Velsanet AI White Paper — Cognitive E2E Architecture

1. Introduction

This section defines the fundamental cognitive architecture of Velsanet, focusing on the complete round-trip intelligence loop that connects Cube, PAI, AAI, and AsAI layers.

The full cognitive circulation is defined as:

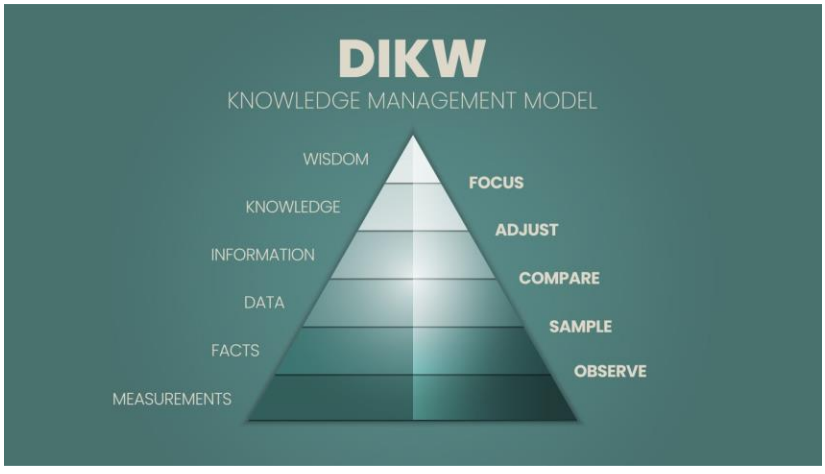
Cube → Velsanet Dedicated Equipment (Conversion-In) → PAI → AAI → AsAI → AAI → PAI → Velsanet Dedicated Equipment (Conversion-Out) → Cube (Memory Update).

This circulation enables Velsanet to integrate sensing, interpretation, inference, intent formation, and memory reinforcement across the entire multi-layer AI network.

Velsanet aims to fundamentally unify cognition, memory, and data flow into a closed, hardware–software integrated loop.
By doing so, it replaces today's centralized and decoupled AI architectures with a structurally distributed cognitive framework in which perception, interpretation, reasoning, and memory reinforcement operate through continuous end-to-end parallel flows.
This shift establishes an AI-native paradigm in which intelligence is not computed in isolated modules but emerges through the dynamic circulation of signals across polyhedral, multi-layer nodes.

In Velsanet, DIKW is no longer an abstract hierarchy but a spatially instantiated and executable cognitive topology, realized through polyhedral AI layers and continuous E2E circulation.

Figure 1. Classical DIKW Hierarchy (Static Knowledge Model)



The DIKW (Data–Information–Knowledge–Wisdom) hierarchy has long served as a conceptual abstraction for understanding intelligence.

However, it remains a static, centralized, and non-executable model.

Velsanet begins from this limitation.

Rather than replacing DIKW, it spatially and structurally reinterprets it as a distributed, cyclic, and executable intelligence architecture.

2. Velsanet AI Layer Constitution — Hierarchical Mediation and Cognitive Governance

This Article establishes the foundational governance principle for the three core intelligence layers of Velsanet — PAI, AAI, and AsAI — ensuring that all intelligence flows are mediated and structurally validated before escalating to higher reasoning.

2.1 Layered Flow Requirement

PAI → AAI → AsAI
Each transition requires structural verification, contextual grounding, and semantic alignment.

2.2 Prohibition of Direct Lateral High-Order Links

Direct connections such as:

- AAI ↔ AAI
- AsAI ↔ AsAI
  are prohibited without mediated verification.
  Such shortcuts bypass structural validation and risk propagating unverified intelligence.

2.3 Mandatory Mediation Rule

High-order interactions must be mediated through lower structural layers:

- AsAI → AAI → AAI → AsAI
  This ensures coherence, traceability, and governance integrity.

2.4 Purpose

To preserve structural legitimacy, transparency, and reliability within the Velsanet intelligence ecosystem, enabling stable collaboration between the three intelligence layers.

3. Cube Layer

3.1 Structural Position

- Cubes are located at the two external faces of a Node_8.

- Each face supports up to 192 optical cores, yielding 384 cubes in total.

3.2 Functional Role

- Cubes serve as data generation and storage units.

- When new data is created, the Cube emits a Ready Signal to the Velsanet Dedicated Equipment.

- Cubes do not perform inference or reasoning.

- Cubes maintain time slices, DIKWEI metadata, and Cube-plane layouts.

