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Smart Fleet

Solution Blueprint 1.0

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Critical Infrastructure, Federal & Aerospace Division

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Executive Summary

The Smart Fleet Solution Blueprint outlines a framework for building intelligent, connected transportation systems that improve safety, efficiency, and reliability across public and private fleets. By combining edge computing with AI inferencing, it enables faster decision-making, predictive maintenance, and optimized operations across diverse transit environments.

Designed for transportation authorities, system integrators, fleet operators, and technology partners, this blueprint serves as both a technical guide and strategic reference for deploying scalable Edge AI solutions. Readers will gain insight into key architectural components, data flows, and cybersecurity considerations necessary to design and manage next-generation fleet systems.

Intel's role is central to this transformation. The Smart Fleet Solution Blueprint leverages Intel's Edge AI portfolio, including optimized processors, accelerators, and software tools such as Intel® OpenVINO™, Metro AI Suite, and Intel® SceneScape, along with a robust ecosystem of hardware and software partners. Together, these technologies empower developers and operators to deliver high-performance, cost-efficient fleet solutions capable of operating reliably under real-world constraints—from inconsistent connectivity and limited bandwidth to harsh environmental conditions.

Date	Revision	Description
November 2025	2025.1	Initial Release

1. Overview

Smart Fleet Solutions leverage Intel® Edge AI technologies to modernize transportation and logistics systems, enhancing safety, security, operational efficiency, and overall mobility performance. Using real-time video analytics, these systems address critical safety and operational challenges, including passenger occupancy, behavior at stations, crowd monitoring, fleet tracking, and driver performance.

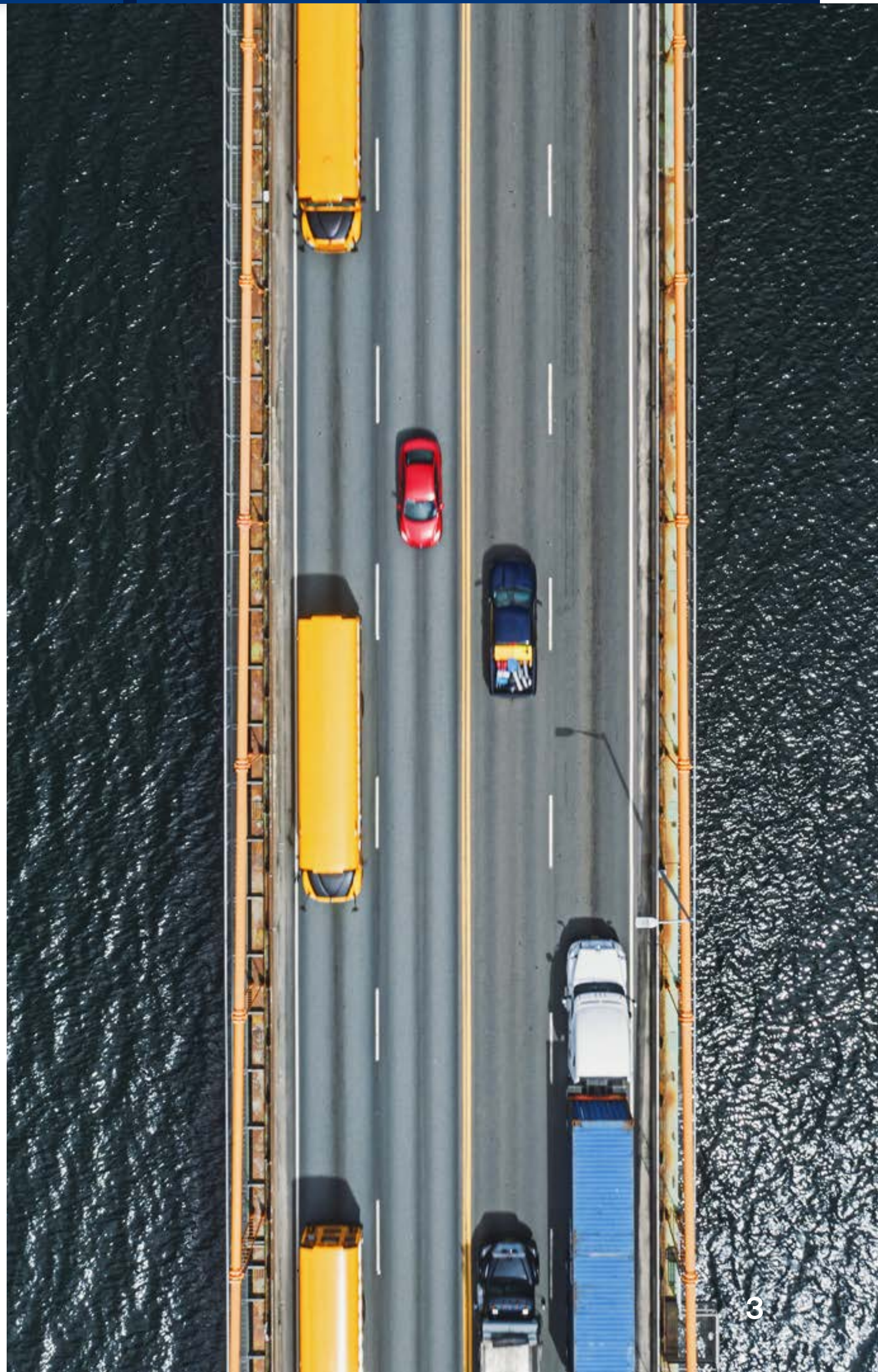
The Smart Fleet Solution Blueprint serves as a comprehensive guide for deploying Edge AI solutions that seamlessly integrate with data center and cloud computing infrastructures. It outlines best practices for utilizing Intel's certified AI systems, software development kits (SDKs), sample applications, and platform blueprints. This blueprint not only documents essential technologies and system benchmarks but also demonstrates the effective use of hardware platforms and software frameworks under real-world operating conditions, such as limited camera bandwidth, intermittent 5G/LTE connectivity, elevated in-vehicle temperatures, and strict video-retention requirements. By providing an integrated approach that combines real-time data processing at the edge with near-real-time analytics at transit management centers, these systems address a wide array of operational challenges.

Key use cases include:

1. **Occupancy Detection:** Utilizing video analytics to accurately count passengers and monitor occupancy levels in buses, enhancing resource allocation and service planning.
2. **Anomalous People Behavior at Stations:** Analyzing video feeds to understand passenger behavior at stations to prevent theft or altercations and improve safety management.
3. **Crowd Detection:** Implementing AI-driven systems to detect and manage crowd formations, ensuring safety and efficient flow of passengers.
4. **Real-Time Fleet Tracking:** Providing precise location data and estimated arrival times, optimizing route planning and reducing wait times for passengers.
5. **Driver Behavior Analytics:** Monitoring driver actions and patterns to enhance safety, reduce accidents, and improve overall service quality.

Transit operators are shifting from traditional tools like laser-based people counting to video analytics technology solutions for greater accuracy and reliability. This shift allows for more accurate, reliable, and comprehensive data collection and analysis, driving transformative improvements in transit operations.

