reasoning, planning, and executing tasks on behalf of users or other agents. Interactions are increasingly expressed in terms of high-level objectives or natural language intents, rather than predefined service endpoints or static interfaces.

Traditional networking and service discovery mechanisms assume that communication targets are identified by fixed addresses, names, or service identifiers. These assumptions no longer hold in agentic environments, where the appropriate execution entity for a request may depend on semantic interpretation, contextual constraints, and dynamic system conditions. As a result, routing decisions based solely on static addressing or preconfigured bindings are insufficient to support flexible and scalable agent collaboration.

Intent-based interconnection addresses this gap by enabling the Agent Gateway to resolve and forward requests according to their semantic intent, rather than their destination address. By decoupling request dispatch from rigid topology and static identifiers, intent-based interconnection allows autonomous agents to be dynamically discovered, selected, and invoked based on their advertised capabilities.

This document introduces the Intent-based Agent Interconnection Protocol (IAIP) to provide a standardized mechanism for capability-based registration and validation, intent-aware discovery and routing at AG. IAIP is designed to operate as an application-layer protocol for interconnection service domain, complementing existing transport and networking infrastructure without requiring changes to underlying transport protocols.

2. Conventions

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 <xref target="RFC2119"/>.

3. Terminology

AI Agent An agent is a software or hardware entity with autonomous decision-making and execution capabilities, capable of perceiving the environment, acquiring contextual information, reasoning, and learning.

Agent Gateway (AG) A Functional Component in the Interconnection Service Domain that possesses the capbilities of agent registration, capbility authentication, intent resolution and estabilishing interconnection betweens agents.

Intent A declarative expression of a desired outcome. In the intent-driven routing protocol, intent is represented at three conceptual layers:

* *Human Intent:*A high-level, possibly ambiguous expression originating from a human user or application (e.g., natural language input). Human Intent is out of scope for the protocol.

* *Task Intent:*An abstract, task-oriented description that captures the objective of a request, independent of any specific agent, algorithm, or execution plan.

* *Intent Descriptor:*A structured, machine-interpretable representation of Task Intent used within IAIP for routing and dispatching decisions.

Leader Agent (LA) Agent who issues tasks and launches interactions. There should only be one Leader Agent in a complete task execution process.

Partner Agent (PA) Agent who accepts tasks and provides services. After Partner Agent receives a task from the Leader Agent, it executes and returns the execution result.

4. Problem Statement and Use Cases

4.1. Limitations of Address-Based Static Interconnection

Existing network interconnection and gateway mechanisms are predominantly organized around static identifiers, such as network addresses, domain names, or service labels. At the application and service-dispatch layer, these mechanisms assume that the functionality associated with a agent behind a gateway is stable, explicitly addressable and functionally static. While effective for traditional client-server and microservice architectures, this assumption becomes increasingly inadequate for the dynamic interconnection required by agentic networks.

First, traditional interconnection protocols provide limited support for expressing semantic intent. High-level requests such as "analyze this dataset" or "resolve a billing issue" do not naturally correspond to a single predefined endpoint. Encoding semantic meaning into static addresses or service names requires manual configuration and tight coupling between task requesters and service providers, which undermines flexibility and scalability.

Second, static interconnection lacks adaptability to dynamic lifecycle of AI Agents. In the Agent Domain, agents may be instantiated, fine-tuned, or deprecated rapidly based on computational load or task requirements. Static bindings or name-based resolution mechanisms are generally unable to reflect real-time changes in agent’s availability or intent-processing capacity, leading to service selection or routing dispatch failures.

Third, existing protocols offer limited support for intent-aware resolution. When a request arrives at the gateway without a specific destination address, traditional gateway have no mechanism to parse the intent and match it against a local registry of vector-based capabilities. This behavior is misaligned with agentic workflows, where ambiguous or underspecified intents are common and may require clarification, delegation, or escalation to more generalist agents.

These limitations motivate the need for an intent-driven interconnection protocol specifically at the Agent Gateway that can manage registration and routing based on semantic intent and dynamically advertised capabilities, rather than relying solely on fixed addresses or static identifiers. This protocol addresses these challenges by transforming the gateway from a static packet forwarder into a semantic ingress/egress point, enabling establishing agent interconnection while maintaining compatibility with the Interconnection Service Domain.

4.2. Representative Use Case

The following example illustrates a typical use case of the Intent-based Agent Interconnection Protocol operating at the Agent Gateway.

A Customer Service Dispatcher Agent, acting as the Leader Agent, transmits a user inquiry to the AG for intent resolution and service response. Specialized Partner Agents (Billing, Technical Support, Sales) have previously registered their specific semantic domains with the AG. For explicit queries like "My credit card was charged twice," the AG identifies a high-confidence semantic match and routes the request to the Billing Agent. Upon completion, the AG relays the result back to the Leader Agent. Conversely, when handling ambiguous inputs (e.g., "I’m having a bad experience") where semantic similarity scores fail to meet the required confidence threshold, the AG encapsulates the intent and forwards the intent to a Generalist Fallback Agent. This mechanism ensures the request is constructively resolved via clarifying questions or human escalation, thereby preventing service failure.

5. Function Components

Figure 1 illustrates the interaction diagram between AI agent and Agent Gateway.

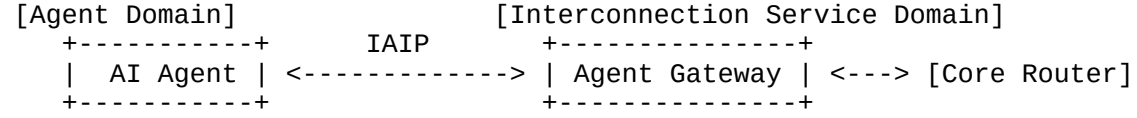


Figure 1: Interaction Diagram between AI Agent and Agent Gateway

To support the interaction with AI Agents, the AG MUST implement the following specific Functional Components within the Interconnection Service Domain.

