IETF-123 I2ICF Side Meeting

An Intent Translation Framework for IoT Networks (draft-gu-nmrg-intent-translator-01)

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Motivation of this Draft

- **An Intent Translation Framework for IoT Networks**
  - This draft defines **a Framework** for extracting an intent from natural language and covert to a high-level policy to manage IoT devices via **Intent Translation framework** by a user in Cloud.
    - **Intent Translator Functions**
      - **Intent Extractor, Semantic Mapper, Intent Resolver, and Intent Composer**
      - draft-gu-nmrg-intent-translator-01
- **Main Contents of this Draft**
  - Intent Translation Framework Components
  - Semantic Mapper Components
  - Intent Resolver Components

Scope for the Draft

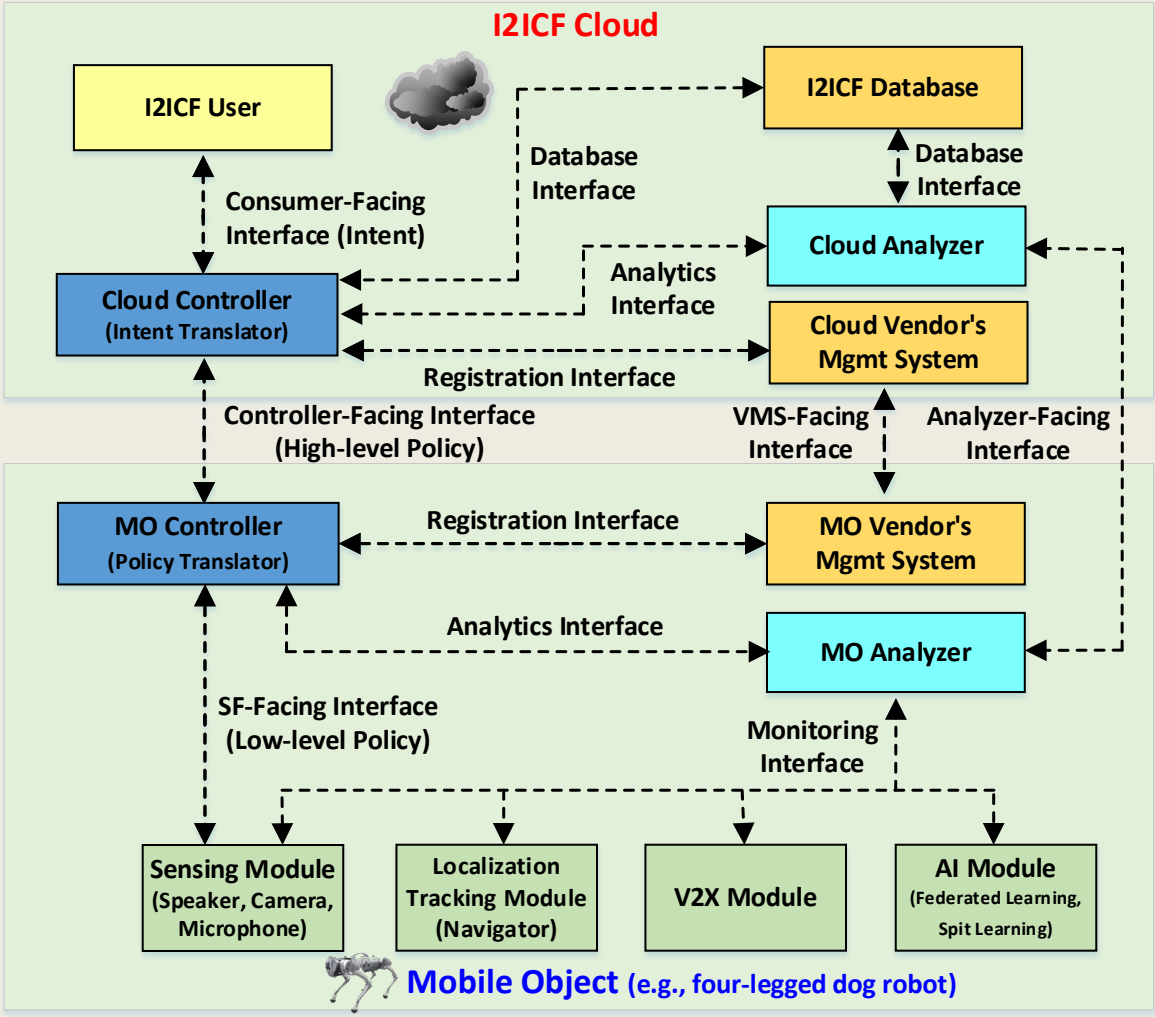
1. **Intent Translation Framework** for intent based network management for IoT Network
   - This framework extracts an intent from natural language commands and converts it into a policy.
2. **Semantic Mapper** of vectorizing structured intent
   - It maps an extracted intent into an embedded vector.
3. **Intent Resolver** for reasoning intent with domain knowledge
   - It matches an embedded intent vector with a domain knowledge graph in Knowledge Base.