By leveraging state-of-the-art AI and video analytics technologies on the latest Intel® Core™, Intel Atom®, and Intel® Xeon® processors and Intel® Arc™ GPUs, Smart Fleet Solutions offer a forward-thinking approach to fleet management, enhancing service quality and ensuring passenger safety across urban environments.

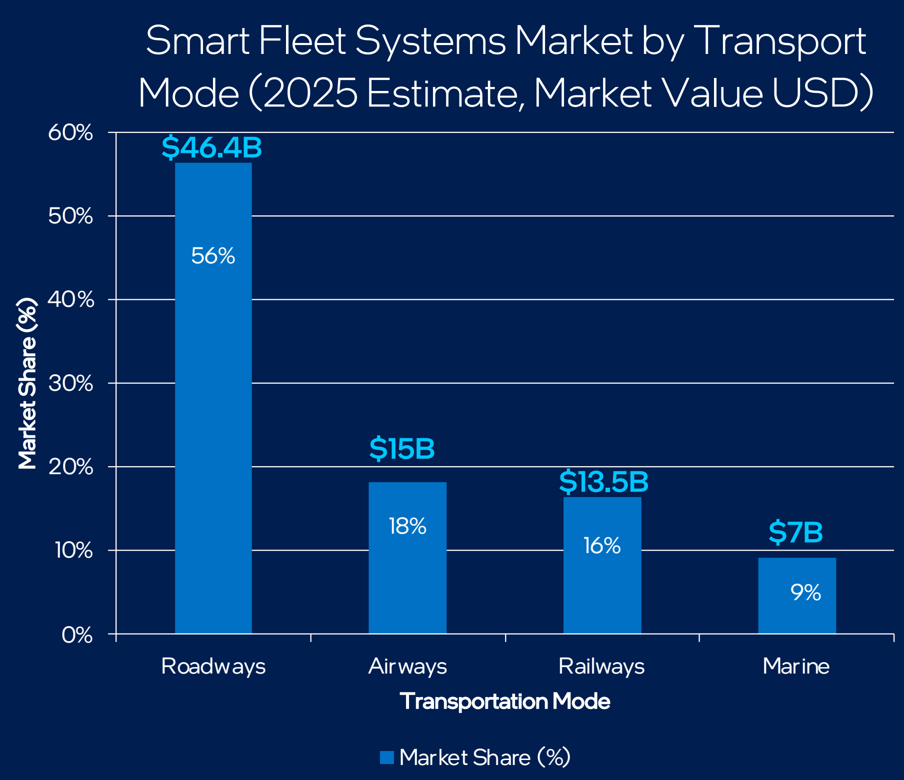


1.1 Market Analysis

The market potential for Smart Fleet Solutions (SFS) is expanding rapidly, fueled by urbanization and rising demand for safer, more efficient public transportation. Intelligent Onboard Units (OBUs) play a pivotal role in this shift, advancing fleet mobility by leveraging AI-driven edge intelligence.

These systems, which manage data processing onboard and at transit stations, represent a market valued at $82.4 billion USD in 2025, projected to reach $174.7 billion by 2035. Growth is led by the hardware segment (42.7%), driven by continued investments in intelligent infrastructure, safety innovation, and edge-AI-enabled fleet operations.[1]

With the integration of advanced technologies such as Intel Xeon-class servers and GPUs, Fleet Management Servers (FMSs) are evolving to support advanced workloads, including generative AI for route planning, passenger safety, and system responsiveness. As autonomous vehicles and SFS continue to develop, OBUs are essential for creating a seamless, efficient, and safe transit environment.



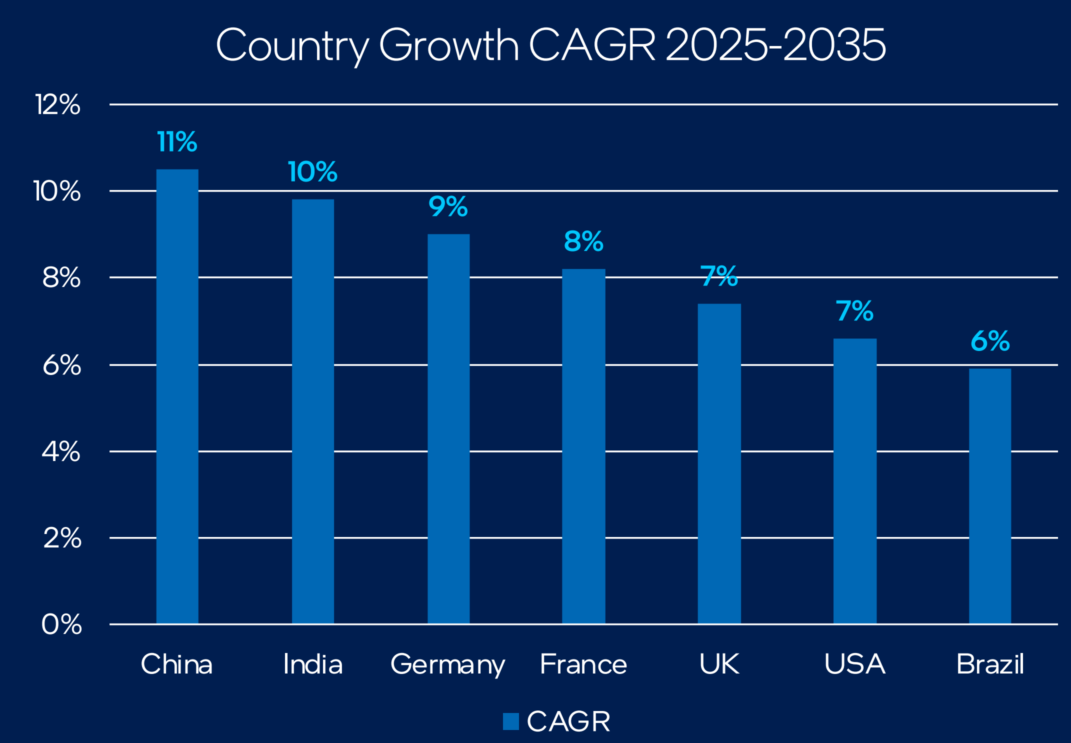


Figure 1. Expected Global Smart Fleet Growth Driven by AI Adoption and Edge Innovation (2025–2035)

Smart Fleet Management Market | Global Market Analysis Report - 2035

2. Use Cases

The Smart Fleet Solution Blueprint is an advanced framework that integrates cutting-edge Edge AI technologies to enhance public transportation systems. By combining Intelligent Onboard Units with a centralized Fleet Management Server, this blueprint offers high-performance solutions designed to interface seamlessly with transit vehicles and infrastructure. Utilizing key technologies such as AI inference, sensor fusion from multimodal sensors like cameras and GPS, generative AI, and cybersecurity, Smart Fleet Solutions aim to modernize fleet operations, improve public safety, optimize commute times, and enhance operational efficiency. This blueprint supports a variety of use cases, including real-time fleet tracking and driver behavior analytics, and is built to operate efficiently in diverse environmental conditions. While the listed use cases are among the top applications, they represent just a subset of the potential supported by this technology. With generative AI and agentic AI, the possibilities for additional use cases can be vast.