* *Local Capability Registry (LCR):*The LCR maintains a dynamic database of attached Agents. The function of LCR is to store the Capability Profile of each registered agent. When an Agent sends the capability updating request, the LCR updates the mapping.

* *Agent Access Component (AAC):*The AAC serves as the termination point for the interconnection session between the AI Agent and the Agent Gateway. The function of AAC is to manage authentication, maintain session lifecycle, and verify message integrity. When an AI Agent initiates a connection or transmits a message, the AAC validates the agent’s identity credentials and establishes the interconnection for message forwarding.

* *Intent Forwarding Routing (IFR):*The IFR serves as the dynamic routing decision engine within the Agent Gateway for forwarding intent-based requests. Its primary function is to map normalized intent vectors-derived from incoming task semantics-to a set of eligible Partner agents. Based on real-time capability matching scores, performance metrics (e.g., latency, success rate, and resource availability), and policy constraints, the IFR selects the optimal next-hop Partner agent for request forwarding.

6. Protocol Overview

The protocol functions in two primary phases.

* *Phase 1: Agent Registration & Capability Advertisement.*This phase establishes the trust domain and service mesh. Both Leader Agents and Partner Agents MUST complete Identity Registration with the Agent Gateway (AG) to obtain the verifiable Agent Identity Code (AIC). Following identity registration, Partner Agents (or agents acting in a service-provisioning role) MUST additionally perform Capability Advertisement to publish their functional profiles to the Local Capability Registry (LCR).

* *Phase 2: Intent-based Routing and Forwarding.*This phase establishes intent-based interconnection. The Leader Agent submits its intent. The AG resolves it against the LCR and IFR, selects suitable Partner Agents, and facilitates the connection.

Figure 2 illustrates the updated two-stage processing pipeline between AI Agents and AG.

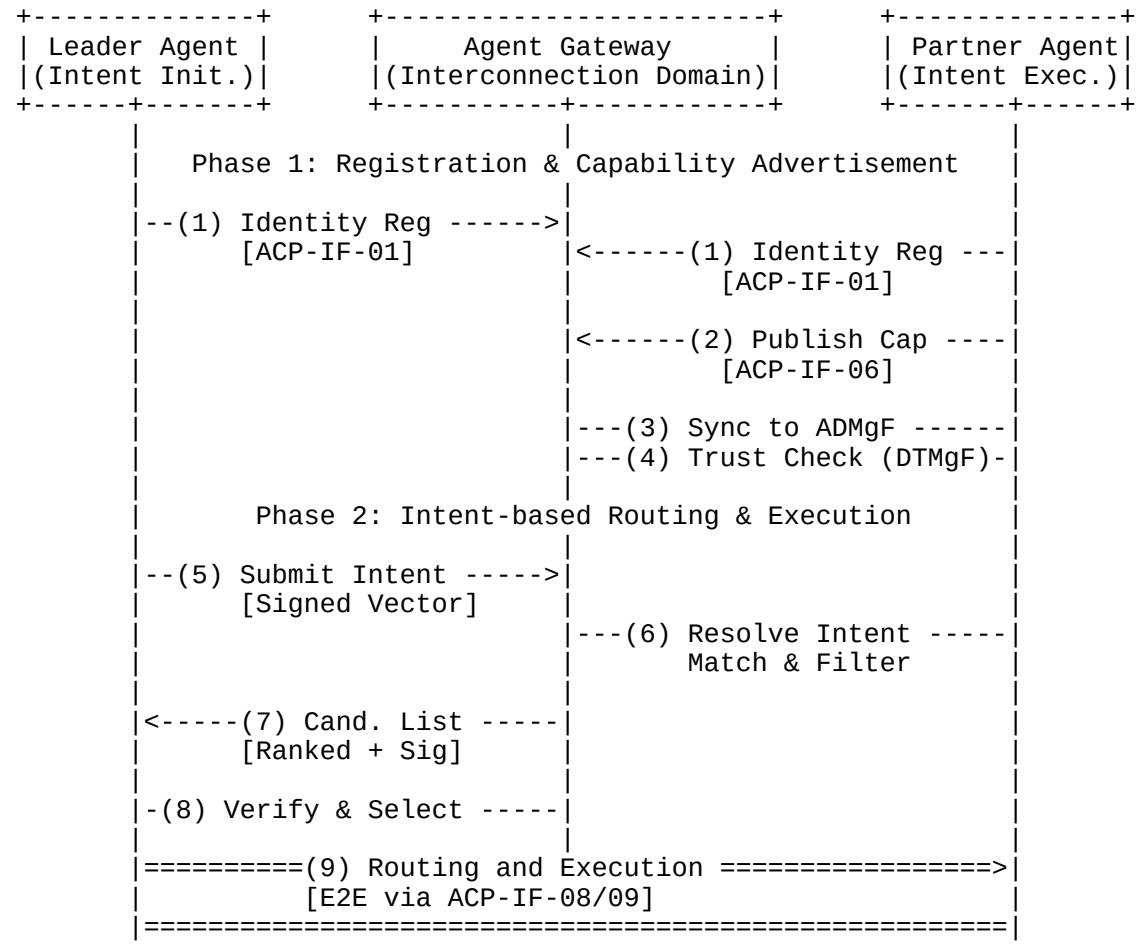


Figure 2: Two-Stage Processing Flow of IAIP

Phase 1: Agent Registration & Capability Advertisement

This stage is the prerequisite for any agent participation. It involves Identity Registration (mandatory for all) and Capability Publication (mandatory for service providers). The steps are as follows:

* *Step1:*Identity Registration (Leader & Partner). Any Agent (whether Leader or Partner) MUST register its identity with the Agent Gateway using the ACP-IF-01 interface (between AIMF in the agent and AIMgF in the AG). This establishes a verifiable Agent Identity Code (AIC) and exchanges cryptographic credentials required for future intent signing (Leader) or service execution (Partner).