Goal of I2ICF Group

- **Goal:** Standardization of **I2ICF for Computing in the Network**
  - **I2ICF Problem Statement**
    - https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2icf-problem-statement/
  - **I2ICF Framework**
    - https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2icf-framework/
  - **I2ICF Use Case**: Intelligent Transportation Systems
    - https://datatracker.ietf.org/doc/draft-ahn-opsawg-i2icf-cits/
  - **I2ICF Intent Translator**
    - https://datatracker.ietf.org/doc/draft-gu-nmrg-intent-translator/

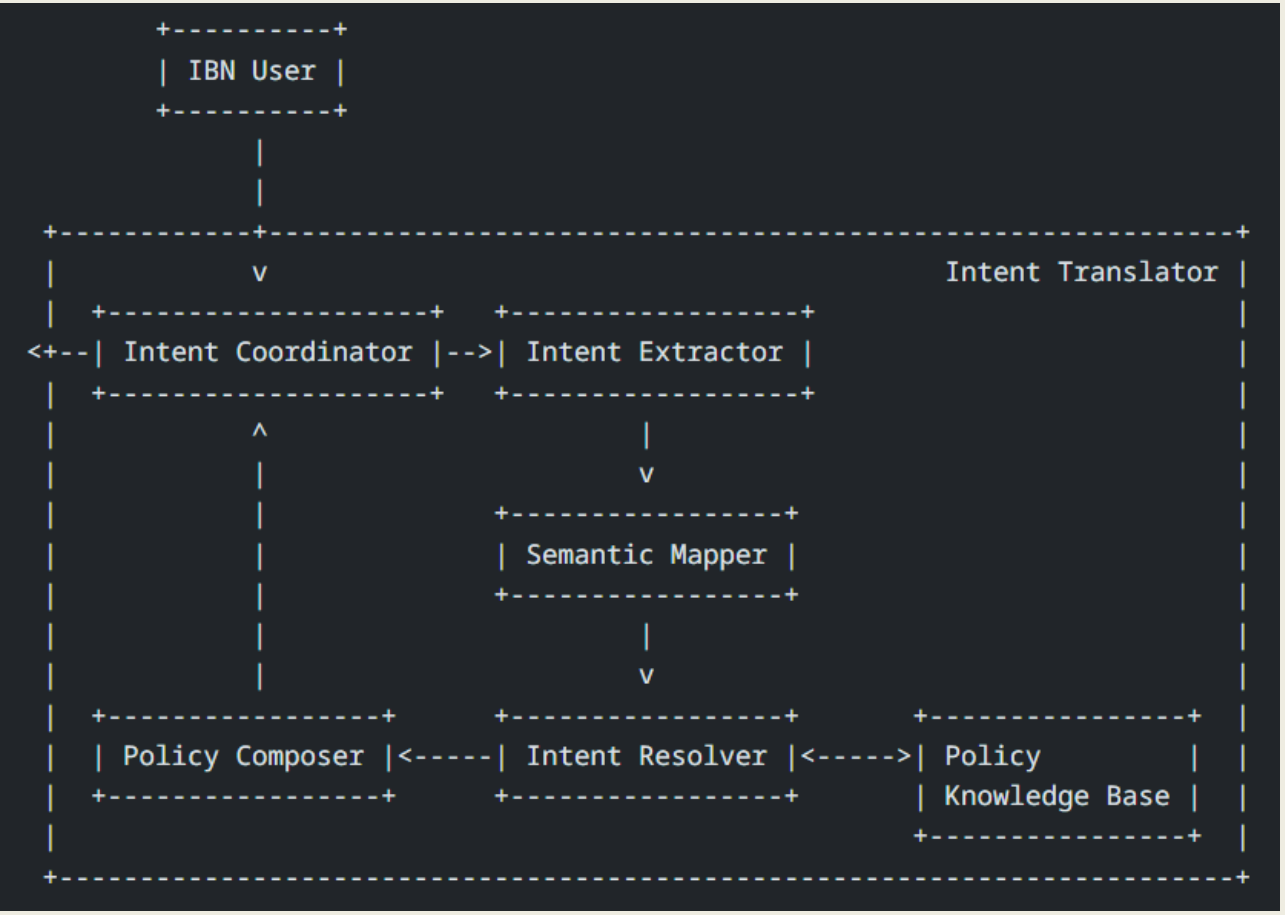
I2ICF Framework for ICF Management
(ICFs in Moving Object)

