

VELSANET

Structure-Native Network Architecture

Seoul Metropolitan 6G Network Infrastructure Deployment Plan

Seoul Metropolitan 6G Infrastructure Deployment Plan

— Including Velsanet 6G RU Design —

Document No.	Velsanet-DEPLOY-SEO-01 (Rev.1)
Date	March 2026
Prepared by	Velsanet Architecture Group / Velsanet Research Institute (Proposed)
Scope	Greater Seoul · Population approx. 10M · Area 605 km ²
Reference Documents	WP #02, #03, #22 · Velsanet Architecture Compendium v1.0 (2026)
Key Revisions	RU/H6 count: fully recalculated based on 400K surveyed utility poles · O8 face structure applied

1. Overview and Deployment Premises

This document defines the node counts (H6, RU, MOCT ribbon fiber, O8) and cable distances required to physically deploy the Velsanet Structure-Native 6G architecture across Seoul. Rev.1 adopts 400,000 surveyed utility poles as the deployment ceiling, fully recalculates RU and H6 counts, and derives accurate O8 quantities based on the O8 face structure (uplink 1–2 / downlink 1–2 / horizontal 3–4).

This architecture replaces multiple legacy networks (FTTx, mobile backhaul, metro rings, aggregation layers) with a unified optical infrastructure.

1.1 Seoul Baseline Data

Item	Value	Source / Note
Total Area	605 km ²	Seoul Metropolitan Government Official Statistics
Effective Coverage Area	480 km ²	Approx. 80% excl. mountains and parks
Population	approx. 10 million	As of 2024
Population Density	approx. 16,000 /km ²	Based on effective coverage area
Households	approx. 4.2 million	Avg. 2.4 persons/household
Office / Commercial Units	approx. 800,000	SMEs and corporations combined
Mobile Subscriptions	approx. 12 million lines	1.2 lines per person
Utility Poles (shared power/telecom)	approx. 400,000	Seoul city survey — RU deployment ceiling

✘ RU cell radius assumed 300m for 6G mmWave. May be adjusted to 200–400m based on building density and radio obstacles.

✘ The 400,000 utility poles are based on Seoul city survey and serve as the RU deployment ceiling (1 pole = 1 RU). This replaces the previous calculation of 312,500 (population ÷ 32 cores) with a pole-survey basis at 48 cores/RU.

2. RU (Radio Unit) Count Calculation

In the Velsanet Structure-Native RAN, each RU operates as a directional wireless access node mapped 1:1 to a physical optical core — not a conventional omnidirectional cell. Deployment count is capped by actual urban infrastructure (utility poles), not population capacity.

2.1 RU Count — 400K Utility Poles × Directional Antenna Basis

Calculation Item	Formula / Value	Result
Seoul Utility Poles (deployment ceiling)	Survey-based	400,000
RU Deployment Mode	Directional antenna RU 1–3 per pole (avg. 2.25)	Directional antenna · avg. 2.25/pole
Planned Deployment (poles × avg. RU)	400,000	900,000 RU
Wireless Capacity Verification	400,000 × 48 cores	900,000 × 48 cores = 43.2M cores ≥ 12M subscriptions ✓

✘ RUs are directional antennas installed 1–3 per pole. At design average 2.25/pole: 400,000 × 2.25 = 900,000 RUs. At 48 cores/RU: 43.2M total cores — 3.6x headroom over Seoul's 12M mobile subscriptions. Surplus cores serve IoT, V2X, high-density video, and PAI workloads.

✘ Seoul's urban core (Jongno, Gangnam, Yeouido) exceeds 25,000 persons/km². Denser deployment at 200m cell radius is recommended.

2.1a Dual Scenario: 48-Core Expansion

Expanding the RU-embedded MOCT ribbon to 48 cores enables two deployment scenarios within the same 400K-pole infrastructure.

Option A — Minimum Deployment (capacity basis): 12M subscriptions ÷ 48 cores = 250,000 RUs (1 per pole, 62.5%

pole utilization). 150,000 unused poles reserved for future expansion.

Option B — Full Deployment (pole basis): 400,000 poles x avg. 2.25 directional antennas = 900,000 RUs x 48 cores = 43.2M cores. 3.6x headroom over current 12M subscriptions. Optimizes per-direction coverage, fully absorbs IoT-V2X-PAI future demand. This document's design baseline.

✘ This document adopts Option B (full deployment) as the design baseline. Option A may be applied as a phased approach following Phase 1 build-out.

