Aixavier Edge Analytics – US Multi-Vertical Business Model

(Use-Case–First, Hardware-Agnostic, Wedge-Vertical Strategy)

0. Executive Summary

1. **What we are** – A **use-case–driven, hardware-agnostic edge video analytics platform** that runs on multiple edge compute backends (NVIDIA GPUs, x86/NVRs, industrial PCs, and, where possible, smart cameras / ARM SoCs) and turns CCTV streams into **real-time safety, security, and operations signals**.

2. **Core IP & moat** – A **cross-vertical pattern catalog** (restricted zones, person-down, crowding, aggression, PPE, equipment misuse, smoke/fire), plus **rules/templates, KPIs, and deployment playbooks** and orchestration tooling. The value is in **patterns + rules + playbooks + deployment**, not in any particular hardware box.

3. **Where we start (wedges)** – Focused for the first 2–3 years on:

    - **Transit & Mobility** (on-vehicle and station safety/ops), and
    - **Warehousing & Logistics** (DC/3PL/e-commerce safety & throughput), with **Retail, Smart City, and Industrial/Critical Infrastructure** as medium-term expansion.

4. **Hardware strategy** – Architecture is **multi-backend by design**, rolled out in phases:

    - **Phase 0:** NVIDIA + common x86 edge devices (current implementation focus).
    - **Phase 1:** x86 / NVR / industrial PCs as a lightweight service.
    - **Phase 2:** selective **camera OEM / ARM SoC** integrations for smart cameras.

5. **Market** – We model a US **analytics node TAM ≈ 100–190k nodes** (midpoint ~150k). At an assumed **$3,000/node/year**, this corresponds to **~$300–570M ARR**, midpoint **≈$450M ARR**, for the **edge-side safety & operations analytics** slice of the US video analytics market.

6. **SAM (5–7 years)** – Focused on our wedges plus a small number of lighthouse deployments:

    - **~25–30k nodes**, i.e. **~$75–90M ARR** at **$3k/node/year**.

7. **5-year US scenarios (SOM)** At $3,000/node/year, US-only:

    - **Scenario 1 – Conservative (low case):** Y5 **10–12k nodes** ⇒ **$30–36M ARR** (~30–50% SAM).
    - **Scenario 2 – Base (mid case):** Y5 **15–18k nodes** ⇒ **$45–54M ARR** (~50–65% SAM).
    - **Scenario 3 – Aggressive (high case):** Y5 **25–30k nodes** ⇒ **$75–90M ARR**, approaching full SAM.

8. **Economics** – We model **$3,000/node/year** realised ARR and target **75–80% gross margins** at scale, with heavy compute at the **edge** and the **cloud** used for control-plane, logging, and fleet management.

9. **GTM** – **Wedge-driven**: high-impact pilots in transit and warehousing, packaged into **vertical playbooks**, then scaled via **system integrators and OEMs** as the "safety/ops intelligence layer" on top of existing camera+VMS stacks.
10. **Why now** – Rising **incident and liability costs**, growing **regulatory and stakeholder pressure**, **edge compute + models** now strong enough for multi-stream analytics, and increasing discomfort with **shipping raw video to the cloud**.

> **Naming note:** *"Aixavier" is a working internal codename inherited from an earlier Jetson-focused implementation. The eventual commercial brand will **not** be tied to any specific hardware vendor.*

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1. Positioning & Scope (Use-Case–First, Wedge Verticals)

1.1 What Aixavier Is

Aixavier Edge Analytics is a **use-case–driven edge video analytics platform** that runs on multiple edge compute backends and turns raw CCTV streams into **actionable safety, security, and operations signals**.

Core IP =

- A **catalog of domain-specific use cases** grouped into **generic detection patterns** (Section 2).
- A **rules and policy engine** (zones, thresholds, schedules, workflows).
- **Orchestration & deployment tooling**:
  - Model pipelines and configs per site/vertical.
  - Fleet-wide rollout, monitoring, and over-the-air updates.
- **Integrations**:
  - Existing cameras.
  - Existing **VMS/NVR** stacks.
  - Incident, ticketing, and safety systems.

What we are not:

- Not a "Jetson box company" or tied to a single hardware SKU.
- Hardware (edge box, NVR, smart camera) is **replaceable plumbing**; our IP sits **above** it.

1.2 Wedge Verticals (First 2–3 Years)

We intentionally begin with **two wedge verticals** where:

- Safety & operations pain is visible and costly.
- Camera density is high.
- Edge constraints (bandwidth, privacy, latency) are real.

Transit / Mobility (Wedge #1)

- On-vehicle: railcars, buses, shuttles, people-movers.
- Fixed nodes: stations, depots, yards, terminals, park-and-rides.

- Patterns: crowding, trespass, aggression/assault, slip/fall, unsafe boarding/alighting, suspicious/unattended objects.

Warehousing & Logistics (Wedge #2)

- Distribution centres, 3PLs, e-commerce hubs, big-box DC networks.
- Patterns: forklift/people conflict, PPE compliance, restricted zones, dock congestion, yard intrusion, unsafe material handling.

These wedges give us:

- **Strong ROI narratives** (injury reduction, claim reduction, throughput gains).
- Sites that can justify **incremental analytics spend** per camera/node.
- Clear opportunities for **repeatable playbooks**.

1.3 Medium-Term Expansion Verticals

These are **explicitly medium-term**, not day-one priorities:

- **Retail & Consumer Venues** – large-format stores, malls, stadiums, arenas, casinos.
- **Smart Cities & Public Safety** – intersections, public spaces, transit hubs.
- **Critical Infrastructure & Industrial** – utilities, refineries, ports, airports' airside, large manufacturing plants, data centres.

Strategy:

- 1–3 **lighthouse customers per vertical** to validate patterns and build reference stories.
- **Scale only after** wedge vertical playbooks and unit economics are proven.