- For the automatic network configuration of MOs, an **Intent-Based Management** is required between the Cloud and MOs.
- This framework shows an **I2ICF framework as an IBS for an MO**. The framework consists of the Cloud and MOs.



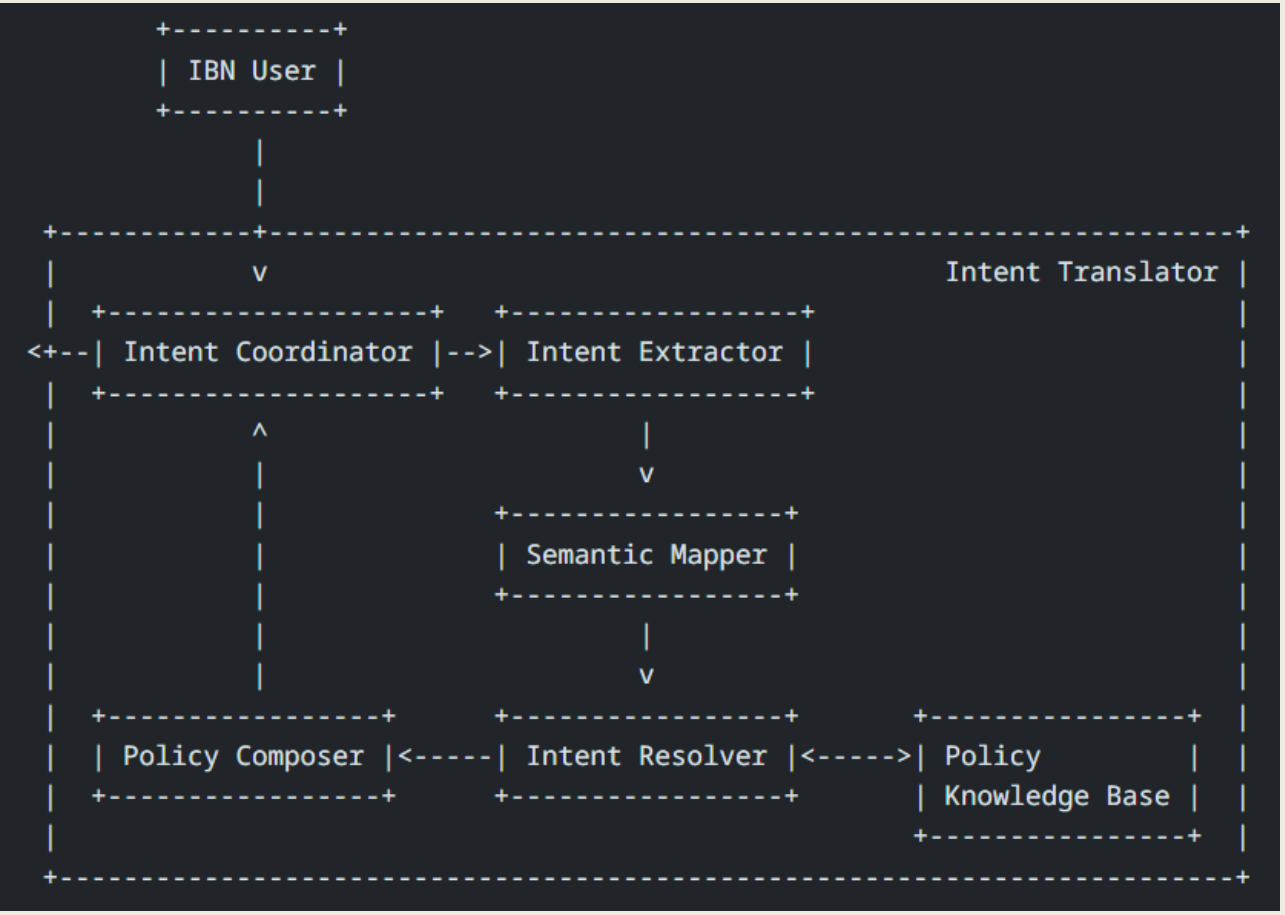