2.2 RU Deployment Mode

RUs are directional antennas installed 1–3 per pole, design average 2.25/pole. Each RU covers a distinct directional sector, sharing 360° coverage. RUs on the same pole connect to Face 1 (primary) and Face 6 (extended) of the same H6. Existing 400K utility poles are prioritized to minimize new civil works. Duplicate coverage in the same direction is prohibited — adjacent H6 covers that sector. Each RU ships factory-fused with a MOCT 48-core ribbon cable (7m) as an integrated unit.

3. H6 Node Count and Pole Deployment

3.1 H6 Count Calculation

One H6 node is installed per pole alongside the RU(s). Each pole holds 1–3 RUs (avg. 2.25); a single H6 accommodates all via Face 1 (primary RU) + Face 6 (additional RUs, max 2). H6 nodes serving wired T4 are counted separately (installed in buildings/complexes). Installation completes with a single field fusion splice connecting the RU-embedded MOCT ribbon (48 cores, 7m) end to the H6 ribbon end. No connectors or patch panels required.

Calculation Item	Formula / Value	Result
Total RU Count	Pole basis	900,000
H6 (RAN pole): 1 per pole, fixed	1 H6 per pole (accommodates 1–3 RUs)	400,000
Additional for contingency and mesh (+10%)	$400,000 \times 1.10$	440,000
Planned deployment count (RAN H6)	—	440,000
H6 (wired T4)	$1 + \text{ceil}((5,200,000 - 4) \div 8)$	approx. 650,000
Total H6 Count	$440,000 + 650,000$	approx. 1,090,000

✘ H6 (RAN pole) count of 440,000 = 400,000 poles + 10% contingency (40,000).

✘ H6 (wired T4) count of 650,000: derived from 5.2M T4 nodes at max 8 T4 per H6.

3.2 H6 Installation Position and Cable Distances

RU and H6 are co-located vertically on the same pole in the following structure:

```
[ RU - pole top, 5-8m ]
  |
  | Embedded MOCT ribbon 48 cores · 7m · factory-fused integral unit
  |
  | ↓ ← 1 field fusion splice (RU ribbon end ↔ H6 ribbon end)
  |
  | [ H6 - pole base, 1-2m ] ← H6 ribbon cable origin (no connectors)
  |   |
  |   | Face 2 → O8 uplink · Face 3/4/5 → adjacent H6 horizontal mesh
  |   |
  |   ↓
  |   [ Optical backbone → O8 ]
```

✘ Field procedure: mount RU on pole → 1 ribbon fusion splice → complete. No connectors, patch panels, or splice enclosures required.

Segment	Distance	Note
RU (pole top) → H6 (pole base)	5 ~ 10 m	MOCT ribbon cable (RU-embedded 7m · 1 field splice)
H6 → adjacent H6 (horizontal mesh)	200 ~ 400 m	Underground or aerial optical cable

H6 → O8 (uplink)	300 m ~ 2 km	Zone aggregation optical cable
O8 → D12 (metro backhaul)	2 ~ 10 km	Underground trunk optical cable

4. MOCT Ribbon Optical Cable — Quantities and Volumes

4.1 MOCT Cable Segment Definitions

The MOCT (Multi-Optical-Core Transceiver) ribbon cable is a connector-free, factory-fused multi-core optical cable as defined in Velsanet White Paper #03. Cable segments span 5 defined sections from T4 endpoint to O8. Segment A connects the RU-embedded MOCT ribbon (48 cores, 7m, factory-fused) to the H6 ribbon end with a single field fusion splice.

4.4 Segment A — RU↔H6 Vertical Cable

Item	Calculation	Result
Total RU Count	Pole basis	900,000
Cables per RU	1 per RU	—
Total Cable Count	900,000 × 1	900,000 lengths
Unit Cable Length (with margin)	Average 7m (+40%)	10 m each
Total Cable Length	900,000 × 10 m	9,000 km

※ As RU count increased from 400,000 to 900,000 (400,000 poles × avg. 2.25), Seg A cable was recalculated from 4,000km to 9,000km. Each RU-embedded MOCT ribbon is 48 cores = 12-core ribbon × 4 bundles, requiring 4 field fusion splices. No connectors or patch panels needed.

4.4a Ribbon Fusion Splice — Technical Specifications

48-Core Structure Definition

RU-embedded MOCT 48 cores = 12-core ribbon × 4 bundles. Field splicing: 4 operations per 12-core unit. Both RU side and H6 side ship with identical 12-core ribbon structure.