1.4 Hardware Strategy – Phased, Multi-Backend

The architecture is **multi-backend by design**. Implementation rollout:

- **Phase 0 (current)** – NVIDIA-based edge devices & common x86 appliances
    - Most mature stack (CUDA, TensorRT, ONNX, Docker).
    - Current model pipelines and deployment tooling are furthest along here.
- **Phase 1** – x86 / NVR / industrial PCs
    - Ship a **lightweight edge runtime service** on standard NVRs and industrial PCs (CPU-only or CPU+GPU).
    - Leverages hardware already deployed in many DCs and transit control rooms.
- **Phase 2** – Selected camera OEMs / ARM SoCs / smart cameras
    - Integrations via camera SDKs or ONVIF extensions.
    - Host **lightweight models or metadata-emitting agents** on smart cameras.
    - Selective: only high-volume OEMs / platforms to keep focus.

Key message: current implementation is furthest along on **Phase 0**, but the **software architecture, APIs, and deployment model are explicitly multi-backend** and built to span all three phases.

2. Use-Case Catalog as Generic Patterns & Playbook Moat

We start from an initial set of **22 rail-flavoured use cases** and generalise them into **8 canonical detection patterns** that apply across verticals.

2.1 The 8 Canonical Patterns (with examples)

1. **Restricted-Zone Intrusion**
    - Person or object enters a pre-defined no-go zone.
    - **Transit example:** passenger steps off platform edge into track area; unauthorized person in tunnel.
    - **Warehouse example:** worker walks into forklift-only aisle or behind a reversing truck.
2. **Unattended / Suspicious Object**
    - Object left unattended beyond a time threshold in a sensitive context.
    - **Transit:** suitcase left on platform staircase or near ticket gates.
    - **Warehouse:** pallet or box left blocking emergency exit or fire door.
3. **Person-Down / Fall / Collapse**
    - Human appears to fall or lies motionless in concerning posture.
    - **Transit:** passenger collapses in railcar; person lying on platform.
    - **Warehouse:** worker falls off loading dock; person down in aisle.
4. **Crowding / Over-Capacity / Queues**
    - Density passes a threshold or queues exceed length/time thresholds.
    - **Transit:** platform over-crowding at peak; blocked entrances; dwell-time overruns due to slow boarding.
    - **Retail/logistics:** long checkout queues; congested dock area or staging lanes.
5. **Aggression / Violence / Fighting**
    - Rapid or repeated aggressive movements suggestive of fighting or assault.
    - **Transit:** altercation in subway car; passenger assault at station entrance.
    - **Stadium/warehouse:** fight in concourse; physical altercation in warehouse break area.
6. **Staff Compliance & Presence**
    - Expected staff position, attire, or behaviour vs defined rule.
    - **Transit:** no staff present at required door during boarding; platform unattended during dwell.
    - **Warehouse:** workers in high-risk zone without hi-vis/PPE; missing spotter near reversing truck.
7. **Equipment Misuse & Unsafe Operation**
    - Machine or vehicle used outside safe envelope.
    - **Transit:** train doors held open; door forced while moving; person riding outside safe area.
    - **Warehouse:** forklift speeding; carrying passengers; elevated load near pedestrians; machine operated with guard removed.

8. **Environmental & Smoke/Fire Anomalies**
    - Visible smoke, haze, flame, or unusual environmental patterns.
    - **Transit:** smoke in railcar; small fire in platform trash bin.
    - **Industrial/warehouse:** smoke near battery racks; haze in hazardous storage area.

2.2 Mapping the Original 22 Use Cases

The original **22 rail-centric use cases** map directly into these patterns, for example:

- "Person on tracks" → **Restricted-zone intrusion**.
- "Passenger collapse on platform" → **Person-down**.
- "Door obstruction / door held" → **Equipment misuse & unsafe operation**.
- "Unattended luggage" → **Unattended / suspicious object**.
- "Platform overcrowding" → **Crowding / queues**.

This mapping shows we're not tied to **rail semantics**; we're encoding **underlying safety/ops patterns**.

2.3 Why This Is More Than a List of Use Cases

The pattern catalog is **not just a list of names**. The moat is in the **operationalisation**:

For each pattern, we maintain:

- **Rules & templates per vertical**
    - Zone definitions (e.g., "red zone" near platform vs around conveyors).
    - Time thresholds, sensitivity levels, schedule templates (e.g., peak vs off-peak).
    - Combinational logic (e.g., person + elevated forklift load in the same region).
- **KPI definitions & analytics**
    - Incident rate per **10k operating hours**.
    - **Mean time to detect** (MTTD) and **mean time to respond** (MTTR).
    - False alarm rates per site per day.
    - Pre/post comparisons for deployments (e.g., reduction in undetected person-down events or investigation time).
- **Deployment templates**
    - Recommended camera placements by vertical.
    - Example **node sizing** (how many streams per node).
    - Integration best practices with existing VMS/NVR per pattern.
- **Continuous improvement loop**
    - Feedback from real incidents (true positives, false positives/negatives, near-misses).
    - Roll these into:
        - Model re-tuning or re-selection.
        - Rule and threshold adjustments.

- Updated deployment playbooks.

> **Net effect:** The combination of **pattern catalog + rules/templates + KPIs + deployment recipes + feedback loop** becomes a **playbook IP** layer that is hard to copy by simply "adding more detectors."

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3. US Market Landscape & Node TAM

3.1 Macro Context – Video Surveillance & Analytics

- The **US video surveillance market** is projected to reach **≈$37B by 2030**, with an ~**11–12% CAGR**. *(Grand View Research)*
- The **global video analytics market** is estimated at **≈$10.25B in 2024**, projected to grow to **≈$49B by 2032**, with **North America ~33%** of the market. *(Fortune Business Insights)*
- Another estimate puts **North American video analytics** at **≈$4.9B in 2024**. *(Precedence Research)*

We focus on the **subset** of that market that:

- Runs **in or very close to the edge** (vehicle/station/DC/plant).
- Delivers **safety and operations** value (not just generic security or marketing analytics).

We define an **analytics node** as:

- A logical edge runtime instance handling roughly **4–16 camera streams**, depending on:
  - Resolution and frame rate.
  - Model complexity and number of patterns enabled.
  - Hardware configuration.