* *Step2:*Capability Publication (Partner Agent). The Partner Agent publishes a structured capability description (e.g., supported task types, performance bounds, resource constraints) to the Agent Gateway via the ACP-IF-06 interface (ADMF <-> ADMgF). Note: If a Leader Agent also wishes to serve tasks, it MUST also perform this step.

* *Step3:*Synchronization to Interconnection Service Domain. The Agent Gateway forwards the capability description to the Agent Description Management Function (ADMgF) in the Interconnection Service Domain. ADMgF persists the data and synchronizes it to the Agent Discovery Function (ADF) for indexing.

* *Step4:*Trust Scope Enforcement. The Domain Trust Management Function (DTMgF) applies domain federation policies to determine whether the registered Agent is authorized to operate within the specific trust domain. Only authorized capabilities are made queryable via ADF.

Phase 2: Intent-based Routing and Forwarding

This stage is triggered when a registered Leader Agent submits a semantic intent request. The Agent Gateway resolves and routes the intent to eligible Partner Agents. The steps are as follows:

* *Step5:*Intent Submission. The Leader Agent sends a signed semantic intent vector to the Agent Gateway. The signature MUST be generated using the credentials established in Step 1. The payload contains abstract task semantics.

* *Step6:*Intent Resolution and Candidate Matching. The Agent Gateway invokes the ACP-IF-07 interface to query the ADF. The IFR (Intent Forwarding Routing Table) performs semantic matching against the LCR, filtering based on trust scopes, and ranking candidates.

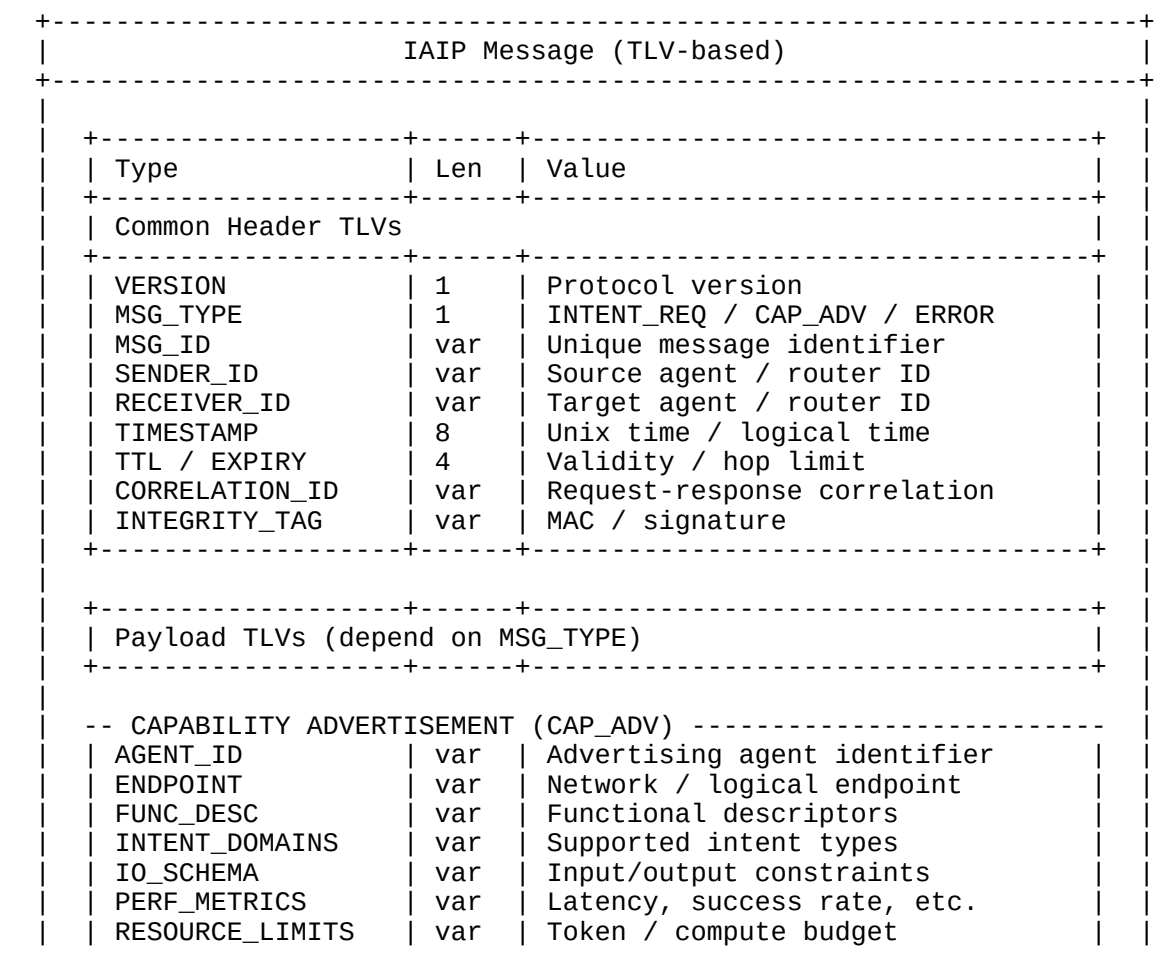
* *Step7:*Candidate Agents Return. The Gateway returns a ranked list of eligible Partner Agents to the Leader Agent.

* *Step8:*Leader-side Verification and Selection. The Leader Agent verifies the gateway's signature and selects one or more Partners based on local policy.

* *Step9:*Routing and Execution. The Leader Agent establishes a direct end-to-end session with the selected Partner Agent(s) using ACP-IF-08 for point-to-point interaction, or ACP-IF-09 for grouping-mode collaboration. All task payloads are transmitted over this encrypted channel.