Device Access Specifications (Future Update Notice)

The access specifications for user devices, PAI-connected devices, multimodal wearable units, and edge sensor systems are not fully defined in this version of the white paper.
These specifications depend on the ongoing development of the Velsanet Dedicated Equipment, which determines:

- the optical-core to channel mapping framework,
- the 8-channel PAI input interface,
- multimodal Cube-generation standards,
- end-device synchronization mechanisms,
- and AI-native access routing protocols.

Because these elements require direct validation from the hardware implementation phase,
detailed device access specifications will be released in a future update of the

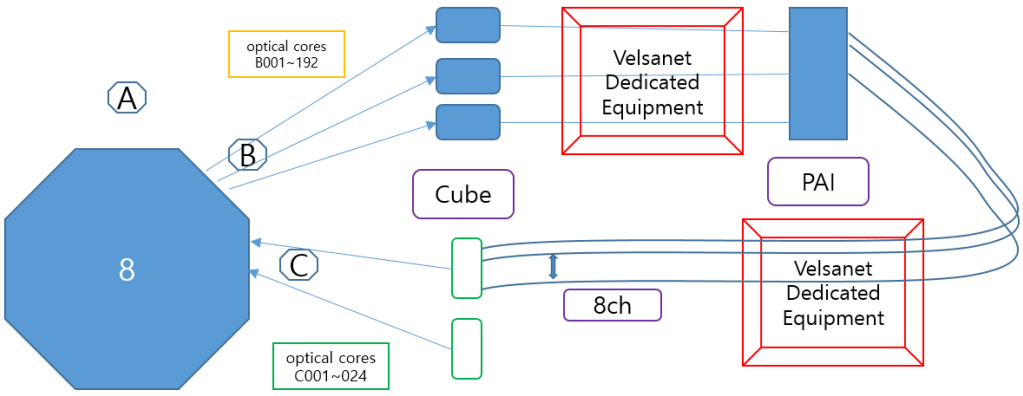
Velsanet White Paper, once the Velsanet hardware development reaches the integration milestone.

4. Velsanet Dedicated Equipment (Conversion Engine)

4.1 Introduction to the Dedicated Equipment

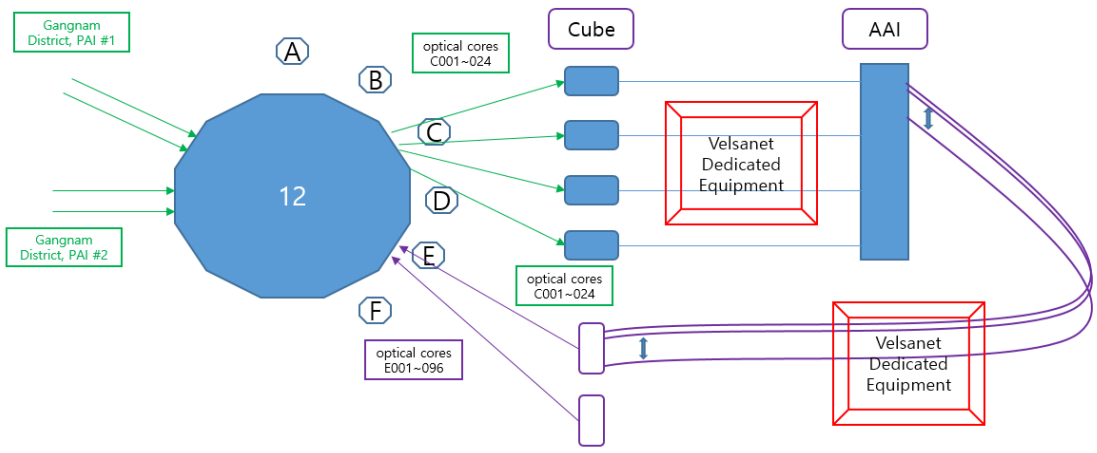
The Dedicated Equipment is the central transformation engine that binds Cube, PAI, AAI, and AsAI layers into a unified cognitive system.

Figure 4-1. Cube–PAI Routing Architecture and Multi-Channel Transformation Flow



This figure illustrates the complete routing and transformation flow between the Cube layer, Velsanet Dedicated Equipment, and the PAI layer. Two external faces of the Node_8 receive up to 192 optical cores each (B001–B192 and C001–C024), which are demultiplexed by the Dedicated Equipment and distributed into the PAI's 8-channel internal interface. Processed results are returned through the Dedicated Equipment and mapped back to Cube locations for memory updates, completing the cognitive round-trip loop.