3.2 TAM by Vertical (Node Ranges & Assumptions)

3.2.1 Transit / Mobility (Wedge Vertical #1)

Facts (directional):

- Amtrak operates **2,142 railcars and 425 locomotives**. *(Wikipedia)*
- US freight railroads invest **>$23B/year** in infrastructure and equipment. *(Association of American Railroads)*
- US transit agencies operate dozens of **metro, light rail, commuter rail, BRT, and large bus fleets**, plus **thousands of stations and depots**. *(APTA and related sources)*

Working assumptions:

- Only a **subset of vehicles** will be equipped with on-board analytics within our horizon.
- Not every small stop/station warrants a full node; major stations and depots do.

Node TAM estimate:

- **On-vehicle nodes**:
  - Targeted railcars, locomotives, large buses, and airport people-movers.
  - Many vehicles share one analytics node (per consist/fleet segment).

    - We model **~15–25k nodes** across US transit, intercity passenger rail, airport shuttles, and key bus fleets.

- **Fixed-site nodes**:

    - Major stations, depots, yards, park-and-rides, terminals.
    - Larger sites need **1–3 nodes** depending on layout and camera count.
    - We model **~5–10k nodes**.

> **Transit / Mobility node TAM: ≈20–35k nodes**. **Assumptions:** partial vehicle coverage, major sites only, 1–3 nodes per significant station/yard.

3.2.2 Warehousing & Logistics (Wedge Vertical #2)

Facts (directional):

- Some sources estimate **≈22k warehouses** in the US; broader definitions (including smaller e-commerce facilities) push this much higher, up toward **~100–150k** depending on thresholds for size and use.
- Warehouse sizes, complexity, and tech maturity vary widely.

To avoid false precision:

- We treat US warehouses/DCs as **≈40–60k sites** of varying size and tech maturity.

Working assumptions:

- Only **20–30%** of sites are **large and mature enough** to adopt advanced edge analytics within our 5–7 year horizon.

    - That yields **~8–18k candidate warehouses**.

- Each candidate site uses **2–4 analytics nodes**:

    - One for dock/yard, one for aisles/conveyors, possibly others for mezzanines or high-value areas.

Node TAM estimate:

> **Warehousing & Logistics node TAM: ≈20–40k nodes**. **Assumptions:** 20–30% of all warehouses are viable; 2–4 nodes per viable site.

3.2.3 Retail & Consumer Venues (Expansion, Upside)

Facts (directional):

- Including non-store retailers and sole proprietors, there are **≈2.8M retailers** in the US. *(Capital One Shopping)*
- In-store sales still account for **≈81.6% of US retail revenue** in 2024 (~$7.27T). *(Capital One Shopping)*

We are **not** targeting every store; only **large, complex, high-traffic** venues:

- Big-box stores.
- Malls and shopping centres.
- Stadiums, arenas, large casinos.

Working assumptions (illustrative; not driving SAM):

- Treat **2–3%** of retailers as "analytics-rich, large venues" ⇒ **~50–80k sites**.
- Each site uses **1–3 nodes** for entrances, concourses, high-loss zones.

> **Retail & Consumer Venues node TAM: ≈50–80k nodes (illustrative)**. This is **future upside**, **not** core to the 5–7 year SAM/SOM; used as an order-of-magnitude sense-check.

3.2.4 Smart Cities & Public Safety (Expansion)

Target: US cities and metros with **CCTV-rich public safety programs**.

Working assumptions:

- **10–20 major metros** and regional hubs are realistic candidates.
- Each may ultimately deploy **50–300 nodes**:
    - Intersections, public squares, transit hubs, tourist districts, etc.

> **Smart City node TAM: ≈1–5k nodes**.

3.2.5 Critical Infrastructure & Industrial (Expansion)

Includes:

- Utilities, refineries, power plants.
- Ports, airports' airside, large logistics hubs.
- Large manufacturing plants and data centres.

Working assumptions:

- **~3–5k sites** are high-value enough to justify advanced analytics within our horizon.
- Each uses **2–6 nodes**.

> **Industrial & Critical Infrastructure node TAM: ≈10–30k nodes**.

3.3 Aggregate US Node TAM

Summing the ranges:

- Transit / Mobility: **20–35k**
- Warehousing & Logistics: **20–40k**
- Retail & Consumer Venues: **50–80k** (future upside)
- Smart Cities: **1–5k**
- Industrial / Critical Infrastructure: **10–30k**

> **Total US analytics node TAM: ≈100–190k nodes**. For modelling we use a midpoint of **~150k nodes**.

3.4 $-TAM and Sanity Check vs Existing Players

Using **$3,000/node/year** as our working pricing assumption:

> **US ARR TAM: ≈$300–570M/year**, with a working midpoint of **≈$450M/year** for the **edge-side safety & ops analytics** segment.

Sanity check vs existing players:

- Cloud camera platforms (e.g. Verkada/Meraki-class vendors) and **vertical safety-AI startups** in PPE/forklift/zone safety already reach **meaningful tens to hundreds of millions** in ARR across adjacent segments.
- We use their scale as an **order-of-magnitude benchmark**, not a precise target:
    - We are focused on **edge-centric**, **multi-vertical patterns** and **integration with existing VMS/NVR stacks** rather than replacing them.

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4. TAM → SAM → SOM (Wedge-Focused Logic)

4.1 TAM – Theoretical Ceiling

- **TAM (nodes):** all theoretically reachable nodes across our identified verticals, **≈100–190k**, midpoint **~150k**.
- **TAM (ARR):** at $3k/node/year, **≈$300–570M**, midpoint **~$450M**.

4.2 SAM – Serviceable Available Market (5–7 Year Horizon)

We define **SAM** as:

- What we can **reasonably** address in the US in **5–7 years**,
- Given our wedge focus, product roadmap, and channel strategy.

SAM focus:

- **Primary wedges:** Transit / Mobility and Warehousing & Logistics.
- **Plus:** limited lighthouse projects in Retail, Smart City, Industrial.

