Velsanet Wired–Wireless Convergence White Paper

1. Purpose of This Document

This white paper defines how wireless access integrates with Velsanet's optical Layer-1, focusing exclusively on:

- **mapping wireless signals into optical cores**,
- **individual E2E creation**,
- **parallel E2E expansion**,
- **mobility and handover**,
- **the role of the V-MCU (Velsanet Mobility Convergence Unit)**.

This document **does not** address Velsanet AI Layers (PAI/AAI/AsAI) or inter-city/core-network connectivity, which belong to separate white papers.

2. Scope of Wired–Wireless Convergence

Wireless access in Velsanet is **not a network**, but an **entry point** into the optical domain.

- The wireless signal is received at the radio unit.
- The signal is immediately mapped into an **optical core**.
- From that moment onward, the communication is handled entirely by Velsanet's Layer-1 optical architecture.

Therefore:

Wireless simply determines how the user reaches the optical core; all network behavior begins after optical mapping.

This document only describes that mapping.

3. Optical Mapping Structure (8-Channel → 1 Optical Core)

Each wireless device is mapped to:

- **one optical core (individual E2E)**
- composed of **8 internal optical channels**.

Key principles:

1. A device = one optical core for individual E2E
2. Channels are not separate cores; they are internal lanes
3. The 1st channel is always reserved for
    - device monitoring
    - topology awareness
    - E2E creation signaling (TCC)

This mapping is universal for all Access Layer nodes (Layer-4/6/8).

Note — Wireless-to-Optical Channel Mapping
The detailed rules for mapping the wireless 8-channel link to individual optical cores
will be defined after the establishment of the Velsanet Research Lab.

This white paper focuses on the **structural architecture and conceptual framework**,
while the precise convergence mechanics will be finalized through real hardware testing and joint research once the Lab is operational.

4. Role of the V-MCU (Velsanet Mobility Convergence Unit)

The V-MCU is **not part of Velsanet equipment**.
It is an **external coordination module** for the wireless domain.

V-MCU is responsible **only for three things**:

4.1 Individual E2E Management

- Keep track of which device uses which optical core
- Create and release individual E2E paths
- Maintain mapping tables for mobility

4.2 Parallel E2E Creation

Parallel E2E is simply **multiple individual E2Es assigned to the same device**.

Process:

1. Device requests parallel E2E
2. V-MCU determines next available optical core
3. V-MCU issues command to Velsanet equipment:
   "Activate next optical core and connect it to this device."
4. Velsanet Layer-1 creates the physical path

Parallel E2E = repetition of individual E2E.

4.3 Mobility / Handover

Mobility is achieved through **overlapped E2E**:

1. Existing E2E remains valid
2. A new E2E is pre-created in the target cell
3. When stable, the old E2E is released

No packet loss.
No PHY/MAC handover complexity.
No re-routing.

V-MCU controls the sequence; Velsanet equipment only executes core activation.

5. What V-MCU Does NOT Do (Critical Clarification)

To avoid conceptual confusion:

V-MCU does not manage inter-city or inter-region routing

Those are handled by:

- Layer-12 (AAI nodes)
- Layer-20 (AsAI nodes)
- Polyhedral E2E structure

These layers belong to the **Velsanet Network AI** and **Matrix Architecture** white papers.

V-MCU does not control optical switching matrices

Layer-1 autonomous optical intelligence handles that.

V-MCU does not handle wired–wireless synchronization

That belongs to the radio unit and optical Layer-1 mapping.

V-MCU does not optimize high-level traffic

Its only job is device-level E2Es.

6. Resource Allocation Principle (Access Layer Only)

To simplify mobility:

All Access Layer nodes (Layer-4/6/8) must use identical optical core resources.

Reason:

- Prevent mismatch during handover
- Simplify parallel E2E extension
- Eliminate unnecessary allocation logic in V-MCU
- Maintain deterministic behavior

V-MCU manages **only Access Layer cores**, not the global core pool.

7. Summary of the Convergence Model

Velsanet wired–wireless convergence is defined by:

- **Wireless provides access → Optical Layer-1 becomes the network**
- **Individual E2E = 1 optical core**
- **Parallel E2E = multiple individual E2Es**
- **V-MCU = control of E2E, parallelization, mobility**
- **Layer-12/20 = global routing → entirely separate**
- **Handover = overlapped E2E**
- **Access Layer = standardized optical core resources**

This structure isolates wireless complexities and guarantees deterministic behavior in the optical layer.

Conceptual Only — Implementation Deferred

The wireless-to-optical channel mapping mechanism described in this document represents a conceptual architecture.
Its detailed physical implementation, including mapping rules, modulation alignment, and hardware integration, will be finalized after the establishment of the Velsanet Research Lab.