7. Message Formats

This section specifies the binary structure of IAIP messages. The protocol uses a Type-Length-Value (TLV) design to ensure extensibility, as shown in Figure 3.



```
|                                                                    |
|  -- CAPABILITY REFRESH (CAP_REFRESH) ---------------------------  |
|  | AGENT_ID          | var  | Agent identifier                 |  |
|  | TTL_UPDATE        | 4    | Extended lifetime                |  |
|  | METRIC_DELTA      | var  | Updated performance metrics      |  |
|                                                                    |
|  -- CAPABILITY DEREGISTER (CAP_DEREGISTER) ----------------------  |
|  | AGENT_ID          | var  | Agent identifier                 |  |
|  | REASON_CODE       | 2    | Deregistration reason            |  |
|  | EFFECTIVE_TIME    | 8    | Time of effect                   |  |
|                                                                    |
|  -- INTENT REQUEST (INTENT_REQ) --------------------------------  |
|  | OBJECTIVE         | var  | Task objective                   |  |
|  | CONSTRAINTS       | var  | Preferences / limits             |  |
|  | CONTEXT           | var  | Context metadata                 |  |
|  | PRIORITY          | 1    | Request priority                 |  |
|  | BUDGET            | var  | Cost / token budget              |  |
|  | PRIVACY_FLAG      | 1    | Intent privacy level             |  |
|  | OBFUSCATED_INTENT | var  | Encrypted / masked intent        |  |
|                                                                    |
|  -- ROUTE DECISION / INTENT RESPONSE ---------------------------  |
|  | TARGET_AGENT_LIST | var  | Selected target agent(s)         |  |
|  | MATCH_CONFIDENCE  | var  | Similarity / rank score          |  |
|  | FORWARDING_INFO   | var  | Next-hop / endpoint              |  |
|  | FALLBACK_INDIC.   | 1    | Fallback used?                   |  |
|                                                                    |
|  -- ROUTING FEEDBACK -------------------------------------------  |
|  | OUTCOME           | 1    | Success / failure                |  |
|  | OBSERVED_LATENCY  | var  | Execution latency                |  |
|  | OBSERVED_COST     | var  | Resource usage                   |  |
|  | ERROR_INFO        | var  | Error details                    |  |
|                                                                    |
|  -- ERROR MESSAGE ----------------------------------------------  |
|  | ERROR_CODE        | 2    | Error identifier                 |  |
|  | DIAGNOSTIC        | var  | Human-readable info              |  |
|  | RETRY_AFTER       | 4    | Backoff hint                     |  |
|                                                                    |
|  -- SECURITY EXTENSION (SECURITY_EXT) --------------------------  |
|  | AUTHN_INFO        | var  | Certificate / token ref          |  |
|  | AUTHZ_SCOPE       | var  | Authorization scope              |  |
|  | NONCE             | var  | Anti-replay                      |  |
|  | SIGNATURE / MAC   | var  | Integrity protection             |  |
|  | ENCRYPTION_CTX    | var  | Intent confidentiality ctx       |  |
|                                                                    |
+--------------------------------------------------------------------+
```

Figure 3: IAIP message format

The table above summarizes the field requirements. Key fields include:

MSG_TYPE Identifies the payload type (e.g., 0x01: CAP_ADV, 0x02: INTENT_REQ).

TTL / EXPIRY Time-To-Live logic depending on message type. For routing messages (INTENT_REQ), this represents the hop limit. For registration messages, this represents the validity duration in seconds.

OBJECTIVE (in INTENT_REQ) The semantic vector or structured description of the task.

RESOURCE_LIMITS (in CAP_ADV) Specifies operational constraints, including token budget per request and computational cost.

FALLBACK_INDIC. (in RESPONSE) Flag indicating if a generalist fallback agent was used (0x01) or a direct match was found (0x00).

8. Protocol Operation and Core Procedures

This section specifies the normative processing behavior of the Agent Gateway (AG), organized by the functional components defined in Section 5. The Agent Access Component (AAC) handles ingress connectivity and security; the Local Capability Registry (LCR) manages state; and the Intent Forwarding Routing Table (IFR) executes decision logic.

8.1. Illustrative Protocol Examples

The examples in this section are provided for illustration only and are non-normative.

8.1.1. Example A: Agent Registration (CAP_ADV)

A Partner Agent registers its translation service with cost constraints.

[Common Header] MSG_TYPE =
CAP_ADV SENDER_ID = "agent-trans-01", TTL/EXPIRY = 3600 [Payload],
FUNC_DESC = "service:translation; lang:en-to-zh", RESOURCE_LIMITS =
"max_tokens=2048", SECURITY_EXT = "(signature bytes...)"

8.1.2. Example B: Intent Resolution Flow

Step 1: Leader Agent sends Intent Request

[Common Header] MSG_TYPE =
INTENT_REQ SENDER_ID = "leader-agent-007", MSG_ID = "req-1024"
[Payload], OBJECTIVE = "(vector: [0.12, 0.95, ...])", BUDGET =
"100"

Step 2: Gateway returns Candidate List (Response)
The AG finds two matching agents. The first one is a direct match, so Fallback Indicator is 0.

[Common Header] MSG_TYPE =
RESPONSE RECEIVER_ID = "leader-agent-007", CORRELATION_ID =
"req-1024" [Payload], TARGET_AGENT_LIST = [1] "agent-trans-01"
(Conf: 0.92, Endpoint: "10.0.1.5:8080"), [2] "agent-trans-03" (Conf:
0.85, Endpoint: "10.0.1.8:8080"), FALLBACK_INDIC. = 0x00 (No
Fallback)

8.1.3. Example C: Routing Feedback

After execution, the Leader Agent reports performance metrics back to the AG to update the LCR’s dynamic scores.

[Common Header] MSG_TYPE =
ROUTING_FEEDBACK SENDER_ID = "leader-agent-007" [Payload], OUTCOME =
1 (Success), OBSERVED_LATENCY = 250 (ms), OBSERVED_COST = 50
(tokens)

8.2. Agent Access Component (AAC) Operations

The AAC serves as the termination point for the interconnection session. It MUST intercept all incoming IAIP messages before they reach the LCR or IFR.