Key Characteristics of Ribbon Fusion Splicer

Item	Description
Multi-fiber simultaneous splicing	Splices a 12-core ribbon simultaneously via arc discharge. Reduces splice time to 1/12 of single-core splicer.
Fixed V-groove method	12 precision-machined V-grooves auto-align core pitch. Eliminates manual alignment error.
Ribbon dedicated holder	Dedicated holder keeps the 12-core ribbon intact when seated in the splicer. Maintaining ribbon form is critical.

Required Auxiliary Equipment

Equipment	Function and Requirement
Thermal Coating Stripper	Removes 12-core coating simultaneously via heat. Standard strippers scatter cores — dedicated tool required.
Ribbon Fiber Cleaver	Cleaves all 12 cores at equal length and angle simultaneously. End-face quality critical to minimize splice loss.
Ribbon Protection Sleeve	Wide heat-shrink sleeve for splice protection. Must be pre-threaded onto cable before splicing — cannot be inserted post-splice.

4.4b Field Fusion Splice Procedure — Full 48-Core Connection

Repeat the following procedure once per 12-core ribbon bundle (4 times total) to complete full 48-core connection. The same pre-processing applies to both RU and H6 sides.

Step	Task	Detail
1	Preparation	Fix one 12-core ribbon bundle from RU in dedicated holder. Pre-thread protection sleeve onto cable (cannot be inserted after splicing).
2	Pre-processing	Strip 12-core coating with thermal stripper → clean with alcohol → cleave end-

		face with ribbon cleaver. Apply to both RU and H6 sides.
3	Splicing	Seat both RU and H6 ribbon ends in splicer V-groove → press once → 12-core simultaneous arc fusion complete.
4	Protection	Slide ribbon heat-shrink sleeve over splice → heat. Secure in splice enclosure.
5	Repeat / Complete	Repeat steps 1–4 for remaining 3 bundles (ribbons 2, 3, 4) → 4 total splices = full 48-core connection per RU.

※ Seoul total: 900,000 RUs × 4 splices = 3,600,000 field splices. At 200 splices/machine/day, approx. 18,000 machine-days required.

4.4c Optical-Wireless Speed Matching and Clock Synchronization Design

The core of Velsanet RU design is precise speed alignment between the wireless signal bandwidth and the total transmission capacity of 8 channels per optical core. A single optical core potentially carries terabit-level (Tbps) bandwidth; when divided into 8 slots, each slot must losslessly accommodate one wireless MIMO stream to achieve 6G ultra-low-latency and ultra-high-speed performance. Clock synchronization across 8 channels is equally decisive — Velsanet resolves both challenges with a single optical core.

1. Optical-Wireless Speed Mapping Structure (Speed Alignment)

Radio Environment	Optical Core Mapping Strategy	Result
Low-band (Sub-6GHz)	Aggregate 8+ channels into 1 core	Optical resource efficiency · increased user capacity
High-band (mmWave · 6G)	8-channel MIMO → 1 core 1:1 mapping	Peak 1 Tbps (125 Gbps/channel × 8)
Mixed band (incl. THz)	Variable bandwidth allocation (Flexible BW)	Optimized transmission efficiency · future THz band ready

2. Speed Matching Hardware Components

Component	Function and Design Significance
Ultra-high-speed DSP	Real-time framing and compression of 8-channel wireless sampling data to match optical core speed. Prevents radio bandwidth from exceeding optical rate.
Coherent Optical Engine	Optical engine using both phase and amplitude to pack 8 channels into 1 core via high-order modulation (PAM4 etc.). Multiplies capacity vs. simple on/off switching.
Time-Sensitive Gearbox	Synchronizes data flow across the wireless-optical interface. Hardware logic that minimizes latency between two domains running at different speeds.

3. Clock Synchronization — Optical Injection Locking

Velsanet dedicates 1 of 48 ribbon cores to clock, transmitting a reference clock from H6 to RU via optical carrier. The RU's Coherent Optical Engine locks onto this signal to synchronize the 8-channel DSP — eliminating separate clock wiring and PTP packets. The fixed physical path makes propagation delay deterministic and correction trivial.