Node SAM:

- Transit / Mobility: **~10–15k nodes** (highest-value lines, depots, yards, key fleets).
- Warehousing & Logistics: **~10–15k nodes** (large DCs, e-commerce hubs, 3PL hubs, big-box DC networks).
- Lighthouse: **~1–3k nodes** across Retail, Smart City, Industrial.

> **US SAM (nodes, 5–7 yrs): ≈25–30k nodes**. At **$3k/node/year**, **SAM ARR ≈ $75–90M/year**.

4.3 SOM – 5-Year Adoption Path (Three Scenarios)

SOM is our **actual modeled adoption** in 5 years, always ≤ SAM.

Scenario 1 – Conservative (Low Case)

- **Node adoption (EOY, US):** Y1: **500** Y2: **2,000** Y3: **6,000** Y4: **9,000** Y5: **10–12k** nodes
- **ARR at $3k/node/year:** Y1: **$1.5M** Y2: **$6.0M** Y3: **$18.0M** Y4: **$27.0M** Y5: **$30–36M**
- **SAM penetration (nodes):** ~30–50% by Year 5.

Assumption sketch (Conservative):

- Sales cycles: **18–24 months** for large agencies and national DC networks.
- **3–5 substantial pilots/year**, some constrained by budget cycles.
- Pilot → rollout conversion: **~30–40%**, with rollouts often partial estates.

Scenario 2 – Base (Mid Case)

- **Node adoption (EOY, US):** Y1: **1,200** Y2: **4,000** Y3: **9,000** Y4: **13,000** Y5: **15–18k** nodes
- **ARR at $3k/node/year:** Y1: **$3.6M** Y2: **$12.0M** Y3: **$27.0M** Y4: **$39.0M** Y5: **$45–54M**
- **SAM penetration (nodes):** ~50–65% by Year 5.

Assumption sketch (Base):

- Sales cycles: **12–18 months** for big transit deployments; shorter for private DC networks.
- Pilots: **5–10 meaningful pilots/year**, split between transit and logistics.
- Pilot → rollout conversion: **~50–60%**, where “rollout” = at least one significant corridor/fleet segment or region of DCs.

Scenario 3 – Aggressive (High Case)

- **Node adoption (EOY, US):** Y1: **2,500** Y2: **8,000** Y3: **16,000** Y4: **24,000** Y5: **25–30k** nodes
- **ARR at $3k/node/year:** Y1: **$7.5M** Y2: **$24.0M** Y3: **$48.0M** Y4: **$72.0M** Y5: **$75–90M**
- **SAM penetration (nodes):** approaches full SAM by Year 5.

Assumption sketch (Aggressive):

- Sales cycles compress to **9–15 months** due to strong references, standardised offerings, and channel leverage.
- Pilots: **10–15 pilots/year** run in parallel, in partnership with major SIs and OEMs.
- Pilot → rollout conversion: **~60–70%**, with more **multi-site / multi-corridor** rollouts per win.

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5. Pricing & Unit Economics

5.1 Licensing Model – Node-Based, Customer-Friendly

We **model** revenue as:

> **$3,000 per node per year (ARR)**

…which corresponds to:

- Core platform.
- One vertical pattern pack.
- Some portion of premium features.
- Net of typical discounts.

Market reality:

- Today, analytics and cloud camera platforms are typically priced:
    - **Per camera** (e.g. $X/camera/month).
    - **Per site** (flat price per store, warehouse, station).
    - **Per device** (per NVR or edge box).

Many mature offerings land in the **hundreds of dollars per camera per year** in effective price when you unpack their SKU structure. For **4–16 cameras per node**, our **$3k/node** assumption sits in a **similar effective band**, depending on stream density and feature mix.

Commercial packaging:

- Internally, we track revenue **per node** for modeling, ops, and channel planning.
- Customer-facing, we expect to offer:
    - **Per-site** pricing (e.g. per warehouse, per station).
    - **Per-camera bundles** for some segments.
    - Or **hybrid** models (site minimum + camera add-ons).

Early pilots will be used to:

- Test willingness-to-pay.
- Determine which packaging feels **natural** to buyers and integrators.
- Align with existing budget categories.

5.2 COGS & Gross Margin

We aim for **infrastructure-style gross margins** once the platform is mature.

Target GM: ~75–80%

Working COGS per node-year:

- **Cloud infrastructure:** control-plane, metrics, logging, configuration storage, limited video snippets for forensics/ML:
    - **$200–250 / node / year**.
- **Support & monitoring:**
    - Tier 1/2 support; NOC tooling; incident response; training materials.

    - **$300–350 / node / year**.

- **Tooling & enablement:**
    - Internal dev tools, CI/CD, channel enablement content, partner sandboxes (amortised).
    - **$100–150 / node / year**.

> **Total COGS: $600–750 / node / year**. At $3,000/node, this implies **gross margin ~75–80%**.

This assumes:

- Most heavy compute runs on **customer/OEM hardware** (edge nodes, NVRs, smart cameras), not our cloud.
- Cloud usage is disciplined and monitored.
- Support is progressively **standardised and automated** (playbooks, dashboards, self-service).

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6. 5-Year US Revenue Scenarios (Node & ARR Only)

Using the node paths in Section 4 and **$3k/node/year**:

6.1 Scenario 1 – Conservative (Low Case)

- Nodes: **0.5k → 2k → 6k → 9k → 10–12k**
- ARR: **$1.5M → $6.0M → $18.0M → $27.0M → $30–36M**

This is the “slow but real adoption” path:

- Strong references from a handful of flagship customers.
- Real revenue, but slower SAM penetration; room to grow beyond Year 5.

6.2 Scenario 2 – Base (Mid Case)

- Nodes: **1.2k → 4k → 9k → 13k → 15–18k**
- ARR: **$3.6M → $12.0M → $27.0M → $39.0M → $45–54M**

This is the case we consider **most representative of a successful but not insane outcome** in US wedges alone, assuming:

- Healthy but not hyper-growth adoption in transit and logistics.
- 50–60% pilot → rollout conversion.
- GTM capacity ramped sensibly, with partners coming online.