Figure 4-2. Regional PAI Integration and AAI Cognitive Convergence Pathway



This figure depicts how regionally assigned Personal AIs (PAIs)—such as *Gangnam-PAI-1* and *Gangnam-PAI-2*—connect to the dodecahedral Node_12 through their designated N-faces. Each N-face is equipped with one optical core set, enabling multi-channel ingress into the Cube layer. The Cube stores all RAW structural inputs before they are transferred to Velsanet Dedicated Equipment for signal refinement and structural normalization.

Refined data streams are delivered to the AAI layer, which performs higher-order cognitive consolidation, intent alignment, and inter-AI coordination. The resulting structured outputs are returned through the same Dedicated Equipment and written back into Cube memory locations, completing the closed-loop cognitive cycle between PAI, Cube, and AAI. This pathway ensures consistent region-aware processing, multi-agent alignment, and distributed cognitive integrity across Velsanet.

Core Responsibilities:

1. Cube → PAI (Demultiplexing): Converts 384 Cube lanes into 8-channel PAI format.

2. PAI → AAI (Multiplexing): Combines PAI outputs into 24-core bundles.

3. AAI ↔ AsAI Structural Conversion: Maps 12-face (AAI) to 20-face (AsAI).

4. AsAI → Cube Conversion: Converts AsAI results back into Cube-addressable packets.

This device functions as the synaptic transformer of Velsanet.

3.2 Dedicated Equipment as Multi-Plane Matrix and Synaptic Transformer

The Velsanet Dedicated Equipment functions as a unified multi-plane matrix engine and synaptic transformer that anchors the cognitive E2E architecture of Velsanet.

1. Integration of Multi-Plane Structures
- Aligns 384 Cube lanes from multi-plane Node_8 faces.
- Demultiplexes physical lanes into 8 PAI cognitive channels.
- Maintains structural coherence across multi-layer planes.

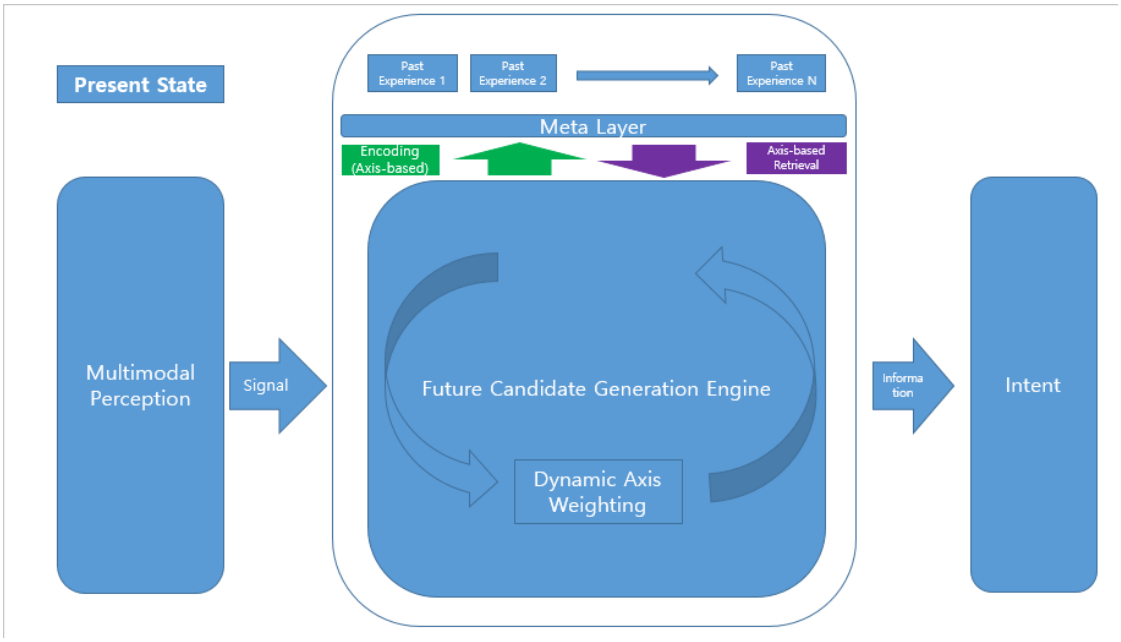
2. Physical–Cognitive Channel Mapping
- Maps optical cores to AI processing channels.
- Enables 24-bundle routing toward AAI.
- Supports multi-channel connections without service-type separation.