People Counting and Occupancy Detection: Smart Fleet Solutions utilize advanced video analytics to accurately count passengers and monitor occupancy levels in buses. This data helps transit operators optimize resource allocation, improve service planning, and ensure compliance with safety regulations. By upgrading from traditional laser-based counting systems, operators gain more reliable and comprehensive insights into passenger flow, ridership patterns, and bus capacity.

Anomalous People Behavior Onboard and at Transit Stations: By analyzing video feeds, Smart Fleet Solutions provide insights into passenger behavior and interactions at stations. This analyzed data provides actionable insights that improve safety response, station management, and passenger flow efficiency. The system detects unusual behaviors, such as theft, disorderly conduct, or malicious or self-harm attempts involving stepping in front of a vehicle and promptly alerts drivers and authorities to potential safety threats, thereby contributing to a safer transit environment.

Crowd Detection and Safety at Stations: Smart Fleet Solutions' AI-driven systems can detect and manage crowd formations at bus stops and transit hubs. This capability ensures safety and efficient movement of passengers, preventing overcrowding and reducing wait times. The system can dynamically adjust bus schedules and routes based on real-time crowd data, optimizing transit operations.

Real-Time Bus Tracking and Driver Behavior Analytics: Smart Fleet Solutions deliver precise location data and estimated arrival times for buses, helping transit operators optimize routes and reduce passenger wait times. Driver behavior analytics further enhance safety by monitoring patterns and actions that can influence service quality and operational efficiency. These insights enable data-driven decision-making and targeted training programs for drivers. Even in the event of a temporary network loss, analytics continue locally, ensuring uninterrupted monitoring and consistent data flow once connectivity is restored. System updates are managed through safe, rollback-aware processes, giving transit IT teams confidence in maintaining system stability and reliability. Typical alert latency remains within a few seconds, fast enough to support near real-time responsiveness across connected fleets. Intel's agentic, multimodal analytics capabilities complement this by integrating live infrastructure data—such as onboard occupancy detection, crowd and passenger flow at transit station, route traffic data, bus schedules, and weather conditions, with vehicle telemetry to help optimize fleet operations. By leveraging state-of-the-art AI and video analytics technologies on the latest Intel® processors and GPUs, Smart Fleet Solutions offer a transformative approach to fleet management, driving operational excellence and ensuring passenger safety across urban environments.

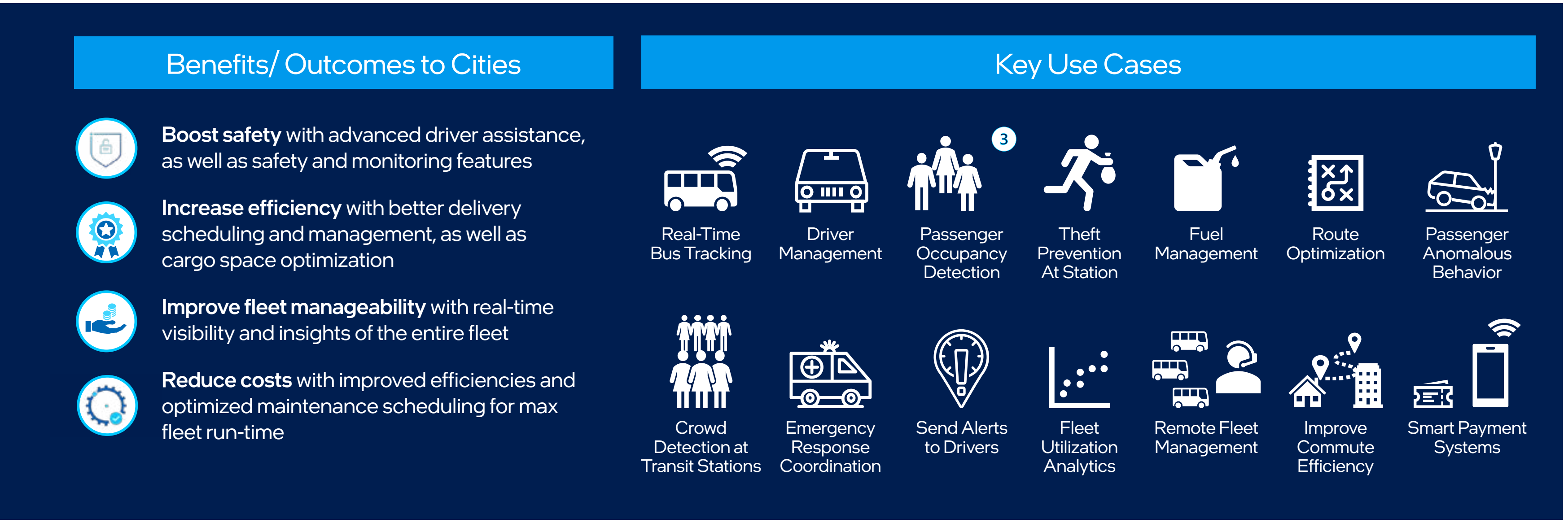


Figure 2. Leveraging Edge AI and Video Analytics for Real-Time Use Cases and Outcomes

3. System Architecture

As cities move toward autonomous driving, traditional transit technologies may struggle to address critical use cases such as passenger safety, operational efficiency, and congestion management. Growing concerns over transit reliability and road congestion highlight the need for intelligent, adaptive transportation solutions. While current systems employ cameras primarily for surveillance, and technologies like lidar and radar are used independently, Smart Fleet Solutions demonstrate how Intel's Edge AI technology can combine these disparate deployments to enhance existing transit infrastructure. By providing capabilities like camera technology and sensor fusion, these solutions enable workload consolidation, which is essential for building public transportation systems of the future. This foundational approach gathers necessary data to develop advanced applications, such as generative AI-based video analytics.