I2ICF Framework for Moving Objects

Step 1: Intent Translator Framework



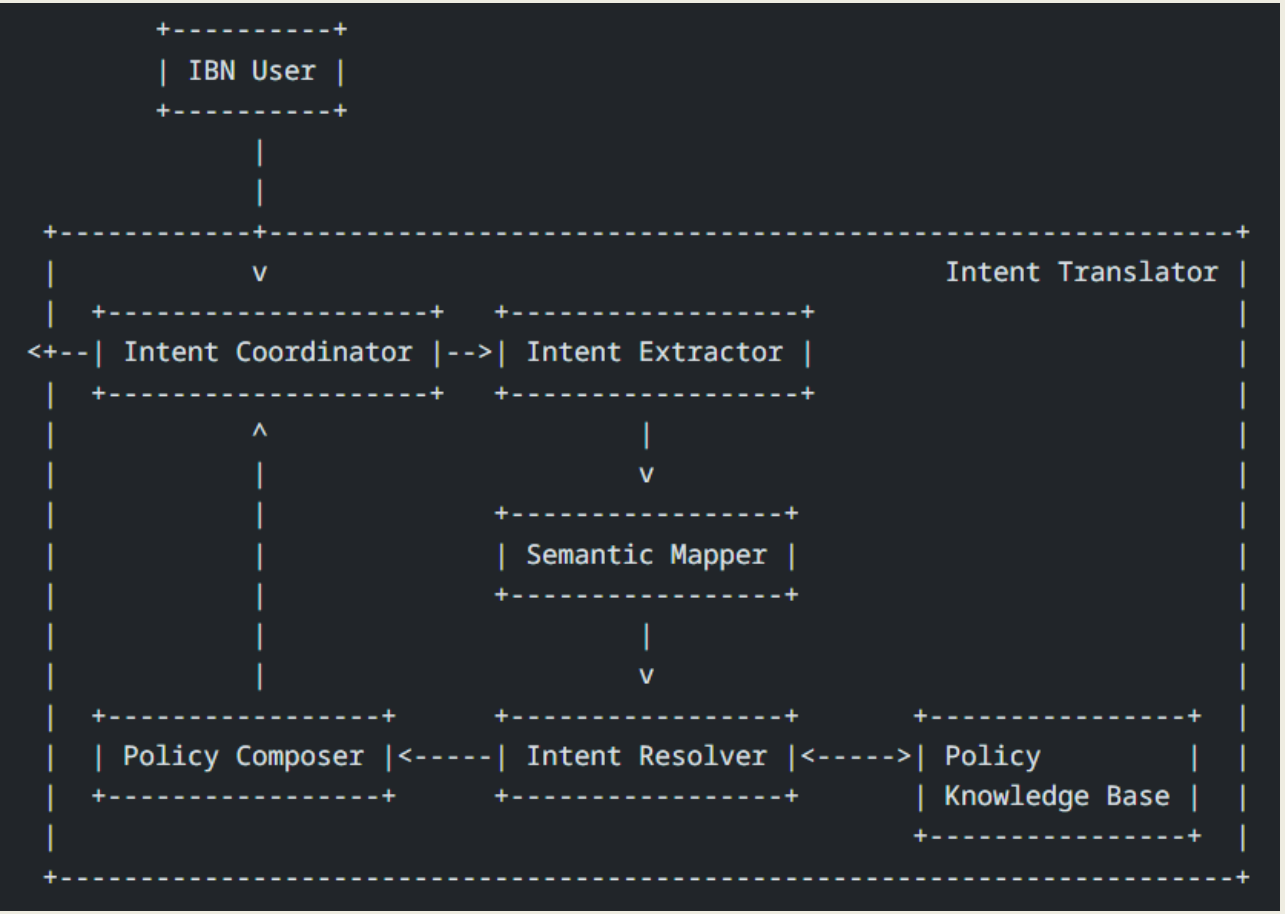
- **Intent Translator**
  - It converts a natural language intent into a structured, network policy for enforcement in intent-based management systems.