Method	Legacy (PTP/IEEE 1588)	Velsanet (Optical Injection Locking)
Clock Distribution Path	Network → PTP packets → clock recovery	H6 → 1 optical core → direct RU lock
Latency / Jitter	Packet processing delay and jitter	Physical propagation delay only · deterministic
Additional Wiring	Separate clock wiring or GPS antenna required	Not required — 1 of 48 cores allocated
H6 Role	Intermediate aggregation node	Aggregation + physical origin of Time Reference

4. Consistency with Velsanet Structural Simplification Principles

Eliminated Element	Legacy Approach	Velsanet
Coaxial cable	RF signal → coaxial transmission	Direct optical core (MOCT integrated)
Connectors / Patch panels	Multiple field connection tasks	Factory splice + 4 field ribbon splices

Clock wiring	PTP packets / separate clock line / GPS	1 optical core → optical injection locking
DU/CU software layer	Virtualization stack present	Structurally eliminated (physical path direct)

※ Path to 1 Tbps — LG Electronics demonstrated 320m outdoor THz-band (155–175 GHz) wireless transmission at Fraunhofer Institute, Berlin in 2022, presenting potential 1 Tbps capacity. Velsanet RU achieves equivalent 1 Tbps through MIMO 8-channel parallel transmission in lower mmWave bands — offering superior coverage stability vs. high-frequency single-channel approaches while maintaining continuity with existing mmWave infrastructure. The more practical path to 1 Tbps for city-wide Seoul deployment.

Velsanet’s design achieves 6G’s 1 Tbps target while maintaining the infrastructure completeness to deploy across all of Seoul through zero-coax and direct MOCT connection.

4.5 Segment B — H6↔H6 Horizontal Mesh Cable

Item	Calculation	Result
Total H6 Count (RAN)	Pole basis	440,000
Avg. mesh connections per H6	2.5 links (Face 3/4/5)	—
Total links (bidirectional deduplicated)	$440,000 \times 2.5 \div 2$	550,000 links
Unit Cable Length (with margin)	Average 300m × 1.20	360 m/link
Total Cable Length	$550,000 \times 360 \text{ m}$	198,000 km

※ H6 count increase (1,550 → 440,000) expands Seg B total from 700km to 198,000km. Sharing existing KT/SKT underground conduit can reduce new civil construction costs by approx. 30%.

4.6 Segment C — H6→O8 Uplink Aggregation Cable

Item	Calculation	Result
Total H6 Count (RAN)	440,000	—
Cables per H6 (Face 2)	1 per H6	—
Total links	440,000 lengths	440,000 lengths
Unit Cable Length (with margin)	Average 800m × 1.25	1,000 m/link
Total Cable Length	$440,000 \times 1,000 \text{ m}$	440,000 km

※ H6 count increase recalculates Seg C total from 1,550km to 440,000km.

4.6b Segment D — O8↔O8 Horizontal Mesh Links

O8 nodes connect directly to adjacent O8 nodes via horizontal faces (3–4 per node). This horizontal mesh provides per-user E2E path diversity and failure bypass routes, forming the foundation for autonomous traffic distribution at the O8 layer.

Item	Calculation	Result
Total O8 Count	Default design value	2,521
Horizontal connections per O8 (Face 3–4 basis)	Average 3.5 (midpoint of 3–4)	—
Total links (bidirectional deduplicated)	$2,521 \times 3.5 \div 2$	≈ 4,412 links
Unit Link Distance (with margin)	Average 750m × 1.20	900 m/link
Total Cable Length	$4,412 \times 900 \text{ m}$	≈ 3,971 km

※ O8↔O8 horizontal links utilize Seoul’s underground trunk optical trenches. Average inter-O8 distance 700–800m; 20% margin

applied → 900m/link. 4,412 links ensure full mesh connectivity across Seoul's O8 layer.

4.7 Total Optical Cable Summary

Segment	Purpose	Count	Length (km)	Note
Seg T0	T4 ↔ T4 intra-building direct	approx. 1.11M	38,850	Using existing conduit
Seg T1	T4 → H6 Face building ingress	approx. 5.2M	99,840	Average 19m
Seg A	RU → H6 vertical	900,000	9,000	RU-embedded 48-core · 10m · 4 field splices
Seg B	H6 ↔ H6 horizontal mesh	550,000	198,000	Underground buried
Seg C	H6 → O8 uplink aggregation	440,000	440,000	Trunk optical cable
Total	All segments	approx. 6.32M	780,690 km	Infrastructure + T4 included

※ Seg A·B·C (infrastructure segments) total: 647,000km. T0·T1 (T4 access segments) total: 138,690km. Grand total approx. 785,690km.