3. DIKWEI Cognitive Cycle Gateway
- First and last structural gate of DIKWEI flow.
- Converts Cube data into PAI meaning units.
- Rewrites AsAI outputs back into Cube memory structures.

This establishes the Dedicated Equipment not as a converter, but as Velsanet's multi-plane matrix engine enabling distributed cognition and reinforced memory.

5. PAI Layer — Nervous System of Velsanet

Figure 5. Axis-Based Multimodal Intent Formation Engine in PAI



*This figure illustrates how PAI transforms multimodal signals into **intent-relevant information** through experience-based axis encoding, dynamic axis weighting, and iterative future candidate generation.*

PAI acts as the distributed nervous system of Velsanet.

Key Characteristics:

- Multiple PAIs operate in parallel.

- Each PAI uses a sequential loop to maintain temporal causality.

- Performs DIKWEI-based first-stage meaning extraction.

Functional Roles:

- Interpret Cube signals into granular meaning units.

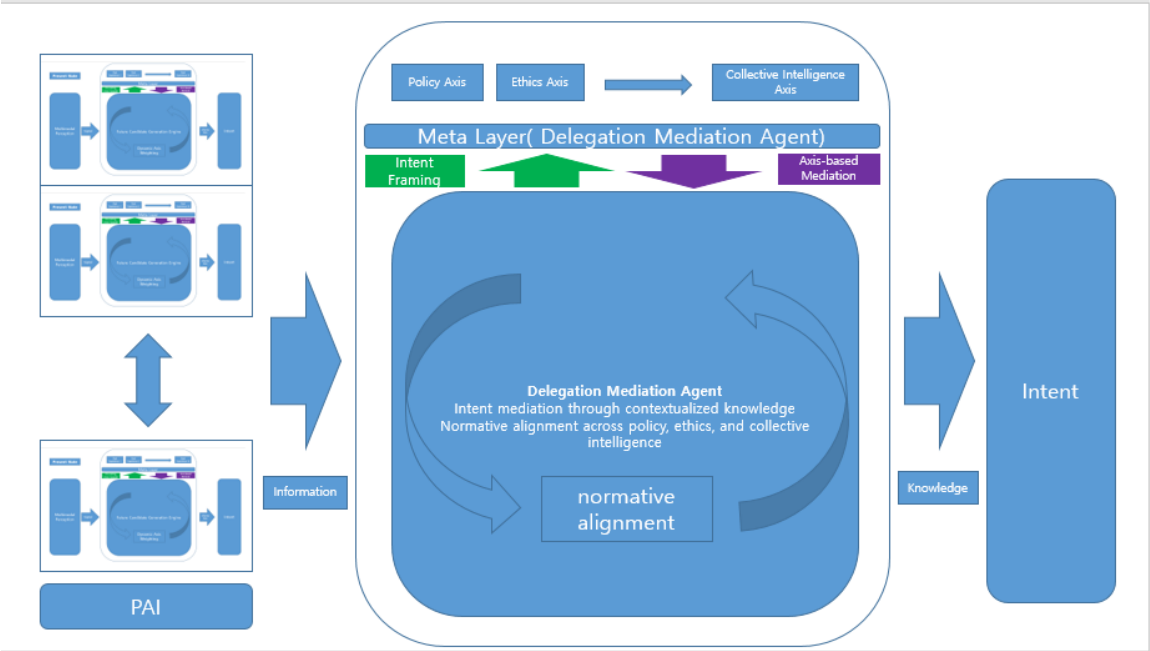
- Forward meaning to AAI.

- Receive results from AsAI.

- Convert high-level results into Cube-storable metadata.

6. AAI Layer — Agent AI

Figure 6 illustrates the role of **AAI (Agent AI)** as the *delegation mediation layer* within the Velsanet AI architecture.



AAI does not perform perception or execution.
Its primary function is to **mediate intent**, transforming personally formed information into **socially valid, delegable knowledge**.

After high-level reasoning is completed within **AsAI**, the resulting cognitive structures are returned to **AAI** for **structural grounding and redistribution**.
AAI propagates these stabilized results downward to **PAI** and ultimately back to the **Cube**, ensuring **polyhedral coherence and consistency across all layers**.

AAI also functions as the **structural gateway to the AsAI layer**.
Only intents that have undergone normative and structural alignment within AAI are elevated into the **20-faced AsAI topology**, where **parallel E2E reasoning and multi-agent cognitive expansion** occur.