Step 1: Intent Translator Framework



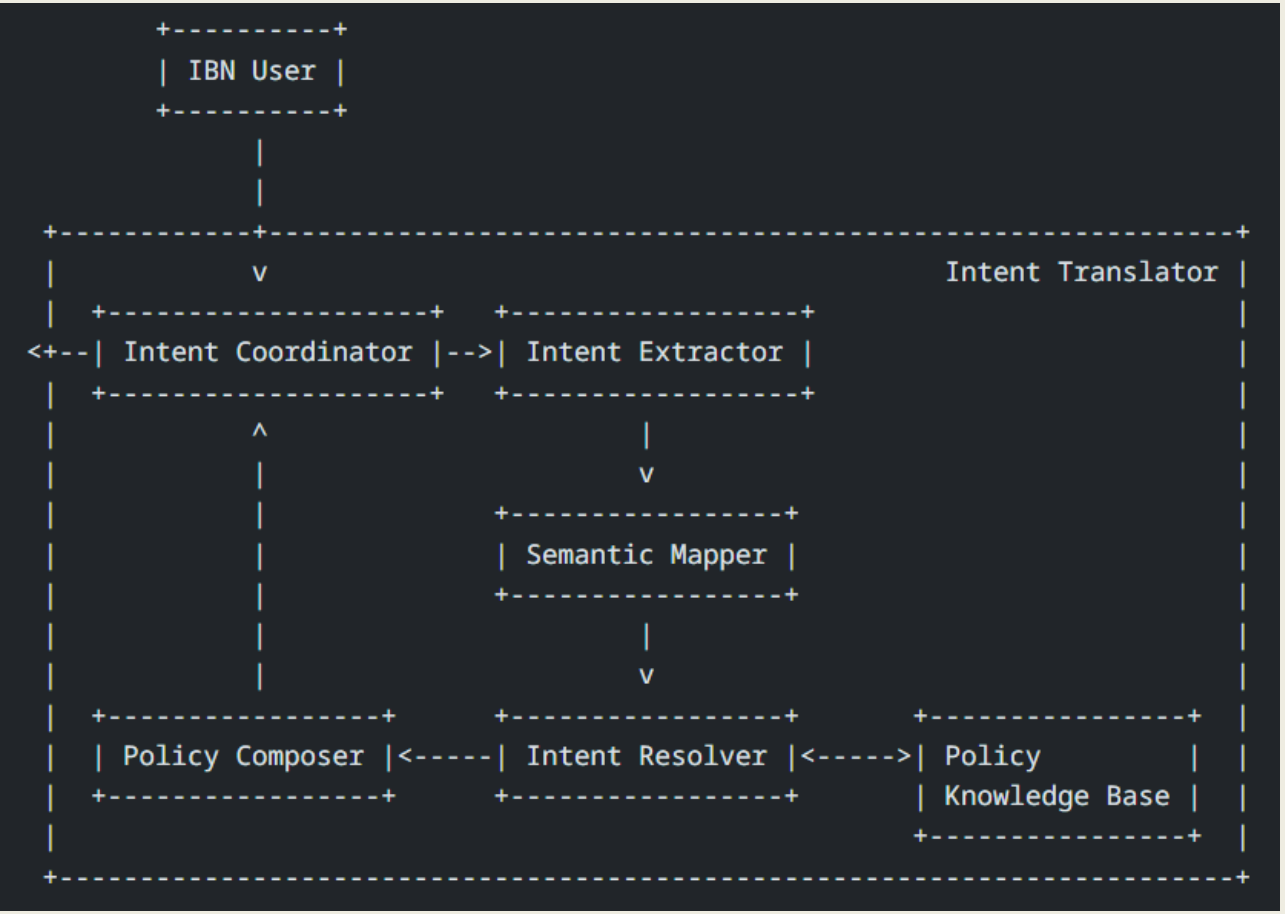
- **Intent Coordinator**
  - It receives an intent submitted by an IBN user and forwards the natural language intent to the Intent Extractor.
  - It also delivers a network policy to downstream systems for enforcement, such as a network orchestration engine.