※ Seg T0·T1 leverage existing in-building wiring infrastructure — no new civil works required.

6. O8 Node — Face Structure and Count

The O8 (Octahedron) node has 8 faces. Each face is allocated to uplink (D12), downlink (H6), or horizontal (O8↔O8 mesh) functions. Maximum O8 cores = $192 \times 8 = 1,536$; H6 capacity per O8 is determined by the number of downlink faces.

6.1 O8 Face Function Allocation

Direction	Faces	Core Count	Note
Uplink (D12)	1 ~ 2	192 ~ 384	Default 1, dual for redundancy
Downlink (H6 aggregation)	1 ~ 2	192 ~ 384	Default 1, 2 for high-density zones
Horizontal (O8↔O8 mesh)	3 ~ 4	576 ~ 768	Urban mesh connectivity
Total	8 face	$192 \times 8 = 1,536$	O8 max cores

※ Max cores per O8: $192 \times 8 = 1,536$. H6 capacity with 1 downlink face: 192. With 2 downlink faces (high-density): 384.

6.2 O8 Count Calculation — Full H6 Coverage Basis

Item	Calculation	Result
Total H6 (RAN)	Pole basis +10%	440,000
O8 downlink faces (default)	1 face	—
H6 capacity per O8 (default)	1×192	192 H6/O8
Required O8 count (default)	$440,000 \div 192$	$\approx 2,292$
Contingency +10%	$2,292 \times 1.10$	$\approx 2,521$
High-density zone (2 downlink faces)	$2 \times 192 = 384$ H6/O8	Optional expansion

※ Default design value: 2,521 O8 nodes (1 downlink face · 192 H6/O8).

※ High-density zones (urban core etc.): applying 2 downlink faces allows 384 H6 per O8 → halves the required O8 count.

※ The previous O8 count of 285 was calculated against 1,550 H6 nodes and was incorrect. The corrected value based on 400K poles is 2,521.

6.3 O8 Deployment Scenarios — Urban Intelligence Density

The baseline O8 count of 2,521 is derived from H6 aggregation capacity: $440,000 \text{ H6} \div 192 \text{ H6/O8} \times 1.1 = 2,521$. At this density, each O8 covers an average area of $605 \text{ km}^2 \div 2,521 \approx 0.24 \text{ km}^2$ — a square with ~490m sides, consistent with the ~390m radius referenced in this document.

However, this density is adequate for human-scale connectivity — not for a future urban environment where O8 operates as the origination point for distributed AI collaboration and urban traffic intelligence. When the design basis shifts from “how many H6 nodes to aggregate” (communication density) to “how many concurrent agents and events to handle” (urban intelligence density), the appropriate O8 count must be redefined accordingly.

The O8 count is not a question of communication density — it is a question of urban intelligence density.

Scenario	O8 Count	Design Basis
Baseline	2,521	Minimum aggregation structure per current H6 design. $\approx 0.24 \text{ km}^2/\text{O8}$ · ~490m cell side. This document's baseline value.
Expanded	5,000+	High-density robotics · V2X · CCTV · real-time control. O8 operated as active event-processing grid node, not passive aggregator.
Urban AI	7,000 – 10,000+	Autonomous systems · public control · large-scale multi-agent coordination. O8 as the fundamental unit of the urban intelligence grid.

※ 2,521 O8 nodes is the minimum baseline to accommodate Seoul's current H6 aggregation structure. In a future urban environment

including robotics, autonomous mobility, CCTV, public sensing, and AI-native machine coordination, the practical O8 count must expand based on control density, event concurrency, and distributed intelligence requirements. The final O8 count is not fixed — it scales with the urban intelligence density the city chooses to deploy.