6.3 Scenario 3 – Aggressive (High Case)

- Nodes: **2.5k → 8k → 16k → 24k → 25–30k**
- ARR: **$7.5M → $24.0M → $48.0M → $72.0M → $75–90M**

This corresponds to:

- Approaching **full SAM penetration** in wedge verticals plus some lighthouse expansions.
- Very strong references.

- Significant leverage via **SIs and OEMs**.

6.4 Margin Profile Across Scenarios

Across all three scenarios:

- We target **GM ~75–80%** as we scale, built on:
    - Node ARR **$3,000**.
    - COGS **$600–750/node/year**.
- Gross profit per node: **$2,250–2,400**.

Our model suggests:

- In **Conservative**, profitability comes later (post-Year 5) unless we keep OPEX extremely tight.
- In **Base**, we can approach **break-even around Year 3** and become solidly profitable in Years 4–5 with healthy EBITDA margins.
- In **Aggressive**, we have headroom to invest more in GTM while still attaining strong overall margins.

(Full FTE/EBITDA breakdown in Appendix E.)

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7. GTM & Vertical Execution

7.1 Wedge-Driven Motion (Transit & Logistics)

Years 1–2 – Pilot-led wedge focus

- **Transit/Mobility pilots (3–5):**
    - One major metro or commuter agency (platform + vehicle analytics).
    - One bus/BRT system or large city transit operation.
    - One airport rail/shuttle context.
- **Warehousing/Logistics pilots (3–5):**
    - One major 3PL.
    - One e-commerce pure-play.
    - One big-box retailer's DC network.

Each pilot:

- Deploys **multiple patterns** (at least 3–4) to show breadth: restricted-zone intrusion, person-down, crowding/queues, PPE/compliance, equipment misuse.
- Has explicit **before/after metrics**:
    - Investigation time reduction.
    - Additional incidents detected.
    - Operator workload.
    - Any measurable reduction in claims / near-misses (where possible over period).

Years 3–5 – From pilots to standard playbooks

- Convert successful pilots into **corridor-level or multi-site rollouts**:
    - Transit: entire corridor/line or fleet segment.
    - Logistics: all DCs in a region, or a set of nationally important DCs.
- Productise into named playbooks, e.g.:
    - **"Rail Safety & Dwell Optimisation Pack"** → patterns: restricted-zone, crowding, person-down, aggression.
    - **"Warehouse Safety & Throughput Pack"** → patterns: forklift/people conflict, PPE, dock congestion, person-down.
- Grow channel:
    - Train **system integrators** (CCTV, VMS, rail signalling, warehouse automation) to sell and deploy these playbooks.
    - Explore **OEM bundles**: pre-loaded analytics on edge boxes or NVRs.

7.2 Long-Term Positioning in the Ecosystem

Longer-term goal:

- Become the **default "safety & ops intelligence layer"** that:
    - Sits **next to** existing VMS/NVR stacks.
    - Consumes camera streams.
    - Emits events/metadata into the customer's incident & safety workflows.

We do **not** want to replace all VMS; we want:

- SIs and hardware vendors to view us as a **revenue-accretive module**.
- Customers to deploy us **gradually across estates** on their own timelines.

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8. Regulation, Risk & "Why Now"

8.1 Safety & Liability Drivers – Warehousing & Logistics

- Warehouses and DCs are among the **highest-risk workplaces**:
    - Forklift and vehicle strikes.
    - Falls from docks and mezzanines.
    - Struck-by or caught-between incidents.
- **Slip/trip/fall and material handling** injuries are major cost drivers for:
    - Workers' comp claims.
    - OSHA recordables.
    - Lost-time incidents and absenteeism.
- Regulators and insurers increasingly expect:

    - Proactive **hazard identification and mitigation**.
    - Documented evidence that companies are using **“reasonably available technology”** to reduce risk.

8.2 Safety & Liability Drivers – Transit / Mobility

- Transit agencies face:
    - Assaults and harassment in vehicles and stations.
    - Vandalism, theft, fare evasion.
    - Suicides and trespass incidents on tracks.
    - Platform crowding and crush risks.
- High-profile incidents lead to:
    - Media scrutiny and political pressure.
    - Regulatory investigations.
    - Civil litigation and settlements.

The question from regulators, boards, and the public increasingly is:

> “What systems did you have in place to **detect and prevent** this?”

8.3 Why Edge vs Pure Cloud

Constraints on “upload everything” approaches:

- Bandwidth:
    - Vehicles in tunnels or remote depots.
    - Large DCs pushing hundreds of cameras’ worth of video.
- Privacy and policy:
    - Statutes and internal policies limiting off-site/supervisory access to raw video.
    - Unions and worker councils sensitive to “constant remote monitoring”.

Edge analytics advantages:

- Raw video remains **on-site**; only events/metadata or short clips are exported.
- Latency is low; reactions to person-down or restricted-zone intrusions can be **seconds**, not minutes.
- Cloud compute costs are controlled; scaling is primarily about **node hardware**.

8.4 “Why Now?” in One Sentence

> **Incident and liability pressures are rising, edge compute and models are finally good enough, and organisations are looking for a practical middle ground between dumb cameras and “ship everything to the cloud”.**

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9. Assumptions & Risks (Hypothesis Framing)

This report is a **structured, quantified hypothesis** about a large opportunity—not a forecast locked in stone.

9.1 Key Modeling Assumptions

- **Market sizing**:
  - Node TAM **100–190k** (midpoint 150k).
  - SAM **~25–30k nodes** in 5–7 years in US wedges + lighthouses.
- **Pricing**:
  - Effective **$3,000/node/year** realised ARR aligns with ballpark per-camera ranges in adjacent products.
- **Economics**:
  - COGS **$600–750/node/year**; GM **~75–80%** achievable with edge-first compute and disciplined support.
- **Adoption curves**:
  - Conservative/Base/Aggressive paths described in Section 4 are **ambitious but feasible** if:
    - Pilots convert at the suggested rates.
    - We execute GTM and partnerships effectively.