Step 1: Intent Translator Framework



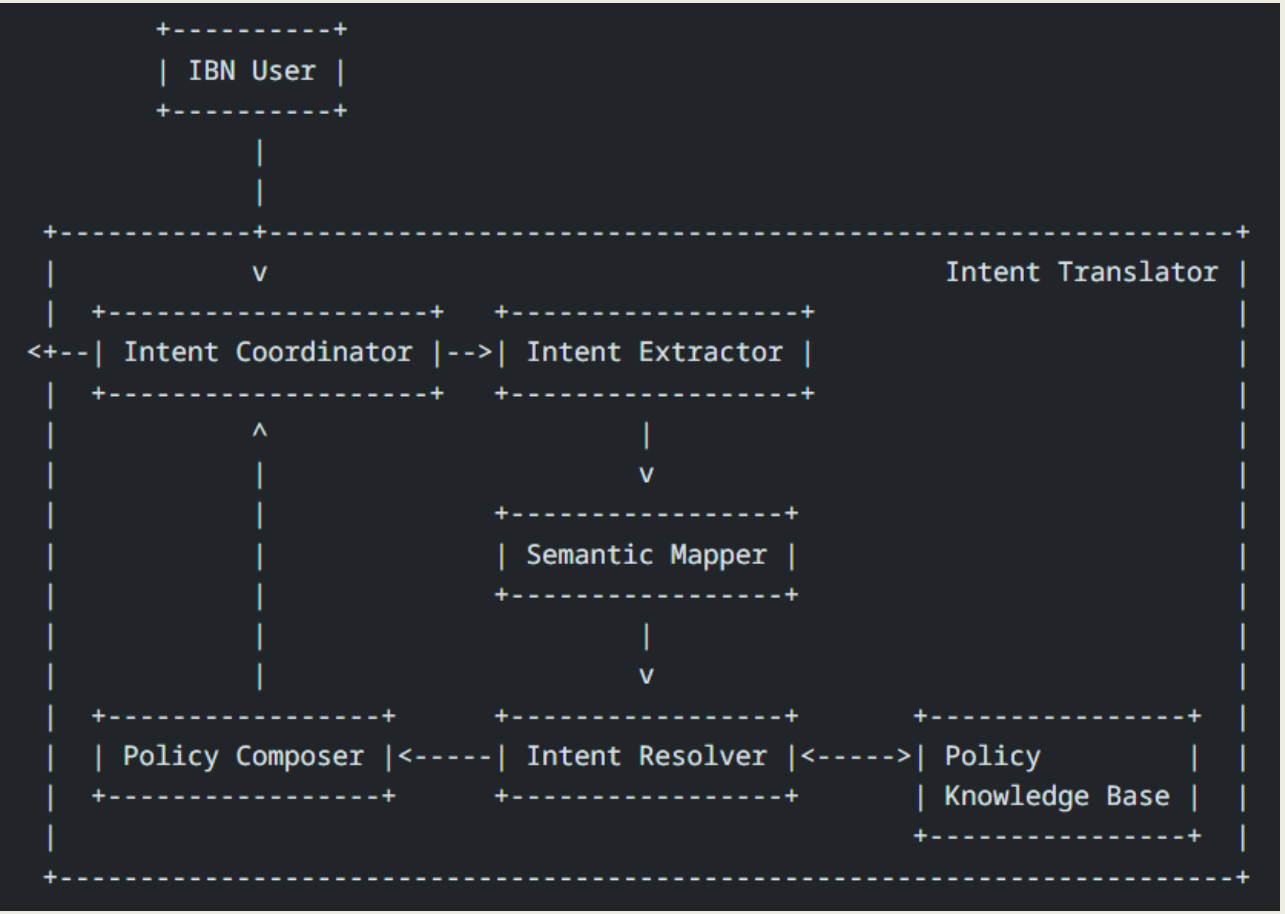
- **Intent Extractor**
  - It extracts structured elements from a natural language intent based on a few-shot based large language model (LLM).
  - It parses the incoming natural language statement to key elements (e.g., action, source, and destination).