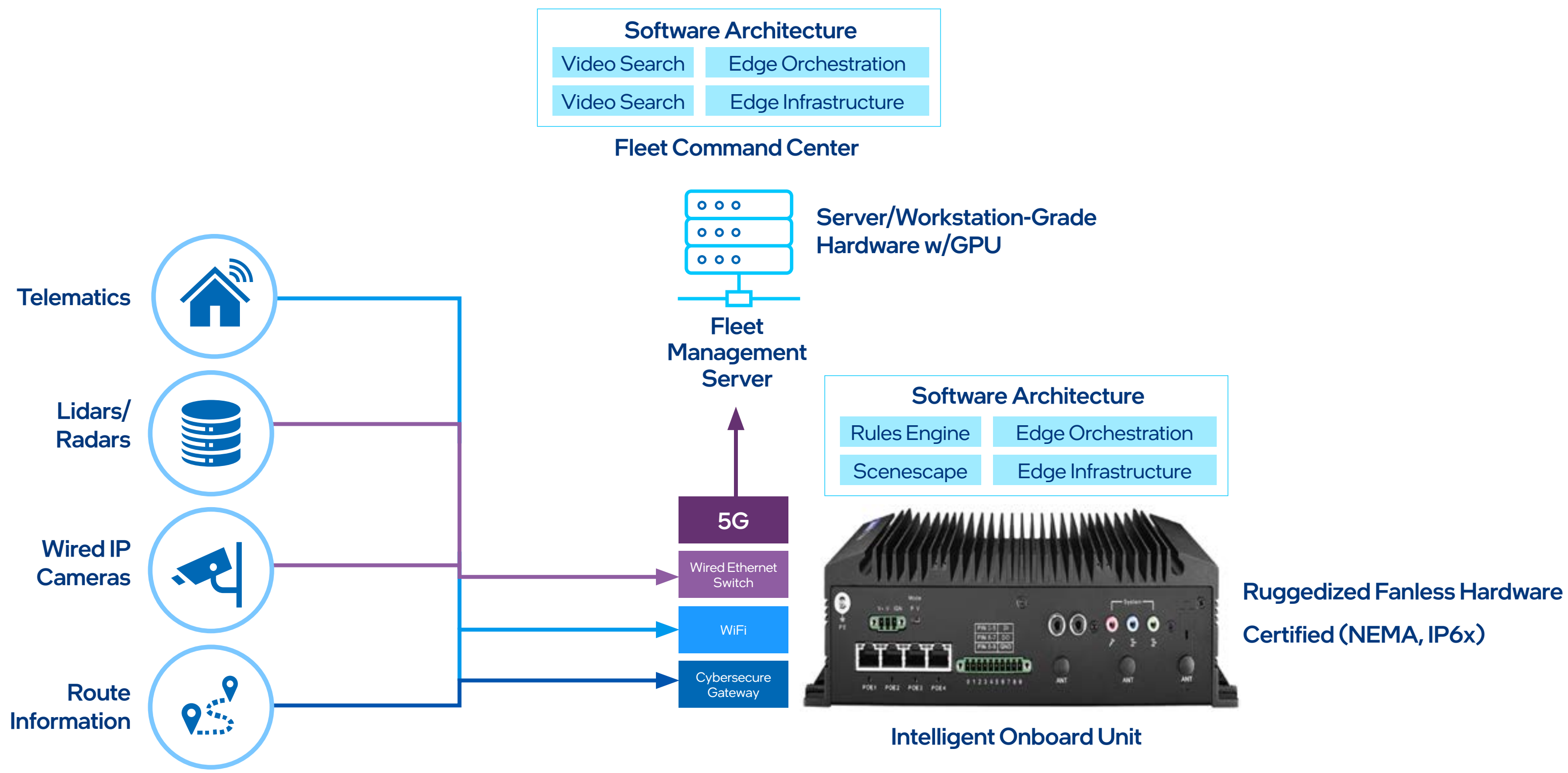


Figure 3. Smart Fleet Solutions Edge AI System Architecture

The Smart Fleet Solution Blueprint illustrates a reference architecture to meet these needs, composed of two key components:

- **Intelligent Onboard Unit:** A ruggedized, fanless hardware platform deployed on buses for real-time sensing and data collection.
  - **Processor Class:** Intel® Core™ Ultra, Intel® Core™, or Intel Atom® processors
  - **Peripherals:**
    - Ethernet switch for camera and GPS inputs
    - Wi-Fi controller for wireless IoT sensors
    - Cybersecurity gateway for secure communication with Fleet Management Servers
    - 5G modem for dedicated management and data backhaul to data center or cloud (optional if fiber backhaul is available)
  - **Operating Temperature Range:** -20 °C to 74 °C
  - **Software:**
    - Scene analytics software for vision-based AI and spatial awareness from sensor data (Intel® SceneScape).
    - Rules engine for specifying incident detection criteria.
    - Edge infrastructure software including operating system and various infrastructure services for security and telemetry.
    - Edge orchestration software including remote device and software management.
- **Fleet Management Server:** A server- or workstation-class hardware platform deployed at transit control centers for near-real-time analytics and summarization of historical sensor data.
  - **Processor Class:** Intel® Xeon® or Intel® Core™ Ultra processor.
  - **Peripherals:**
    - Intel® Arc™ GPU for generative AI video search and summarization.
  - **Operating Temperature Range:** 18 °C to 27 °C
  - **Software:**
    - Video Management System (VMS) for storing raw videos.
    - Event monitor/rules engine to monitor events generated by scene analytics and extract video clips from video storage.
    - Vector database for storing embeddings from processed video clips.
    - Natural language search and summarization service based on vision language models (VLMs).

Operational Flow:

1. Real-Time Streaming Protocol (RTSP) video feeds are sent to the Video Management System (VMS) and a scene analytics system like Intel® SceneScape.
2. Scene analytics systems analyze frames and create rich metadata for each object, including timestamps, geo coordinates, spatial coordinates, speed, heading and object attributes. Additional attributes like license plate, make and model may be included. Events are generated when objects enter regions of interest.
3. Continuous event monitor/rules engine subscribes to event topics, extracts timestamps and uses them to retrieve clips from the VMS.
4. Vision language models like CLIP or BLIP extract vectors from video clips as they are received in near-real time.
5. Vectors are stored in an in-memory vector database like Intel's Visual Data Management System (VDMS).
6. Users can perform natural language queries to search for specific instances.
7. Natural language queries are converted into vectors using CLIP or BLIP.
8. These vectors are matched against those in the VDMS to retrieve associated videos. Queries can be set as rules to trigger alerts when new events occur.

By leveraging Intel's advanced edge AI technologies, Smart Fleet Solutions enable a transformative approach to bus transit management, enhancing safety, efficiency and passenger experience in modern urban environments.

4. Platform Recommendation Guide

4.1 Platform Sizing Methodology

The hardware platform sizing is derived by benchmarking various target silicon platforms with specific end-to-end video/AI pipelines. Each pipeline (see Figure 4 below) is composed of the following components:

- Decode for incoming encoded video streams.
- Pre-processing (color conversion, resize, precision conversion).
- AI-based detection of specific objects.
- AI-based classification of detected objects.
- Optional transcode and display.
- Delivery to storage, stream out or download.

Pipelines are created using Intel® Deep Learning Streamer (Intel® DL Streamer) and consistently executed on different platforms. Performance measurements are captured to derive the platform sizing to match the use case.