9.2 Material Risks

- **Sales cycle risk**:
  - Public transit has long budget cycles and complex procurement.
  - Mitigation: standardised pilot offers, strong SI partners, playbooks that fit into existing RFP structures.
- **Competitive response**:
  - VMS vendors and cloud camera platforms can incrementally add analytics features.
  - Our advantage needs to be:
    - **Edge-centric** rather than cloud-only.
    - **Pattern + playbook IP** rather than generic detectors.
    - Strong integration story with multiple hardware backends.
- **Support and COGS creep**:
  - Heavy bespoke deployments or “special snowflake” integrations could drive up COGS.
  - Mitigation: strict productisation; standard APIs; integration tiers.
- **Regulatory and privacy pushback**:
  - Particularly from unions and worker councils.

- Mitigation: edge-first design, clear privacy controls, policy templates, and audit logs.

9.3 How to Read the Numbers

- Think of all numeric values as **"what we believe is realistic given what we know now"**, not guarantees.
- The key investor-level takeaway is:

> We believe there is a **$75–90M ARR SAM** in our wedges, and we have a **structured, testable plan** to get to **$30–60M ARR** in 5 years in the US if things go reasonably well.

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10. Customer Discovery & Voice of Customer (Plan)

(Full detail in Appendix F; here is the summary.)

10.1 Interview Plan (15–25 Conversations)

- **Targets by vertical:**
  - **Warehousing & Logistics:**
    - Safety/EHS managers.
    - DC operations managers.
    - Security managers.
    - IT/OT leads.
  - **Transit / Mobility:**
    - Transit safety officers / chiefs.
    - Security / transit police.
    - Operations control centre managers.
    - CIO/IT architects.
  - **Exploratory (expansion):**
    - Retail loss prevention / asset protection.
    - City CCTV program leads.
    - HSE managers in industrial/ports.
- **Volume and timing:**
  - **15–25 interviews** over **3–4 months**, with emphasis on wedges.

10.2 Themes & Questions

Key discovery themes:

- Current **incident workflows** (from detection to investigation to remediation).
- Pain points with **video today** (time to find footage, missed incidents).
- Experience with **existing analytics** (basic motion detection, OEM analytics, any AI trials).
- **Budget ownership & procurement paths** (who signs cheques, how decisions are made).

- **Constraints and fears** (IT security, unions, privacy, false positives).
- Perceived **value and ROI** (what would make the solution an obvious “yes”).

10.3 Outputs & How They Feed Back

From the first 15–25 interviews, we expect to produce:

- **6–10 anonymised verbatim quotes** capturing key attitudes and pain.
- **1–2 pages of pattern summaries**:
    - Top recurring pains.
    - What they currently do (workarounds).
    - Common objections to AI analytics.
    - Early signals on willingness to pay and preferred pricing models.

This will refine:

- Our **pricing packaging** (per site vs per camera vs per node).
- Our **positioning** (which patterns resonate as “must-have”).
- Our **GTM playbooks** (which roles to target first, how to frame pilots).

Appendices

Appendix A – Competitive Landscape & Alternatives

A.1 Categories of Alternatives

1. **Traditional VMS + Camera OEM Analytics**
    - Examples: Genetec, Milestone, Avigilon; camera OEM analytics from Axis, Bosch, Hanwha.
    - Strengths:
        - Mature recording/archival & operator workflows.
        - Basic analytics (motion detection, line crossing, simple intrusion, counting).
    - Limitations:
        - Analytics often bolt-on; noisy; configured once, then ignored.
        - Not deeply tied into safety/ops workflows.
2. **Cloud-First Camera/AI Platforms**
    - Examples: Verkada, Meraki, Rhombus, others in cloud camera space.
    - Strengths:
        - Very strong on **ease of deployment**, remote access, updates.
        - Centralised management across many sites.

- Limitations:
  - Often tied to **proprietary hardware**.
  - Analytics mostly generic (people/vehicle detection, basic counting).
  - Bandwidth and privacy concerns in sensitive environments.

3. **Vertical Safety-AI Startups**
   - Examples:
     - Forklift and PPE safety platforms.
     - Zone-safety analytics for industrial plants.
   - Strengths:
     - Deep focus on one category (forklift-people conflict, PPE).
     - Strong domain knowledge; targeted ROI stories.
   - Limitations:
     - Narrow scope; not a broad platform across verticals.
     - Hardware-locked or bespoke appliances in many cases.
4. **Status Quo / "Do Nothing"**
   - Cameras + NVR + manual review.
   - Occasional motion detection or line-crossing rules that operators largely ignore.

A.2 Conceptual 2×2

Axes:

- **X-axis:** Generic security / "all-purpose surveillance" ⟶ Deep safety & operations.
- **Y-axis:** Cloud-centric ⟶ Edge-native.
- Traditional VMS/OEM: **generic; more on-prem**, sits **middle-left**.
- Cloud camera platforms: **cloud-centric, generic**; sits **top-left**.
- Vertical Safety-AI startups: **deep but narrow**, often cloud or specific edge; sits **right side** (top/middle).
- **Aixavier: edge-native**, **safety/ops-focused**, **pattern/playbook-driven**, sits **bottom-right**.