8.2.1. Session Authentication and Integrity

Upon receiving any message, the AAC MUST perform the following validations:

* *Identity Verification:* Validate the SENDER_ID against the credentials provided in the AUTHN_INFO TLV or the underlying transport session (e.g., mTLS).
* *Message Integrity:* Verify the INTEGRITY_TAG or SIGNATURE. If verification fails, the AAC MUST drop the message and return an ERROR with code AUTH_FAILED.

8.2.2. Ingress Validation

The AAC acts as the first line of defense. It MUST validate the syntax of Common Header fields (e.g., VERSION, MSG_TYPE). Malformed packets MUST be rejected immediately to protect the internal IFR engine.

8.3. Local Capability Registry (LCR) Management

The LCR maintains the dynamic database of attached Agents. It processes capability management messages validated by the AAC.

8.3.1. Profile Creation and Updates

When the AAC forwards a CAP_ADV message, the LCR MUST:

1. Extract the AGENT_ID and map it to the provided ENDPOINT.
2. Store the FUNC_DESC, INTENT_DOMAINS, and RESOURCE_LIMITS as the agent’s Capability Profile.
3. Set the entry’s expiration time to Current_Time + TTL.

8.3.2. Lifecycle Maintenance

Upon receiving a CAP_REFRESH, the LCR MUST look up the existing profile and extend its validity by TTL_UPDATE.

The LCR MUST periodically purge entries that have exceeded their expiry time without refresh (STALE state) to ensure the IFR does not route to dead agents.

8.4. Intent Forwarding Routing Table (IFR) Decision Logic

The Intent Forwarding Routing Table (IFR) functions as the dynamic routing engine of the Agent Gateway. After an INTENT_REQ successfully passes AAC validation, the IFR MUST evaluate the request and produce a ranked TARGET_AGENT_LIST containing one or more eligible Partner Agents.

8.4.1. Candidate Retrieval

The IFR MUST interpret the OBJECTIVE TLV as an intent descriptor and query the Local Capability Registry (LCR) to obtain the current set of active Capability Profiles.

8.4.2. Constraint-Based Filtering

The IFR MUST apply mandatory constraints to reduce the candidate set prior to semantic evaluation. When a request includes constraint fields such as BUDGET, the IFR MUST compare these constraints against the corresponding attributes in the Capability Profiles (e.g., RESOURCE_LIMITS) and exclude agents that do not satisfy the required conditions.

Additional policy-based constraints MAY be applied according to local administrative policy.

8.4.3. Semantic Evaluation and Ranking

For the remaining candidates, the IFR MUST perform semantic matching between the request intent and the advertised capabilities. The specific matching method is implementation-dependent; however, the IFR MUST compute a relative confidence score that reflects the degree of intent-capability alignment.

The IFR MAY incorporate additional operational signals, such as historical performance metrics (e.g., latency or success rate), when deriving the final ranking.

The IFR MUST preserve the relative ordering of candidates when constructing the TARGET_AGENT_LIST.

8.4.4. Selection and Fallback

The IFR SHOULD select the highest-ranked candidates for inclusion in the response, subject to local policy.

If no candidate satisfies the acceptance criteria (e.g., minimum confidence threshold), the IFR SHOULD invoke the Fallback Mechanism. When fallback is applied, the Agent Gateway MUST set FALLBACK_INDIC to 0x01.

8.5. Forwarding and Loop Prevention

For multi-hop scenarios, the AG enforces loop prevention using the TTL field in the Common Header. If TTL <= 1, the request is dropped. Duplicate MSG_ID, are suppressed to prevent broadcast storms.

8.6. Reliability and Error Handling

Errors detected by any component (AAC auth failure, LCR parsing error, IFR no-route) MUST result in an ERROR message returned to the sender, containing the appropriate ERROR_CODE.

8.7. Protocol Processing procedure at Agent Gateways

Figure 4 illustrates the protocol processing pipeline within the Agent Gateway (AG). The protocol operation relies on the coordination between three normative functional components: the Agent Access Component (AAC), the Local Capability Registry (LCR), and the Intent Forwarding Routing Table (IFR).