Step 1: Intent Translator Framework



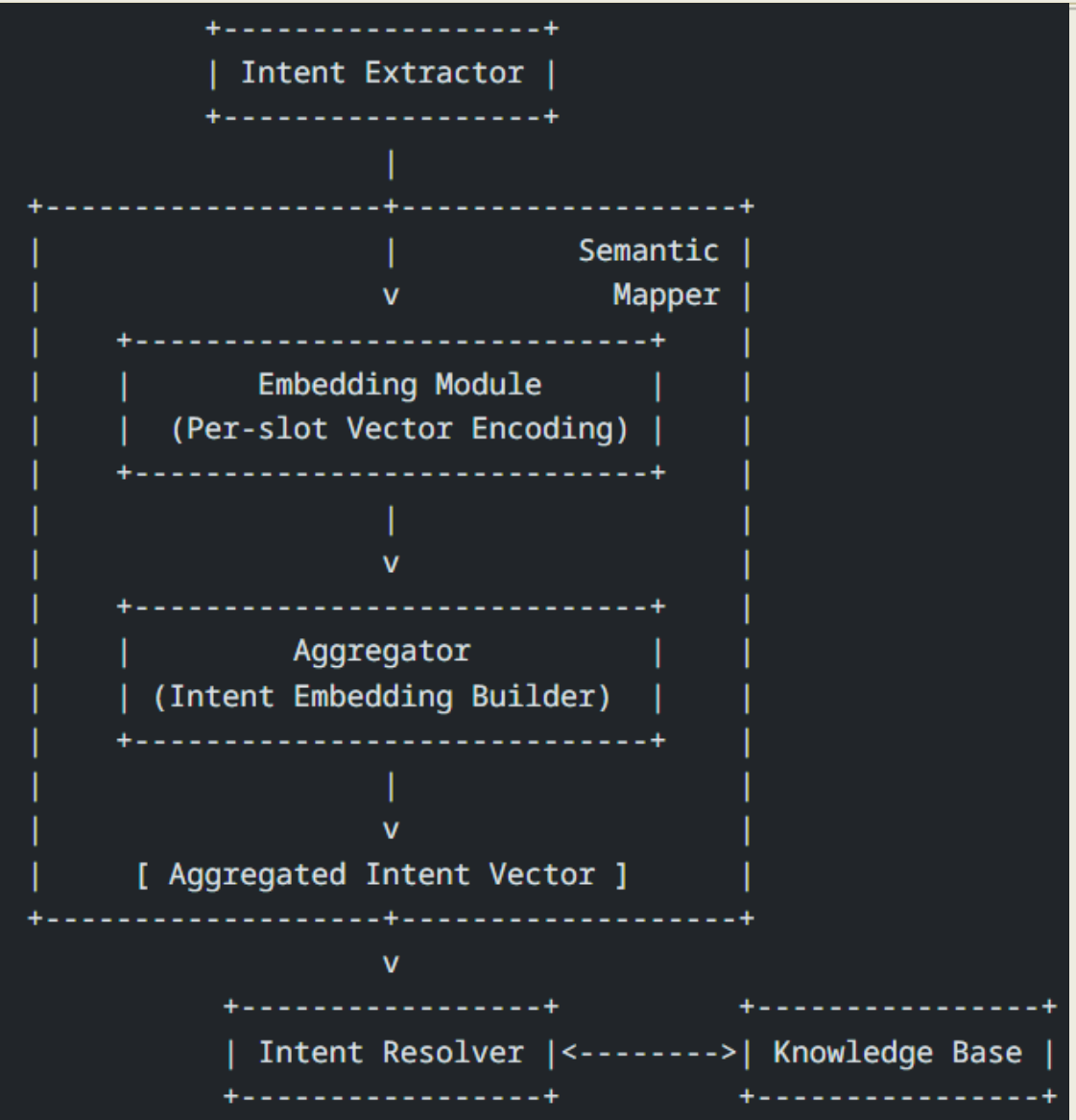
- **Semantic Mapper**
  - It projects the structured intent into semantic space using pretrained embedding space.
- **Intent Resolver**
  - It compares the embedded intent vector against the domain knowledge stored in the Policy Knowledge Base.