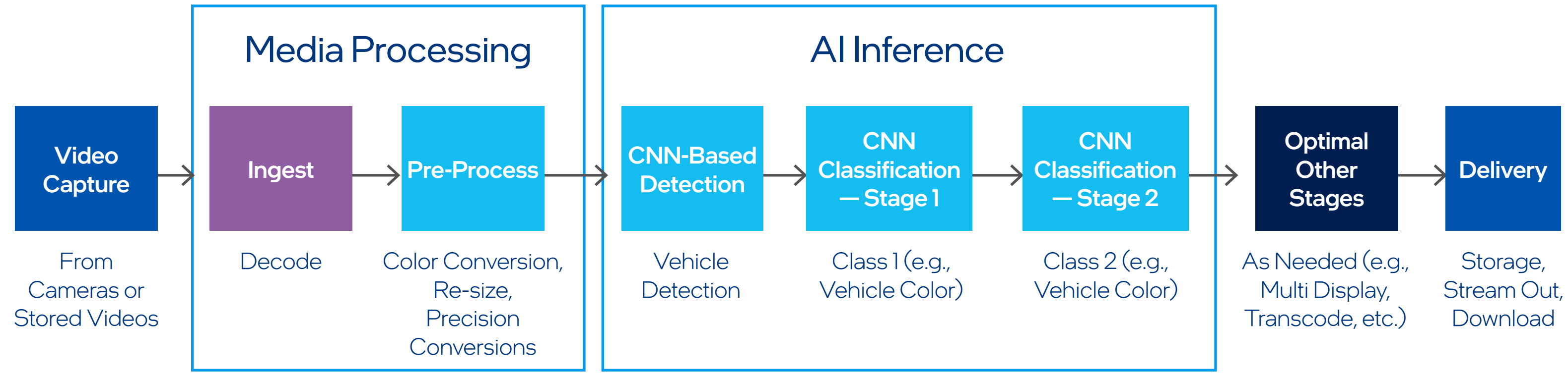


Figure 4: End-to-End Video Processing and AI Pipeline

4.2 Platform Sizing Guide

Selecting the right hardware for the Smart Fleet Solution Blueprint hinges on matching the processing power to the demands of each deployment scenario. The blueprint organizes systems into three distinct tiers — Entry, Mainstream, and Performance — each tailored to handle specific workloads, from lightweight monitoring to heavy-duty AI-driven analytics. These tiers account for variables like types of use cases, camera counts, frames per second (fps), end-to-end AI inference, video processing pipeline, and workload requirements.

Figures 5 and 6 below outline each tier's specifications, providing a clear guide for engineers and planners to align hardware with operational needs. Contact us for specific business application needs.

Platform Sizing Guide for Intelligent Onboard Unit

Entry	Mainstream	Performance
Use Case: Onboard passenger counting, low AI density fleet applications	**Use Case:** Occupancy detection, seat availability, medium AI density fleet applications	**Use Case:** Driver behavior monitoring, passenger anomalous behavior insight system, heavy AI density fleet applications
Video Requirements: 1-4 cameras, ~12 fps, low performance, low accuracy	**Video Requirements:** 4-8 cameras, ~20-30 fps, low to medium performance, medium accuracy	**Video Requirements:** 8+ cameras, ~20-30 fps, mid-high performance, high accuracy
Workload: **Detect:** Detect passengers	**Workload:** **Detect-Track-Detect-Classify:** Detect crowd-track passenger flow	**Workload: Detect-Track-Classify-Detect-Classify:** Detect crowd, classify anomalous expression, detect and classify theft or fall, detect and classify driver expressions
Platforms Used: Intel Atom® Processor X Series	**Platforms Used:** Intel® Core™ Ultra Series 3 processor (4xe)	**Platforms Used:** Intel® Core™ Ultra Series 3 processor (12xe)

Figure 5: Platform Sizing Guide for Intelligent Onboard Unit

Platform Sizing Guide for Fleet Management Server

Entry	Mainstream	Performance
Use Case: Video search and summarization with light vision AI compute at edge	**Use Case:** Video search and summarization with medium vision AI compute at edge	**Use Case:** Video search and summarization with advanced vision AI compute at edge
Video Requirements: Crowd detection at transit station onprem, with onboard occupancy detection, bus schedules, route traffic and weather analysis on cloud (hybrid architecture)	**Video Requirements:** Crowd detection at transit station and onboard occupancy detection on-prem, with bus schedules, route traffic and weather analysis on cloud (hybrid architecture)	**Video Requirements:** Crowd detection at transit station and onboard occupancy detection, bus schedules, route traffic and weather analysis on-prem
Workload: 150M parameter VLM for simple video search by text: CLIP (OpenAI)	**Workload:** 3B parameters VLM for advanced video search by text: PaliGemma 3B (Google)	**Workload:** 12B parameter VLM for more advanced video search by text: Pixtral-12B (Mistral)
Platforms Used: Intel Xeon SP Processors + 2 GPUs	**Platforms Used:** Intel Xeon SP Processors + 4 GPUs	**Platforms Used:** Intel Xeon SP Processors + 6 GPUs

Figure 6: Platform Sizing Guide for Fleet Management Server

4.3 Certification Requirements Guide

Intelligent Onboard Units (OBUs) are designed to function in challenging environments, such as extreme vehicle vibration, high temperature and similar rugged conditions, making adherence to industry standards critical. These units must withstand years of exposure while consistently maintaining uptime, complying with safety regulations and ensuring seamless interoperability with other systems. The rigorous standards governing OBUs specify their purpose, application and testing criteria, providing deployment teams with a comprehensive framework to certify these units for long-term reliability. By meeting these stringent requirements, OBUs ensure robust performance and reliability, contributing to safer and more efficient public transportation systems.

Table 1. Smart OBU Certification Guide

Category	Certification	Purpose
Systems Safety and Functional Certifications	IP66, IP67	Essential for smart OBUs as they ensure protection against dust and water ingress, allowing the units to operate reliably in harsh outdoor conditions, including heavy rain and temporary submersion.
	IP40	To ensure protection against solid objects larger than 1mm, ensuring basic protection from dust and small particles in harsh environments.
Interoperability Standards	ITxPT certification	Ensures hardware in public transport meets interoperability and ITxPT standardization requirements to facilitate seamless integration and communication between different systems in fleet. It defines requirements for devices to be compliant with their architecture for onboard units.

4.4 AI Cybersecurity Technologies

Intel technologies strengthen AI cybersecurity across the Smart Fleet Solution platform roadmap, enabling cyber threat analysis and mitigation for distributed edge deployments.

4.4.1 Threat Analysis

The Smart Fleet Solution (SFS) represents a digital infrastructure that leverages edge computing and AI inferencing to optimize fleet operations and bolster public safety.[3] Typically, it has a distributed edge deployment composed of multiple interconnected elements, as illustrated in Figure 7. This type of deployment with data and AI workloads across multiple edge platforms introduces cybersecurity vulnerabilities, underscoring the need for robust AI cybersecurity strategies for Edge AI applications to ensure its integrity and operational reliability. Examples of threats include:

- The integrity of data sources, including camera and sensor feeds, can be compromised through unauthorized alterations.[4]
- Edge systems, such as the Intelligent Onboard Unit or Fleet Management Server, are vulnerable to denial-of-service or ransomware attacks, which can disrupt the reception of traffic data feeds.
- Passengers and transit station users' information is at risk of unauthorized modifications for malicious purposes, as well as privacy compromises.
- Actionable insights derived from data analytics can be subject to tampering, affecting decision-making processes.
- The AI model operating within the edge device, responsible for processing video feeds, may be susceptible to compromise, potentially leading to inaccurate analytics, which can lead to undesirable actions.