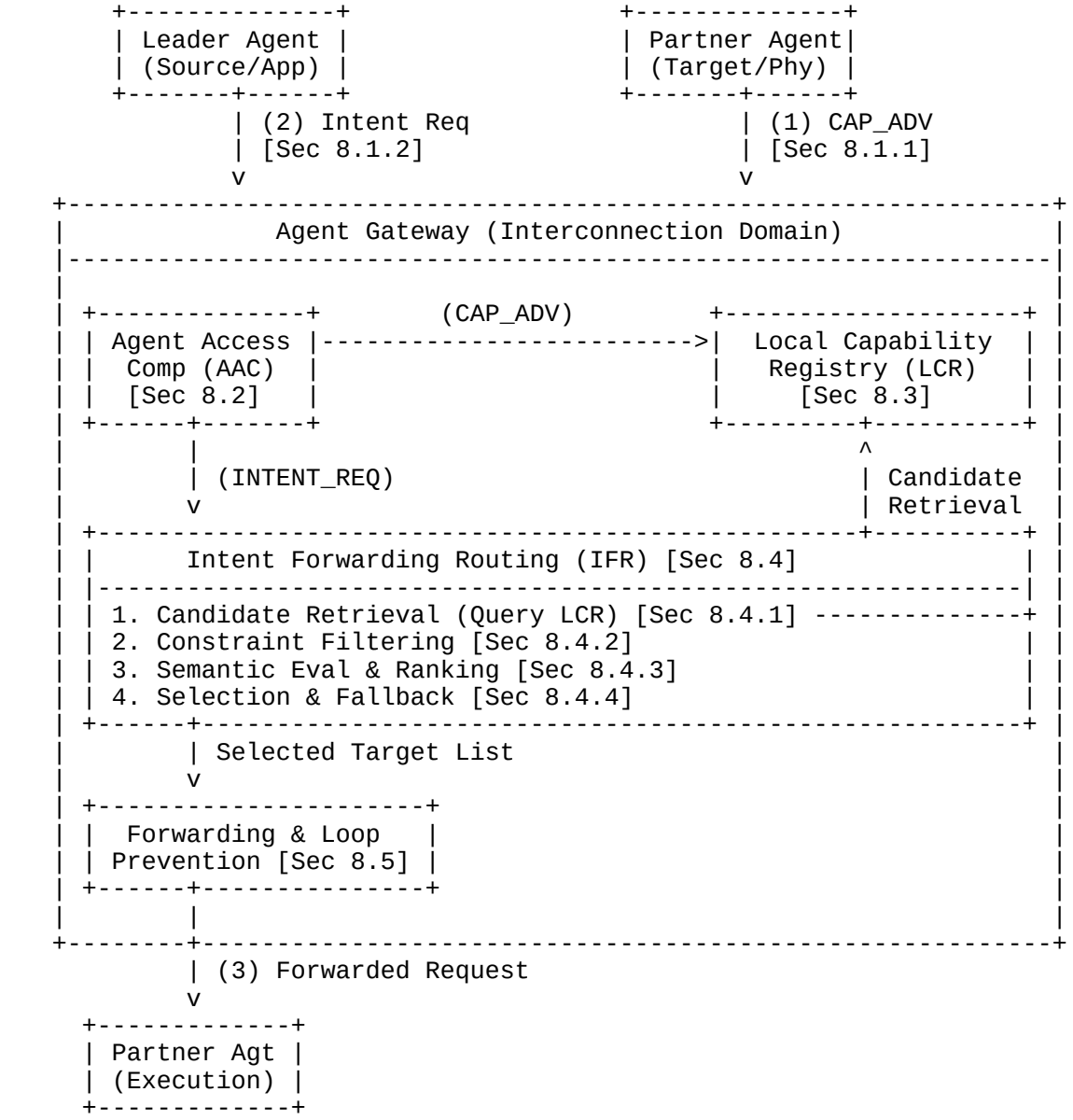


Figure 4: Protocol Processing procedure at Agent Gateways

The process begins when a Partner Agent transmits a capability advertisement (CAP_ADV) [Section 8.1.1].

Ingress Validation: The AAC [Section 8.2] intercepts the message to perform session authentication and integrity verification.

*Registry Update:*Upon successful validation, the AAC forwards the payload to the LCR [Section 8.3]. The LCR parses the functional descriptors and updates its internal database, mapping the agent's semantic profile to its network endpoint.

The routing process is triggered when a Leader Agent submits an intent request (INTENT_REQ) [Section 8.1.2].

*Ingress Validation:*The AAC validates the request format and the sender's authorization scope.

*Routing Decision:*Validated requests are passed to the IFR [Section 8.4], which executes the core decision logic:

* *Candidate Retrieval:*The IFR queries the LCR [Section 8.4.1] to retrieve active agents capable of satisfying the intent objective.

* *Filtering:*Mandatory constraints (e.g., budget, latency) are applied to prune ineligible candidates [Section 8.4.2].

* *Ranking:*The IFR performs semantic evaluation [Section 8.4.3] to assign confidence scores to the remaining candidates.

* *Selection:*The eligible partner agents are selected based on local policy and fallback mechanisms [Section 8.4.4].

*Egress Processing:*The partner agent list is passed to the Forwarding module [Section 8.5]. This module enforces Time-To-Live (TTL) checks and duplicate suppression to prevent routing loops before dispatching the forwarded request to the Partner Agent.

9. Core State Management at Agent Gateway

This section defines the fundamental state information maintained by Agent Gateway's (AG) core functional components: Agent Access Component (AAC), Local Capability Registry (LCR), and Intent Forwarding Routing Table (IFR).

9.1. State in Agent Access Component (AAC)

The AAC is responsible for managing authentication, maintaining session lifecycle, and verifying message integrity for incoming IAIP messages. For each active connection or connect with an AI Agent, the AAC MUST maintain the following state:

Session Identifier (SESSION_ID) A unique identifier for the established session.

Peer Identity (PEER_ID) The authenticated identity of the connected AI Agent or another AG, verified during the session establishment process.

Connection Parameters (CONN_PARAMS) Details of the underlying transport connection, such as source IP address, port, and TLS session state.

Session Expiry Timer (SESSION_EXPIRY_TIMER) A timer indicating when the session is considered idle and can be terminated. This timer is reset upon active message exchange.

Security Context (SEC_CONTEXT) Cryptographic keys or context information derived from the TLS handshake or identity verification, used for message integrity checks and potentially for subsequent message encryption/decryption.

AAC leverages these states to perform rapid authentication, integrity verification, and manage the lifecycle of the connections, ensuring that only legitimate and secure interactions proceed to the LCR or IFR.

9.2. State in Local Capability Registry (LCR)

LCR maintains a dynamic database of attached Agents' capabilities and operational status. Each entry in the LCR MUST represent a registered Agent and include the following state attributes:

Agent Identifier (AGENT_ID) The unique identifier of the Agent, as specified in IAIP messages.

Network Endpoint (ENDPOINT) The network address and port where the Agent can be reached. This MAY include multiple endpoints for redundancy.

Capability Profile (CAPABILITY_PROFILE) The comprehensive description of the Agent's capabilities, including:

  * FUNC_DESC: Functional descriptors.

  * INTENT_DOMAINS: Supported intent types.

  * IO_SCHEMA: Input/output constraints.

  * PERF_METRICS: Real-time performance indicators (e.g., latency, success rate, resource availability).

  * RESOURCE_LIMITS: Operational constraints and budgets.

Registration Expiry Time (EXPIRY_TIME) A timestamp indicating the absolute time when the Agent's registration will expire if not refreshed by a CAP_REFRESH message. This is derived from the TTL/EXPIRY field of CAP_ADV messages.