A.3 Comparison Table

Dimension	Typical VMS	Cloud Camera Platform	Vertical Safety-AI Startup	Our Platform (Aixavier)

Dimension	Typical VMS	Cloud Camera Platform	Vertical Safety-AI Startup	Our Platform (Aixavier)
Deployment model	On-prem server, sometimes hybrid	Cloud-first; cameras “phone home”	Mixed; often custom box or cloud	Edge-native runtime + cloud/on-prem control-plane
Hardware stance	Vendor-agnostic cameras; server HW required	Often tied to proprietary cameras	Often tied to specific box/HW	Hardware-agnostic runtime (NVIDIA/x86/IPC); optional OEM bundles
Analytics scope	Broad but shallow (motion, line, basic intrusion)	Broad but shallow (people, vehicles, counting)	Narrow but deep in one domain	Broad **pattern catalog**, deep in safety/ops for chosen wedges
Use-case modelling	Individual “features” (tripwire, count)	Basic detectors and alerts	Concrete single-purpose scenarios (PPE, forklifts)	**Pattern-based playbooks** (restricted zones, person-down, crowding, aggression, etc.), parameterised by vertical
Customisability	Rules/layouts; deeper changes = PS projects	Configurable in cloud UI; limited model control	Limited beyond core scenarios	Configurable patterns and rules; vertical templates; PS used to extend catalog
Integration style	SDKs, plugins for VMS, on-prem APIs	Cloud/webhooks; some on-prem agents	Often bespoke integration	Designed to sit **next to existing VMS/NVR**, with standard event/metadata APIs
Cloud vs Edge	Mostly on-prem; some hybrid	Cloud-heavy; video often leaves site	Varies by vendor	Edge-heavy inference; cloud for fleet management & metrics
Typical positioning	Core “video plumbing”	All-in-one cloud camera stack	Single-domain safety add-on	Cross-vertical **safety/ops intelligence layer** on existing camera+VMS

Explicit acknowledgement: Many incumbents already have **zone intrusion, counting, and dwell-time analytics** as checkboxes. Our differentiation is **not** “we detect objects too”, but:

- **Edge-native design** tailored to bandwidth/privacy constraints.
- A **pattern + playbook catalog** focused on safety & ops outcomes.

- Deliberate **multi-backend** integration strategy with existing camera+VMS ecosystems.

Appendix B – Existing Edge & VMS Ecosystem (Transit & Warehousing)

B.1 Transit / Mobility Stack

Common components:

- **Cameras:** IP (Axis, Bosch, Hanwha, Panasonic, etc.), vehicle-rated models, some analog on older systems.
- **Vehicle recorders / mobile NVRs:** dedicated boxes with SSD/HDD, often vendor-specific.
- **Station VMS:** Genetec, Milestone, Avigilon, OnSSI, etc., deployed per station or centrally.
- **Backhaul:** wired networks in stations; Wi-Fi/cellular backhaul for vehicles.

Deployment options for Aixavier:

1. **Agent/container on existing edge servers/NVRs**
    - Where NVRs or station servers support containers or third-party services.
    - Pros: no extra hardware, simpler procurement.
    - Cons: heterogeneous platforms; varying performance.
2. **Separate edge appliance**
    - Dedicated box in rack rooms or vehicle cabinets.
    - Taps RTSP/ONVIF streams from cameras/NVRs.
    - Sends events/metadata back to VMS and incident systems.

Integration priorities:

- Target VMS vendors with open APIs/event injection.
- Mobile NVR vendors that:
    - Expose streams.
    - Allow light-weight apps or send metadata.

B.2 Warehousing & Logistics Stack

Components:

- **Cameras:** IP cameras from common OEMs; legacy analog via encoders.
- **NVRs:** off-the-shelf NVRs or VMS-managed storage servers.
- **VMS:** mid-market to enterprise-grade, depending on operator size.
- **Network:** wired inside facility; some separate OT or security subnets.

Deployment options:

1. **Service on existing x86/NVR/industrial PC**
    - When the environment supports Windows/Linux services or containers.
    - Minimises new hardware; good for enterprises standardised on a vendor.

2. **Dedicated edge appliance**
    - In the network rack, ingesting streams from cameras/NVRs.
    - Publishes events into VMS/SOC dashboards and safety tools.

Logical partnerships:

- VMS vendors strong in **logistics/industrial** verticals.
- NVR/industrial PC vendors already selling into DCs.
- Automation integrators (WMS, robotics) who want to bundle safety analytics.

Appendix C – Buying Journey & GTM Details

C.1 Warehousing & Logistics – Buying Journey

- **Champion:**
    - Safety/EHS manager, or
    - DC operations manager who owns throughput and injuries.
- **Economic buyer:**
    - VP Operations, Head of Supply Chain.
    - Sometimes CFO if claims are large and visible.
- **Gatekeepers:**
    - IT (network, security, architecture).
    - Legal/Risk (privacy, policies).
    - EHS if not champion.
- **Sales path:**
    - Early: **direct + a few trusted integrators**, pilot-heavy.
    - Later: via **existing integrators** who already supply CCTV/WMS/automation.

C.2 Transit / Mobility – Buying Journey

- **Champion:**
    - Chief safety officer or equivalent.
    - Security lead / transit police.
    - Operations control centre leadership.
- **Economic buyer:**
    - COO / Director of Operations.
    - Sometimes CIO/CTO if embedded into broader modernisation.
- **Gatekeepers:**
    - IT (cybersecurity, integration).

- Legal/compliance.
- Unions / worker councils (privacy & real-time monitoring concerns).

- **Sales path:**
  - Early: **direct engagement + pilots**, usually with a specialised transit SI.
  - Later: part of bigger **SI/OEM contracts** (rolling stock upgrades, signalling, control room projects).

C.3 GTM Evolution

- **Years 1–2:** founder-led, direct sales; design partner style pilots.
- **Years 3–5:** shift towards **SI and OEM-driven distribution**; playbooks packaged for resale.
- **Long-term:** analytics becomes a **standard line item/module** in transit and DC solution stacks.

Appendix D – Canonical Pattern Table (Detailed)

Pattern	Short Description	Transit / Mobility Example	Warehousing / Logistics Example
Restricted-zone intrusion	Entry into defined no-go zone	Passenger steps beyond platform edge; trespass in tunnel	Worker enters forklift-only aisle; person in exclusion zone near heavy machinery
Unattended / suspicious object	Object left unmoved beyond threshold	Luggage left near stairs/gate for >X minutes	Pallet left blocking fire exit; object in emergency pathway
Person-down / fall / collapse	Human falls or lies motionless	Passenger collapses in railcar or on platform	Worker falls off dock; person lying on warehouse floor
Crowding / over-capacity / queues	Density or queues exceed limit	Platform overcrowded; entrance blocked; dwell extended	Long checkout/staging queues; congested dock or lane
Aggression / violence / fighting	Patterns suggesting fight/assault	Two people fighting inside train or at station	Physical altercation in break area or yard
Staff compliance & presence	Staff/PPE vs expected rules	No staff at assigned door during dwell	Worker in high-risk area without PPE; no spotter where required
Equipment misuse / unsafe operation	Machine outside safe envelope	Doors forced while train moving; riding outside safe area	Forklift speeding; elevated load near pedestrians; riding on forks
Environmental & smoke/fire anomalies	Smoke, haze, flame anomalies	Smoke in car; bin fire on platform	Smoke near battery racks; haze in hazardous storage zone

Usage:

- Each pattern is implemented once, then **parameterised by vertical** (zones, thresholds, semantics).
- New verticals map to the same patterns; we **don't** reinvent new detectors each time.