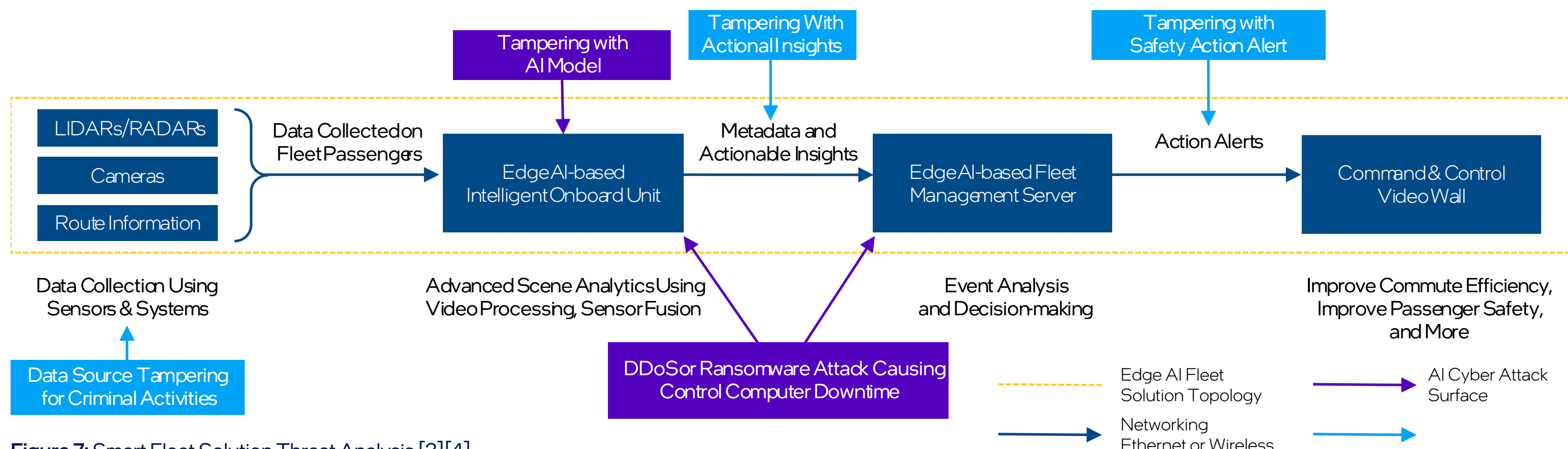


Figure 7: Smart Fleet Solution Threat Analysis [3][4]

4.4.2 Intel® Cybersecurity Technologies Across the Smart Fleet Infrastructure Platform

Based on the Platform Sizing Guide (Section 4.2) for this blueprint, this section outlines Intel technologies that enable AI cybersecurity within this platform roadmap.

Processor Family	Processor Model Formerly Known as	APICv	Intel® AES-NI	Intel® BIOS Guard	Intel® Boot Guard	Intel® CET	Intel® OS Guard	Intel® PFR	Intel® PTT	Intel® QAT	Intel® Secure Key	Intel® SHA Extensions	Intel® SGX	Intel® TME	Intel® TDX	Intel® TDX Connect	Intel® TXT	Intel® VT	Intel® VT-RP	LASS	MPK	MBEC	SM3 / SM4	SRIOV	UMIP
Intel® Xeon® Scalable Processors	Sapphire Rapids SP								dTPM	Integrated					CSP									LAN	
	Emerald Rapids SP								dTPM	Integrated														LAN	
	Granite Rapids SP								dTPM	Integrated														LAN	

Figure 8: Security Features Across Intel® Xeon® SP Platforms in Smart Fleet Solution

- Plan of Record (POR)
- Planned
- Unavailable

dTPM: For Intel Xeon-based platforms, there is no support for integrated TPM; use discrete TPM instead.
CSP: In Sapphire Rapids SP, Intel® Trust Domain Extensions (TDX) is available only via cloud service provider offerings, not supported for edge deployments.
LAN: SR-IOV support for select Intel® Ethernet products.

		Crypto Optimization and Acceleration					Platform Trust and Integrity					Workload and Data Protection								Software Hardening					
Processor Family	Processor Model Formerly Known as	Intel® AES-NI	Intel® SHA Extensions	Intel® Secure Key	SM3/SM4	Intel® QAT	Intel® BIOS Guard	Intel® Boot Guard	Intel® PFR	Intel® PTT	Intel® TXT	Intel® VT	Intel ®VT-RP	SRIOV	APICv	Intel® TME	Intel® SGX	Intel® TDX	Intel® TDX Connect	Intel® CET	LASS	MBEC	MPK	Intel® OS Guard	UMIP
Intel® Core™ Processors	Alder Lake	POR	POR	POR	POR	Unavailable	POR	POR	Unavailable	POR	Intel® vPro	POR	Intel® vPro	iGPU		Intel® vPro	Unavailable	Unavailable	Unavailable	Intel® vPro	POR	POR	POR	POR	
	Raptor Lake	POR	POR	POR	POR	Unavailable	POR	POR	Unavailable	POR	Intel® vPro	POR	Intel® vPro	iGPU		Intel® vPro	Unavailable	Unavailable	Unavailable	Intel® vPro	POR	POR	POR	POR	
	Meteor Lake	POR	POR	POR	POR	Unavailable	POR	POR	Unavailable	POR	Intel® vPro	POR	Intel® vPro	iGPU		Intel® vPro	Unavailable	Unavailable	Unavailable	Intel® vPro	POR	POR	POR	POR	
	Arrow Lake	POR	POR	POR	POR	Unavailable	POR	POR	Unavailable	POR	Intel® vPro	POR	Intel® vPro	iGPU		Intel® vPro	Unavailable	Unavailable	Unavailable	Intel® vPro	POR	POR	POR	POR	

Figure 9: Security Features Across Intel® Core™ and Intel® Core™ Ultra Platforms in Smart Fleet Solution

Plan of Record (POR)
Planned
Unavailable

GFX: SR-IOV support for integrated GPUs.

Processor Family	Processor Model Formerly Known as	APICv	Intel® AES-NI	Intel® BIOS Guard	Intel® Boot Guard	Intel® CET	Intel® OS Guard	Intel® PFR	Intel® PTT	Intel® QAT	Intel® Secure Key	Intel® SHA Extensions	Intel® SGX	Intel® TME	Intel® TDX	Intel® TXT	Intel® VT	Intel® VT-RP	LASS	MPK	MBEC	SM3 / SM4	SRIOV	UMIP
Intel Atom® Processors	Elkhart Lake		POR	POR	POR		POR	Unavailable	BOTH	Unavailable	POR	POR	Unavailable	Unavailable	Unavailable	Unavailable	POR		Unavailable	Unavailable	POR	POR	Unavailable	
	Amston Lake		POR	POR	POR		POR	Unavailable	BOTH	Unavailable	POR	POR	Unavailable	Unavailable	Unavailable	Unavailable	POR		POR	POR	POR	POR	GFX	

Figure 10: Security Features Across Intel Atom® Platforms in Smart Fleet Solution

- Plan of Record (POR)
- Planned
- Unavailable

GFX: SR-IOV support for integrated GPUs. BOTH: Integrated TPM and discrete TPM supported.

4.4.3 Cyber Threats Mitigation Leveraging Intel® Cybersecurity Technologies

This section revisits the threats identified in the Smart Fleet Solution use case threat analysis (Section 4.6.1) and examines the potential AI cybersecurity attacks each threat may lead to. Further, it highlights how these threats intersect with the use case outlined in Section 4.6.1. Finally, we describe mitigation mechanisms and showcase Intel security technologies that can help prevent the listed attacks.

There are five categories identified for AI cybersecurity threats: data tampering and poisoning (for data both at rest and in transit), attacks on AI models, distributed denial of service (DDoS) attacks, privacy and data breaches and vulnerabilities in multi-tenant Edge AI workloads within shared edge environments.