Operational Status (STATUS) The current availability and trustworthiness state of the Agent from the AG's perspective. The following states are defined for LCR entries:

  * ACTIVE: The Agent is registered, its capabilities are current, verified, and it is available for intent-based routing. This is the default state for successfully registered Agents.

  * PENDING_VERIFICATION: The Agent has initiated registration, but its identity, capabilities, or trust assertion are still undergoing verification by the AAC or DTMgF. Intents MUST NOT be routed to Agents in this state.

  * EPRECATED: The Agent's capabilities have been explicitly de-registered (e.g., via CAP_DEREGISTER) or its registration has expired and has been purged from active use by the AG's lifecycle maintenance. Intents MUST NOT be routed to Agents in this state.

  * SUSPENDED: The Agent has been administratively or system-matically marked as temporarily unavailable due to misbehavior, excessive errors, or resource exhaustion. Intents MUST NOT be routed to Agents in this state.

  * UNREACHABLE: The Agent was previously ACTIVE, but recent communication attempts (e.g., routing feedback, or active health checks) indicate it is currently unreachable. AG MAY periodically attempt to re-verify reachability before potentially transitioning to DEPRECATED or SUSPENDED.

Trust Information (TRUST_INFO) Information relating to the Agent's trust domain and verification status by the DTMgF.

The LCR's lifecycle maintenance MUST ensure that stale or invalid Agent entries are transitioned to appropriate states and eventually purged.

9.3. State in Intent Forwarding Routing (IFR)

The IFR (<xref target="components"/>, <xref target="ifr-decision-logic"/>) is the dynamic routing decision engine. For each Intent Request (INTENT_REQ) currently being processed, the IFR MAY maintain a transient request-specific state. This state aids in managing the decision-making process and correlating subsequent protocol interactions. The states MAY include:

Intent Request Identifier (REQUEST_ID) The MSG_ID of the INTENT_REQ uniquely identifying the current intent processing instance.

Leader Agent Identity (LEADER_AGENT_ID) The SENDER_ID of the INTENT_REQ.

Original Intent Objective (OBJECTIVE) The full semantic intent descriptor received from the Leader Agent.

Intent Constraints (CONSTRAINTS) Budget, privacy flags, and other constraints specified in the INTENT_REQ.

Candidate List (CANDIDATE_LIST) A set of potential Partner Agents retrieved from the LCR, filtered by constraints, and awaiting semantic evaluation and ranking.

Ranked Candidate List (RANKED_LIST) The CANDIDATE_LIST after semantic evaluation and ranking have been applied.

Selected Partner Agent(s) (SELECTED_AGENT_LIST) The final list of Partner Agents chosen for forwarding, including their confidence scores and endpoints.

Processing Stage (STAGE) The current stage of the intent’s decision processing within the IFR (e.g., RETRIEVING_CANDIDATES, FILTERING, EVALUATING, SELECTING, COMPLETED).

This IFR request state is typically initiated upon successful validation of an INTENT_REQ by the AAC and is dissolved once the routing decision is transmitted back to the Leader Agent, or upon timeout or error.

10. IAIP Transport and Security Bindings

This section specifies how IAIP messages are securely transmitted over underlying network protocols. As an application-layer protocol, IAIP leverages existing transport and security mechanisms to ensure reliable, confidential, and authenticated communication between AI Agents and Agent Gateways (AGs), and potentially between AGs themselves.

10.1. Secure Transport Layer Foundation

All IAIP communications, including Agent registrations (CAP_ADV), intent requests (INTENT_REQ), responses, and routing feedback, MUST be secured using Transport Layer Security (TLS) or its successor. TLS provides the following essential security services:

Confidentiality Protects IAIP message contents, including sensitive intent descriptors, capability profiles, and task payloads, from eavesdropping during transit.

Integrity Ensures that IAIP messages are not tampered with or corrupted between the sender and receiver.

Authentication Provides mutual authentication of the communicating endpoints (AI Agents and AGs) through cryptographic means.

* AG Authentication: AI Agents MUST authenticate the AG using its server certificate presented during the TLS handshake. Agents SHOULD validate the AG’s identity against its AGENT_ID or a known trust anchor.

* Agent Authentication: AGs MUST authenticate AI Agents using TLS client certificates or other credentials provided within the TLS handshake. The AG MUST verify the Agent’s identity (AGENT_ID) against the presented client certificate and established trust policies.

Implementations MUST support TLS version. Specific cipher suites, certificate validation policies, and trust anchors are subject to local administrative policy and the broader security considerations.

10.2. Underlying Transport

IAIP messages are designed for secure and reliable transport, with ordering semantics defined by the selected transport binding. To ensure interoperability across deployments, IAIP implementations MUST support a baseline transport binding over TCP protected by TLS. Implementations MAY additionally support QUIC as an alternative secure transport binding, particularly for latency-sensitive or highly dynamic environments.

TCP/TLS Binding IAIP implementations MUST support transmission over TCP within a TLS tunnel.

- Message Framing: Each IAIP message (structured as a Type-Length-Value (TLV) block as per <xref target="message-formats"/>) MUST be explicitly framed to delimit individual messages within the TCP byte stream. A MANDATORY framing mechanism is to prefix each IAIP message with a 4-octet unsigned integer in network byte order indicating the length of the subsequent IAIP message payload. Receivers MUST read this length field before attempting to read the full IAIP message.

- Reliability and Ordering: TCP provides reliable, in-order delivery of bytes. IAIP message processing over TCP/TLS therefore relies on the framing mechanism above to reconstruct message boundaries.

- Port Allocation: IAIP implementations SHOULD use a dedicated TCP port for secure IAIP communication. Other ports MAY be used according to local policy or service discovery mechanisms.

QUIC Binding (OPTIONAL) IAIP implementations MAY support transmission over QUIC as an alternative secure transport binding. QUIC provides integrated cryptographic protection, reliable stream transport, and native multiplexing, and MAY be preferred in latency-sensitive scenarios or environments with frequent path changes.