Step 1: Intent Translator Framework



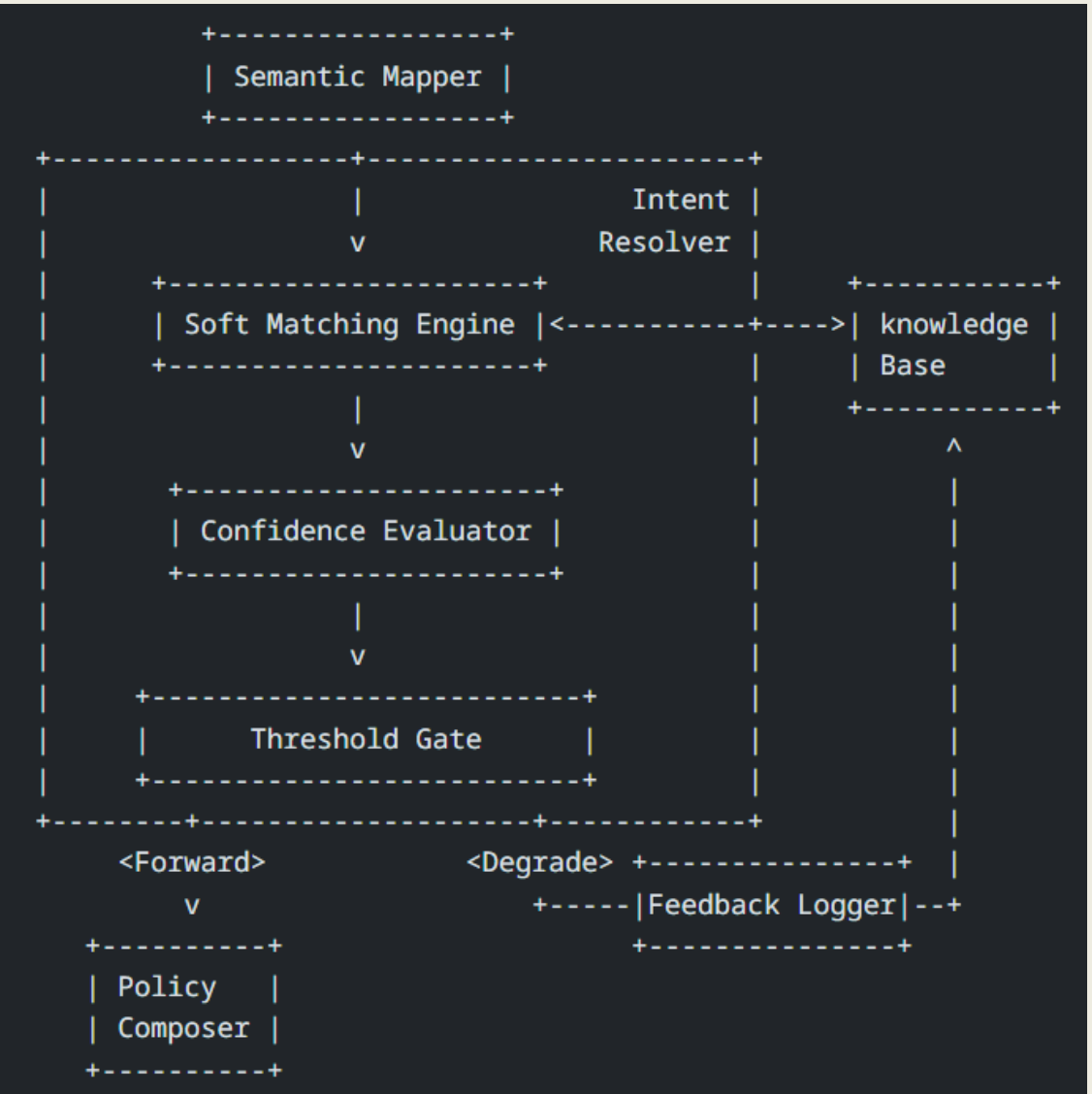
- **Policy Knowledge Base**
  - It stores the domain knowledge as a knowledge graph to support semantic mapping and approximate inference between intents and policies.
- **Policy Composer**
  - It generates a policy document in YAML format based on the extracted intent structure and selected knowledge graph items.

Step 2: Semantic Mapper Module



- **Semantic Mapper**
  - It embeds extracted intents from Intent Extractor into semantic space aligned with the domain knowledge graph and transforms them into vectors.
  - It deliver the aggregated intent representation vector to Intent Resolver for reasoning.

Step 3: Intent Resolver Module



- **Intent Resolver**
  - It semantically matches intent embeddings and Knowledge Base and evaluates the similarity for feedback to Knowledge Base.

Summary

- This document proposes a practical and scalable architecture for intent translation in next-generation management systems.
- Through this, the natural language intent can be reliably mapped to structured policy outputs for automatic network service configuration.
- Based on the proposed framework, it enables knowledge-grounded automation in complex service domains such as IoT network and intelligent edge infrastructures (e.g., Robotic AI agents).

Next Steps

- This draft will be enhanced to accommodate problems as follows:
  - Deployment Considerations: the actual operational policy and pre-embedding verification
  - Degradation and Human Oversight Considerations: high-trust environments and human verification procedures through review and documentation.
  - Security Considerations: secure channels and include verification and policy conflict detection functions for malicious input.
- I2ICF Group will prepare a WG-Forming BoF in the IETF 124 in Montreal in November in 2025.
- I2ICF Group will prepare IETF-124 Hackathon Project to clarify (i) I2ICF Intent Translator and (ii) Use Case for Robotic AI Agents.