8. Seoul Deployment Final Summary (Rev.1)

Component	Count	Note
RU (Radio Unit)	900,000	Directional antenna 1–3/pole · avg. 2.25 · 6G mmWave · 48 cores embedded
H6 Node (RAN pole)	440,000	Pole base · 10% contingency included
H6 Node (wired T4)	approx. 650,000	Installed in buildings / complexes
Total H6 Count	approx. 1,090,000	RAN + wired combined
T4 Node (wired)	5.2M	Households · offices · IoT
Optical Cable Infrastructure (Seg A+B+C)	647,000 km	A:9,000 + B:198,000 + C:440,000
Total Optical Cable (incl. T4)	approx. 780,690 km	T0+T1+Infrastructure combined
O8 Node (default)	2,521	1 downlink face · ~390m radius
O8 Node (high-density expansion)	2 downlink faces applied	192x2=384 H6/O8 · optional

8.1 Layer-by-Layer E2E Flow Summary

Layer	Node	Count	Role
L0	T4	5.2M	Subscriber endpoint
L1a	H6 (RAN pole)	440,000	RAN + wired convergence
L1b	H6 (wired T4)	approx. 650,000	Building / complex wired aggregation
L2	RU	900,000	6G wireless RAN · 48 cores/RU · directional antenna
L3	O8	2,521 (default)	Intelligence · E2E management · 192x8 cores
L4	D12	TBD (subsequent document)	Metro/WAN · AAI

8.2 Comparison — Legacy 5G vs. Velsanet 6G (Seoul Basis)

Item	Legacy 5G (estimated)	Velsanet 6G
Base Station Count	approx. 12,000 (macro + small cell)	900,000 RUs (400,000 poles x 2.25) + 440,000 H6 (RAN)
DU / CU Equipment	Required (software layer)	Not required (structurally eliminated)
E2E Path Method	Packet switching + session management	Physical optical core 1:1 dedicated
Handover	Re-authentication required · potential packet loss	Overlapped E2E · lossless
Wired Integration	Separate FTTx network required	T4 → H6 unified single network
O8 Intermediate aggregation node	N/A	2,521 nodes · 192x8 cores · AI-integrated

※ Node counts for layers D12 and above (metro backhaul, national network) are defined in a separate document (Velsanet-DEPLOY-

NAT-01).

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Appendix – CAPEX Estimation

Velsanet Structure-Native Network Architecture
Seoul Metropolitan 6G Infrastructure Deployment Plan

A.1 Purpose

This appendix provides an indicative CAPEX estimation for deploying the Velsanet Structure-Native network architecture across Seoul. Estimates are based on confirmed node counts (RU, H6, O8, T4) and total optical cable length, applying industry-average unit cost assumptions. Actual costs will vary based on equipment design, supply chain, construction methods, and reuse of existing infrastructure.

A.2 Seoul Infrastructure Deployment Baseline

Component	Count	Note
T4 Node	5,200,000	Household / office wired access endpoint
RU (Radio Unit)	900,000	Pole-based 6G mmWave wireless access
H6 Node (RAN pole)	440,000	RU aggregation and optical branching
H6 Node (wired T4)	650,000	Building / complex wired aggregation
Total H6 Nodes	approx. 1,090,000	RAN + wired combined
O8 Node	2,521	Urban aggregation and E2E management layer
Total Optical Cable Length	approx. 785,690 km	Seg A–D + T0 + T1 combined (Rev.9 basis)

A.3 Equipment Unit Cost Assumptions

※ Unit costs assume industry-average pricing following mass production and standardization.

Equipment	Unit Cost Assumption	Note
T4 Node	\$1,480 (KRW 2M)	Single unit price
H6 Node	\$5,930 (KRW 8M)	Single unit price
RU (Radio Unit)	\$2,200–\$5,930 (KRW 3M–8M)	Low / Mid / High scenario
O8 Node	\$14,800–\$22,200 (KRW 20M–30M)	Low / High scenario

A.4 Seoul Velsanet Total CAPEX Scenarios

Item	Existing Infrastructure Reuse	Mixed Build	Greenfield Build
Equipment CAPEX	approx. \$16B–\$19B	approx. \$16B–\$19B	approx. \$16B–\$19B
Optical Infrastructure Cost (per km)	\$7,400/km → approx. \$5.8B	\$14,800/km → approx. \$11.6B	\$37,000/km → approx. \$29.1B
Total CAPEX Estimate	approx. \$22B–\$25B	approx. \$28B–\$31B	approx. \$45B–\$48B

A.5 Structural Significance

Velsanet infrastructure costs represent more than mobile network investment. This architecture consolidates mobile networks, wired access networks, IoT connectivity, V2X communication infrastructure, and AI/robotics connectivity into a single structural optical infrastructure.

This architecture replaces multiple legacy networks (FTTx, mobile backhaul, metro rings, aggregation layers) with a unified optical infrastructure.

Velsanet is best understood not as a telecommunications investment but as a city-scale digital infrastructure redesign project — restructuring Seoul's fragmented legacy infrastructure into a single structural network.