The table below outlines the five categories of AI cybersecurity threats, provides a breakdown of the specific attacks we identified within each category and maps them to the use case (described in Section 4.6.1). It also presents mitigation strategies and the corresponding Intel security technologies.

AI Cybersecurity Threat/Attack Types		Mitigation/Prevention	Intel® Security Technologies
Data Tampering & Poisoning (data in transit/ at rest)	Input data for AI algorithms Metadata and insights Action alerts data	Encryption	Intel® AES-NI Intel® Secure Key Intel® PTT Intel® QAT
Attacks on AI Models	Modifying input data to AI models (Evasion)	Memory Encryption	Intel® TME
	Altering AI models	AI Model Integrity Protection through Hashing	Intel® SHA MPK
	AI Control flow hijacking	AI Runtime Integrity Protection through Memory Corruption Resilience	Intel® CET MPK
DDoS	Overconsume resources (CPU/ GPU/NPU/Memory)	Hypervisor Protection	Intel® TDX Intel® VT & Intel® VT-d MBEC
	Overwhelm AI algorithms	Protected Execution	Intel® TXT SR-IOV
	Data flood mimicking collected data	Data Integrity Verification	Intel® TXT Intel® PTT
Vulnerabilities in Multi-Tenant Edge AI Workloads within Shared Edge Environments	AI algorithm theft Data privacy compromise Resources contention	Workload Isolation Resources Isolation Memory Access Protection Secure and Isolated I/O Access	SR-IOV for Network Cards & GPUs Intel® TDX Intel® VT & Intel® VT-d Intel® SGX Intel® TME MPK MBEC

Table 2: Cyber Threat Types and Mitigation Using Intel® Cybersecurity Technologies

5. Software Development Kits & Tools

This section presents a collection of software development tools and reference software from Metro AI Suite, a part of Intel's Edge AI Portfolio, intended to support various stages of the design and development process for fleet management solutions. These royalty-free, modular software packages let developers choose the tools that best fit their specific project needs.

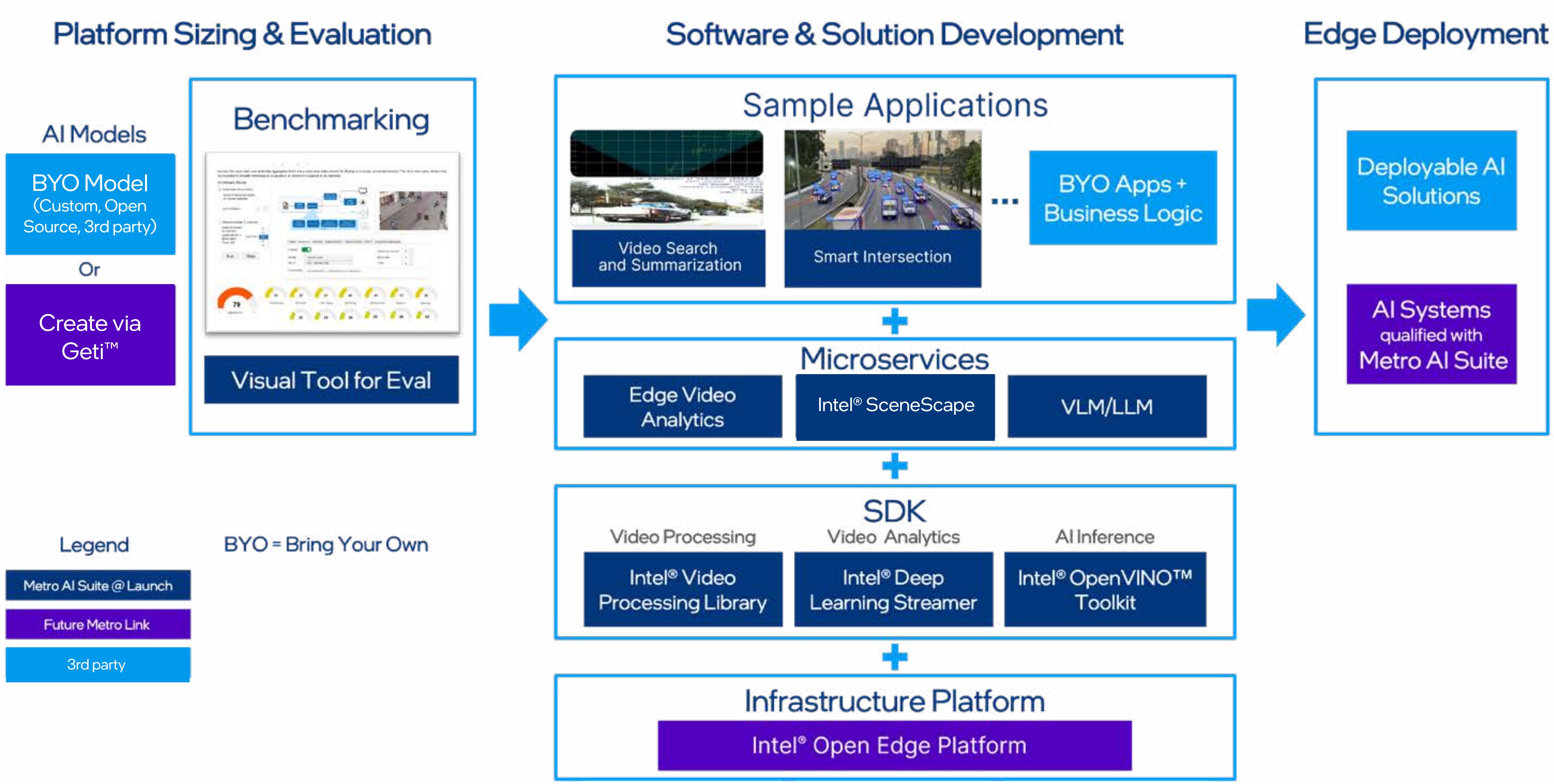
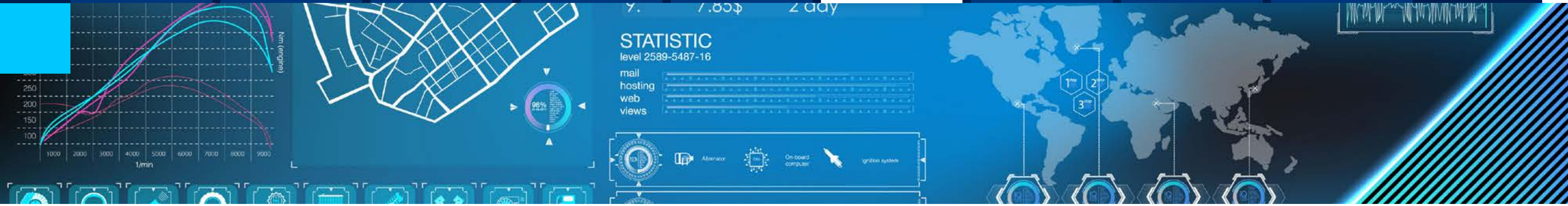


Figure 11. Metro AI Suite Software Development Kits & Visual AI Tools



5.1 Software Development Kit (SDK)

The SDK is a comprehensive and modular toolkit for accelerated media processing and AI inference, designed to fast-track the development of visual AI solutions. It enables simple installation of Linux, kernel, graphics, Intel® Video Processing Library (Intel® VPL), Intel® OpenVINO™ toolkit, Intel® DL Streamer, etc., for quick and easy design and development of media and AI-based solutions at the Edge. Learn more about Metro AI Suite Software Development Kit and its component functionalities:

1. **Intel VPL** is a cross-platform library that offers a unified API for accessing hardware-accelerated video decoding, encoding, and processing capabilities. It is designed to streamline video processing tasks across various Intel hardware architectures, enabling developers to achieve high performance and scalability in applications such as network video recorder, multi-view display, video capture and streaming, media codec and more.