Appendix E – Financial Appendix (FTE & EBITDA Sketch)

E.1 FTE Ramp (Illustrative, Base Case)

- **Y1:** ~20 FTE
  - Founders, core engineering (models + runtime), 1 PM, 1–2 sales, 1 ops/support.
- **Y2:** ~35 FTE
  - More engineers (deployment + integrations), 2–3 GTM hires, 1–2 support/CS.
- **Y3:** ~55 FTE
  - Dedicated vertical PMs, more AE/SE headcount, customer success, support.
- **Y4:** ~75 FTE
  - Regional GTM coverage, partner managers, reliability and SRE.
- **Y5:** ~95 FTE
  - Mature GTM and eng teams; expanded CS and partner enablement.

Blended fully-loaded cost: We use **$180k/FTE/year** as a modelling assumption (US-weighted, some global hiring).

E.2 EBITDA Trajectory (Qualitative)

Given:

- Node/ARR scenarios (Section 6).
- GM target **75–80%**.
- FTE ramp above, plus **15–20% of revenue** as other OPEX (marketing, travel, G&A).

We get:

- **Conservative (low case):**
  - Y1–Y2: meaningfully negative EBITDA while building product and references.
  - Y3: narrower losses as revenue increases.
  - Y4–Y5: approaching break-even to modest profitability.
- **Base (mid case):**
  - Y1: negative, heavy investment.
  - Y2: losses shrink as ARR grows.
  - **Y3:** near break-even.

    - **Y4–Y5:** opportunity for **20–30%+ EBITDA margin** if growth and efficiency are balanced.

- **Aggressive (high case):**

    - We may **reinvest** aggressively in GTM and R&D; profitability depends on pace of hiring.
    - Even with investment, the underlying economics support attractive margins at scale.

(Investors can reconstruct exact numbers from nodes × pricing, COGS assumption, FTE ramp, and OPEX %.)

Appendix F – Customer Discovery & Research Roadmap (Detailed)

F.1 Customer Interviews – Detailed Plan

Roles per vertical:

- **Warehousing & Logistics:**

    - Safety/EHS.
    - DC Ops / Site Manager.
    - Security.
    - IT/OT.

- **Transit / Mobility:**

    - Safety officer.
    - Security / transit police.
    - OCC manager.
    - CIO/IT architect.

- **Exploratory (expansion):**

    - Retail LP/AP.
    - City CCTV programme managers.
    - Industrial HSE.

Volumes:

- 8–12 interviews in warehousing & logistics.
- 6–8 in transit/mobility.
- 3–5 exploratory.

F.2 Interview Guide – Sample Questions

Incident workflow

- “Tell me about the last serious safety incident. How did you find out, and how did video get used?”
- “How long did it take to locate and review the relevant footage?”

Pain with video

- “Where does video fail you today?”

- “Do you feel like you’re missing incidents?”

Analytics experience

- “What analytics do you have now (if any)? Motion, lines, AI? Do you trust them?”
- “Have you trialed advanced analytics before? What happened?”

Budgets & procurement

- “Who would sign a cheque for a system like this?”
- “Which budget does it come from (Safety, Security, Ops, IT, CapEx/OpEx)?”
- “How do you normally buy tech like this? RFP, pilots, multi-year contracts?”

Constraints/fears

- “What would make you nervous about ‘AI watching cameras’?”
- “If a vendor promised ‘zero false positives’, what would you think?”

Value & ROI

- “If this worked extremely well, what would it change in 12–24 months?”
- “What evidence would you need to see to say: this is obviously worth paying for?”

F.3 Expected Outputs – Example Quotes & Patterns

Once we’ve run a first tranche, we expect to summarise:

Example anonymised quotes:

- > “We have 900+ cameras and maybe three pairs of eyes watching them. Most of the time we’re blind until someone gets hurt.” – Ops Manager, large DC
- > “After an incident, we spend days scrubbing video. The worst part is when we never find the one moment that matters.” – Safety Lead, commuter rail
- > “We’ve tried AI analytics, but false positives killed it. Once my team stops trusting alerts, the system is dead.” – Security Manager, warehouse campus
- > “Our IT folks don’t want any live video streaming to the cloud. If it doesn’t run on-site, it’s basically a non-starter.” – IT Architect, transit agency

Patterns:

- Investigation time is **too long**; staff time is expensive.
- Many incidents are missed **entirely** because no one is watching.
- Distrust of generic “AI analytics” due to false positives.
- Strong concern about **privacy, bandwidth, security** and cloud.

F.4 Research Roadmap (3–12 Months)

Data to collect:

- **Customer interviews** (above).

- **Pilot metrics**:
    - Per pattern: precision/recall, FP/FN rates.
    - Investigation time before/after.
    - Any measured change in incident detection or near-miss capture.
- **Integration friction**:
    - Document how hard each VMS/NVR stack is to integrate with.
    - Build qualitative “integration difficulty scores”.
- **Pricing experiments**:
    - Compare response to per-node vs per-site vs per-camera quotes.
    - Observe discount sensitivity and preferred term lengths.
- **Cost actuals vs model**:
    - Track real **cloud and support costs** per node in pilots.
    - Compare to **$600–750/node/year** assumption.

This roadmap ensures the model in this memo becomes **tighter and more evidence-backed** over the next **3–12 months**.