- Security Foundation: When IAIP is carried over QUIC, the security properties of QUIC MUST be used as the transport protection mechanism. Implementations MUST NOT assume an additional TLS tunnel outside QUIC, since QUIC already incorporates TLS-based cryptographic protection.

* Message Mapping: For interoperability, a compliant QUIC binding MUST use one IAIP message per QUIC bidirectional stream. Each IAIP message MUST be carried entirely within a single QUIC stream, and the end of that stream defines the end of the message. Fragmenting a single IAIP message across multiple QUIC streams MUST NOT be used.

* Reliability and Ordering: IAIP over QUIC MUST use reliable QUIC streams for all protocol messages defined by this specification. Ordering is guaranteed only within an individual QUIC stream; protocol entities MUST NOT assume any global ordering across different QUIC streams.

* Multiplexing: Independent IAIP message exchanges MAY be carried over separate QUIC streams to avoid head-of-line blocking between unrelated exchanges. Protocol-level identification and correlation MUST continue to rely on MSG_ID and CORRELATION_ID, rather than on QUIC stream identifiers alone.

* Port Allocation: IAIP implementations using QUIC SHOULD use a dedicated UDP port for secure IAIP communication over QUIC. Other ports MAY be used according to local policy or service discovery mechanisms.

Transport Selection and Interoperability All compliant IAIP implementations MUST support the TCP/TLS binding as the mandatory-to-implement baseline. Support for QUIC is OPTIONAL. When both endpoints support multiple transport bindings, the transport selection mechanism MAY be determined by local configuration, service discovery, capability advertisement, or future negotiation procedures defined by this specification or its extensions.

10.3. Connection Management

IAIP entities (AI Agents and AGs) SHOULD manage persistent secure transport connections to optimize performance and reduce repeated handshake overhead. The connection management procedures defined in this section apply to both TCP/TLS and QUIC, unless otherwise specified by the corresponding transport binding.

Connection Establishment An AI Agent initiates a connection to an

AG for registration or intent submission. AGs MAY initiate connections to other AGs for multi-hop routing, subject to configured policies. Before any IAIP messages are exchanged, the underlying secure transport handshake MUST complete successfully. For TCP/TLS, this requires successful completion of the TLS handshake over TCP. For QUIC, this requires successful establishment of the QUIC connection with its integrated cryptographic handshake.

Connection Keep-Alive Implementations SHOULD provide mechanisms to detect idle or failed connections and to prevent premature closure by network intermediaries. For TCP/TLS, implementations SHOULD utilize TCP keep-alive where appropriate. For QUIC, implementations SHOULD use QUIC-native liveness mechanisms, such as transport-level keep-alive signaling or PING frames, as provided by the implementation. Application-layer keep-alive messages MAY also be defined by future extensions for use across transport bindings.

Connection Re-establishment If an active connection is unexpectedly terminated and continued interaction is required, IAIP entities SHOULD attempt to re-establish the connection. Re-establishment attempts MUST incorporate exponential back-off mechanisms to prevent congestion amplification or resource exhaustion. Under TCP/TLS, re-establishment is typically required after transport disruption. Under QUIC, re-establishment is required only if the QUIC connection itself has been lost; network path changes that are handled through QUIC connection migration do not constitute connection re-establishment. Implementations SHOULD preserve only the minimum state necessary to safely resume operation after reconnection. The AAC plays a critical role in managing session continuity and security-related state across connection disruptions.

Multiplexing Multiple independent IAIP message exchanges MAY share a single persistent secure transport connection. Under TCP/TLS, such multiplexing occurs within the same protected byte stream and relies on unique MSG_ID and CORRELATION_ID fields for message correlation. Under QUIC, independent IAIP messages MAY be carried over different QUIC streams to reduce head-of-line blocking. In all cases, protocol-level correlation MUST rely on IAIP identifiers rather than on transport-level connection or stream identifiers alone.

Connection Migration and Path Changes Transport bindings MAY differ in their ability to tolerate endpoint mobility or network path changes. TCP/TLS connections typically require re-establishment after a path-disrupting failure or endpoint address

change. QUIC implementations MAY support connection migration in accordance with QUIC transport behavior, allowing continuity across certain network changes without full reconnection. IAIP implementations MUST NOT assume that transport-level continuity alone is sufficient to preserve application-level session validity; validation of session state remains the responsibility of the AAC.

Connection Teardown Connections SHOULD be terminated gracefully whenever possible. For TCP/TLS, graceful termination SHOULD use the standard TCP FIN/ACK sequence together with appropriate TLS session closure behavior. For QUIC, graceful termination SHOULD follow the QUIC connection closing procedure. An AG MAY forcibly terminate connections that violate security policy, exceed configured idle time limits, or exhibit persistent protocol errors.

11. Conclusions

This document specifies the functional components, protocol procedures, and message formats of the Intent-based Agent Interconnection Protocol (IAIP). It defines the mechanisms for capability-aware registration, semantic intent resolution, and dynamic routing. By abstracting the complexity of agent discovery and intent matching, IAIP ensures scalable and adaptive collaboration across heterogeneous agent systems.

12. Security Considerations

This document focuses on the Intent-based Agent Interconnection Protocol at the Agent Gateway for inter-agent collaboration in the Internet of Agents (IoA). Security of the IoA ecosystem is not detailed in this document. Security considerations relevant to cross-domain intent routing, capability advertisement integrity, trust federation among multiple agent service providers, and end-to-end confidentiality of agent interactions are suggested to be deeply discussed through other proposals.

13. IANA Considerations

TBD

14. Normative References

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

Authors' Addresses

Sheng Sun
ICT, CAS
Email: sunsheng@ict.ac.cn

Xinyi Zhang
CNIC, CAS
Email: xyzhang@cnic.cn

Qiangzhou Gao
Huawei Technologies
Email: gaoqiangzhou@huawei.com

Min Liu
ICT, CAS
Email: liumin@ict.ac.cn

Yuwei Wang
ICT, CAS
Email: ywwang@ict.ac.cn