2. **Intel OpenVINO** is a toolkit that accelerates the development and deployment of computer vision applications by optimizing deep learning models for various Intel hardware, ensuring high performance and efficiency. It is particularly beneficial for visual AI-based Intelligent Onboard Unit (OBU) applications, enabling real-time processing of visual data with low latency, ideal for enhancing safety and traffic management in smart transportation systems.

3. **Intel DL Streamer** is a framework that integrates with GStreamer to enable efficient deployment of deep learning inference pipelines for video analytics, leveraging Intel's hardware acceleration. It is ideal for visual AI-based Intelligent Onboard Unit (OBU) applications, as it facilitates real-time video processing for tasks like fleet monitoring and object detection, enhancing safety and fleet management with low latency.

5.2 Benchmarking Tool

Visual Pipeline and Platform Evaluation Tool (ViPPET) is an AI benchmarking tool that enhances both developer and user experiences through its web-based interface. It offers two main functions: Visual Pipeline Prototyping, which provides customizable end-to-end AI and video processing proxy pipelines, and Platform Evaluation, which benchmarks visual AI and media performance on Edge-AI-qualified hardware. This tool helps in sizing AI platforms for specific pipelines and understanding CPU and GPU utilization, assisting decision-makers and developers in determining if an Intel platform suits their visual analytics needs. Ultimately, it enables TCO optimization by guiding the selection of the recommended Intel powered hardware that leverages heterogeneous computing across CPU, iGPU, dGPU, and NPU. Learn more about ViPPET.

5.3 Scene Analytics Tool

Intel SceneScape is a microservice framework that streamlines advanced visual data processing and scene analysis. It offers scalable tools for interpreting complex visual environments, ideal for smart fleets and AI-driven solutions. Utilizing Intel's hardware and software, Intel SceneScape delivers real-time insights and analytics, boosting the performance of visual data applications.

Learn more about Intel SceneScape.

5.4 AI Model Training Tool

Geti™ is a versatile AI platform designed to simplify the development and deployment of computer vision models for technical system integrators and end customer ecosystem. It offers intuitive tools for data annotation, model training, and optimization, enabling seamless integration with existing systems. Leveraging Intel's robust hardware and software capabilities, Geti™ ensures efficient and scalable AI solutions, empowering system integrators to deliver customized applications that enhance operational insights and decision-making for end customers.

Learn more about Geti.

6. Commercial Solutions Catalog

6.1 Hardware Platforms

Table 3. Intel-Powered Partner Hardware Platforms

Product Dimension	Hardware Partner	Product	Details
Mainstream	Axiomtek	UST520	▪ LGA1700 14th/13th/12th Gen Intel® Core™ i9/i7/i5/i3 or Celeron® processor (up to 65W) with Intel® R680E ▪ Fanless and wide operating temperatures from -40°C to +70°C
Mainstream	Aaeon	VPC-5640S	▪ 12th Gen Intel® Core™ i7 Processor ▪ -40°C ~ 70°C Operating Temperature
Performance	OnLogic	Karbon 523	▪ Intel Core Ultra Series 1 & 2 (Meteor and Arrow Lake) ▪ -40°C to 70°C operating temp

7. Video:

AI Cybersecurity for Transportation ›

8. Appendix

8.1 Glossary

Term	Definition
Intel® Arc™ GPU	Intel's discrete graphics processing unit, such as the Intel® Arc™ A770, engineered for high-performance video analytics and AI workloads.
Intel® Deep Learning Streamer (Intel® DL Streamer)	Intel's open-source framework built on GStreamer, optimized for constructing real-time video analytics pipelines with hardware acceleration on Intel platforms, supporting multi-stream processing.
Edge Computing	A distributed computing architecture that processes data at or near its source such as OBUs minimizing latency and reducing reliance on centralized servers for time-sensitive tasks.
H.265 (HEVC)	High-Efficiency Video Coding, a compression rate delivering 1080p video at half the bitrate of H.264 (e.g., 2 Mbps at 30 fps) while preserving visual quality, widely adopted in ITS applications.
Inference Rate	The frequency of artificial intelligence model predictions per second.
Intelligent Onboard Units	Intelligent Onboard Units (OBUs) leverage AI-driven edge intelligence to manage data processing onboard and at transit stations.
IP66/67	Ingress Protection ratings per IEC 605529. IP66 ensures dust-tight enclosures and resistance to powerful water jets (100L/min); IP67 extends protection to 1-meter submersion for 30 minutes.
Metro AI Suite	Intel's end-to-end toolkit for developing, deploying, and managing AI applications across edge and server platforms, featuring prebuilt modules and workflows.
NEMA	National Electrical Manufacturers Association's (NEMA) standard for enclosure, providing weather and corrosion resistance, validated by tests such as 200 hours of exposure to salt spray.
NLP Search	Natural Language Processing functionality enabling text-based queries of video data powered by advanced Vision Language Models in the Smart Fleet Solution.
OpenVINO™	Intel's open-source toolkit for optimizing deep learning models like Yolo-V5S and ResNet-50, reducing latency on Intel hardware platforms.
Sensor Fusion	The integration of data from multiple sensors (cameras, radar, lidar) into a cohesive environmental model, improving accuracy and reliability.
SFS	Smart Fleet Solution
Traffic Command Center (TCC)	A centralized hub aggregating OBU data, analyzing traffic patterns, and coordinating responses across a region, typically equipped with high-performance servers and visualization tools.
Vector Database	A specialized database (e.g., Pinecone) that stores processed video clips as vectors, enabling efficient indexing and retrieval for AI-driven searches within large datasets.
VLM	Vision Language Model
V2X Communication	Vehicle-to-Everything protocols (e.g., C-V2X, DSRC), facilitating data exchange between vehicles, OBUs, and infrastructure, enhancing coordination in real time.
Yolo-V5S	A lightweight version of the You Only Look Once (v5) object detect model, optimized for edge devices, processing images at 640x640 resolution with INT8 precision.

8.2 List of Figures

8.3 List of Tables

8.4 References

Citation	Description
1	Future Market Insights, Inc. Smart Fleet Management Market Size and Share Forecast Outlook 2025 to 2035.
2	Harbor Market Research. Smart Systems Market Insight: The Future of Data in Smart Cities. 2023
3	Steve Wilson, Contrast Security. Cybersecurity and Artificial Intelligence: Threats and Opportunities. 2023.
4	United States Cybersecurity Magazine. Flashing Red Lights: Cybersecurity for Intelligent Transportation Systems. Winter, 2024.

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