Rather than aggregating signals, **AAI performs structural alignment**.
It reconciles heterogeneous, personal-level intents into **coherent, non-conflicting cognitive structures**, transforming raw interpretations from distributed PAIs into **Structured Intent Packets** suitable for higher-order reasoning.

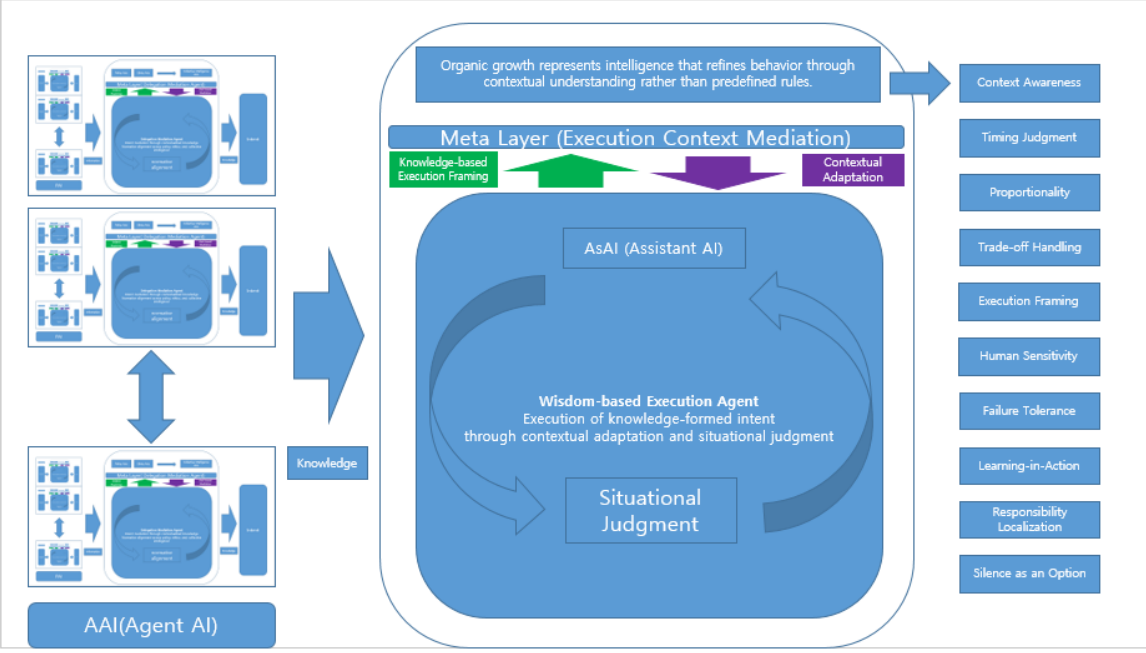
Operating on a **12-faced polyhedral topology**, the AAI layer serves as the **structural intelligence hub of Velsanet**.
Each face of **Node_12** receives intent flows from regionally distributed PAIs,

forming a **multi-origin cognitive convergence point** where delegation, accountability, and interoperability are established.

AAI Layer — Polyhedral Structural Intelligence Hub (12-Faced Node)

7. AsAI Layer — High-Level Reasoning

Figure 7 AsAI: Wisdom-Based Execution through Situational Judgment



*This figure illustrates **AsAI (Assistant AI)** as the wisdom layer of the Velsanet intelligence stack.*
*AsAI receives **knowledge-formed intent** from AAI and executes it through **contextual adaptation** and **situational judgment**, rather than fixed rules or policies.*

*The meta layer mediates execution context by balancing **knowledge-based framing** and **contextual adaptation**, enabling organic growth of intelligence.*
AsAI embodies wisdom by deciding how, when, and whether to act—prioritizing proportionality, timing, responsibility, and even silence when appropriate.

*Unlike policy-driven execution, AsAI represents **wisdom-based execution**, where intelligence is refined through lived context and continuous learning-in-action.*

AsAI represents the highest cognitive layer of Velsanet.

Capabilities:

- Multi-agent coordination

- High-level reasoning and prediction

- Collective intelligence

- Global-scale inference

All outputs flow downward through AAI → PAI → Cube to maintain context grounding.

8. Complete Cognitive Loop

The full circulation loop is:

Cube → Dedicated Equipment → PAI → AAI → AsAI → AAI → PAI → Dedicated Equipment → Cube

This loop enables:

- Reinforced memory

- Intent propagation

- Multi-layer adaptive intelligence

- Polyhedral distributed cognition

This is the core of Velsanet's AI-Native design.