VOLUNTARY SAFETY SELF-ASSESSMENT

BOT AUTO

AUTOMATED DRIVING SYSTEM

"Safety isn't a feature—it's our foundation. And on this foundation, we're building the operational reality of autonomous trucking."

Dr. Xiaodi Hou, Founder and CEO

This Voluntary Safety Self-Assessment reflects Bot Auto's commitment to transparency, public trust, and continuous proactive safety practices as we drive innovation in high automation commercial freight.

OVERVIEW

This Voluntary Safety Self-Assessment (VSSA) outlines Bot Auto's approach to the safe development, testing, and deployment of our Level 4 autonomous trucking systems.

Bot Auto's Level 4 trucks are designed to operate without human intervention within defined operational design domains (ODDs), which include specific roadways, weather conditions, and operational factors. We leverage a safety-first engineering philosophy that spans every layer of our autonomous stack—from perception and planning to redundancy and real-time monitoring. Our development and validation process integrates rigorous simulation, closed-track testing, and controlled on-road operations under safety driver supervision

In alignment with the U.S. Department of Transportation's Automated Driving Systems 2.0 and subsequent guidance, this VSSA addresses key safety elements such as system safety, object and event detection and response (OEDR), fallback behavior, vehicle cybersecurity, and compliance with applicable laws. Each element is presented through the lens of our technical architecture, operational safeguards, and system validation strategy.

We believe that a voluntary, transparent safety dialogue supports not just innovation but public understanding and stakeholder collaboration. Bot Auto's VSSA affirms our readiness to work with regulators, partners, and communities as we responsibly bring Level 4 autonomous trucking to market.

We have developed a comprehensive safety framework that addresses both the technical challenges of autonomous vehicle development and the broader societal responsibilities that come with deploying this transformative technology.

From Our Founder

The Bot Auto Commitment

At Bot Auto, we believe that true innovation in autonomous trucking isn't just about the technology we build, it is about the responsibility we carry.

While many in this industry focus on the next "demo" or technical milestone, we have a different mandate. Bot Auto is a transportation provider. Our customers rely on us to move the goods that fuel the economy, and the public relies on us to do so with an uncompromising commitment to safety.

Our comprehensive safety framework is designed to go beyond preventing accidents; it is built to earn and maintain the public trust necessary for this technology to reach its full potential. We bridge the gap between visionary engineering and practical, everyday reliability. We are ensuring that every mile we drive is a mile driven with purpose.

We aren't just building autonomous trucks—we are laying the foundation for a safer, more efficient, and more trustworthy transportation future.

Dr. Xiaodi Hou

Founder and Chief Executive Officer

Table of Contents

SAFETY IS OUR FOUNDATION

We've developed a multi-layered safety architecture that combines transparent validation, practical innovation, and efficient operations to create a system that earns trust through demonstrated performance, not promises.

The Bot Auto Safety Philosophy

Safety at Bot Auto operates on three fundamental principles:

1. **System Safety by Design:** Our trucks utilize a suite of LiDAR, radar, and cameras to ensure comprehensive environmental perception. This is backed by a fully redundant architecture where every essential system—including braking, steering, power, and computing—is mirrored to eliminate single points of failure.
2. **Continuous Validation:** Our data-driven approach means every mile driven feeds back into our safety systems, creating an ever-improving cycle of operational excellence. This isn't about perfection on day one—it's about systematic, transparent improvement that stakeholders can see and measure.
3. **Operational Transparency:** Our operations are built on a foundation of transparency, from sharing our rigorous pre-departure safety protocols with first responders to maintaining real-time system health monitoring. We don't just claim to be safe; we provide the visibility to prove it, ensuring our customers and the communities we serve have full confidence in every mile we drive.

Safety Through Efficiency

Our disciplined, iterative approach to development is a deliberate safety strategy. By prioritizing practical, high-impact improvements over speculative "moonshot" projects, Bot Auto achieves a level of operational precision that directly enhances public safety:

- Accelerated validation cycles: Our agile development model enables faster safety feedback loops, allowing us to identify, validate, and mitigate potential risks with greater speed and accuracy.
- Operational Control: Through our Transportation-as-a-Service (TaaS) model, we maintain total oversight of the vehicle's lifecycle. By eliminating third-party implementation gaps, we ensure our rigorous safety standards are never compromised.
- Sustainable Safety Investment: Our focus on capital efficiency ensures a clear path to profitability that preserves rather than pressures our long-term investments in safety-critical systems.

Technical Excellence Through Practical Innovation

Our development philosophy leverages foundation models trained on vast amounts of diverse data, but always with a deterministic approach that ensures consistent, predictable behavior that is crucial for safety-critical applications. This combination allows us to:

- Handle diverse scenarios with proven reliability.
- Maintain rigorous testing and validation in advanced simulation environments.
- Implement continuous monitoring and feedback loops.
- Deploy robust security measures against adversarial attacks.

System Reliability in Autonomous Operations

Transitioning to a driverless model requires a system capable of managing the full spectrum of road conditions and emergency responses. Our architecture is engineered to exceed traditional safety benchmarks through:

- Redundant Mission-Critical Systems: A fail-safe design across braking, steering, power, and compute ensures the vehicle maintains a safe state even in the event of a component failure.
- Multi-Modal Sensor Fusion: Integrated LiDAR, radar, and cameras provide a continuous 360-degree safety cocoon, delivering environmental perception that surpasses human visibility.
- Deterministic Decision-Making: Our system operates with constant vigilance, processing data at sub-second speeds without the risks of fatigue, distraction, or human error.
- Dynamic Risk Management: Safety is integrated into every phase of the mission, from rigorous pre-departure diagnostics to real-time, continuous route monitoring.

The Transportation-as-a-Service (TaaS) Model: Safety Through Integrated Operations

Unlike decentralized technology licensing, Bot Auto's Transportation-as-a-Service (TaaS) model integrates hardware, software, and fleet operations into a single safety ecosystem. This approach eliminates the "safety gap" often found between developers and third-party operators.

Direct Operational Accountability

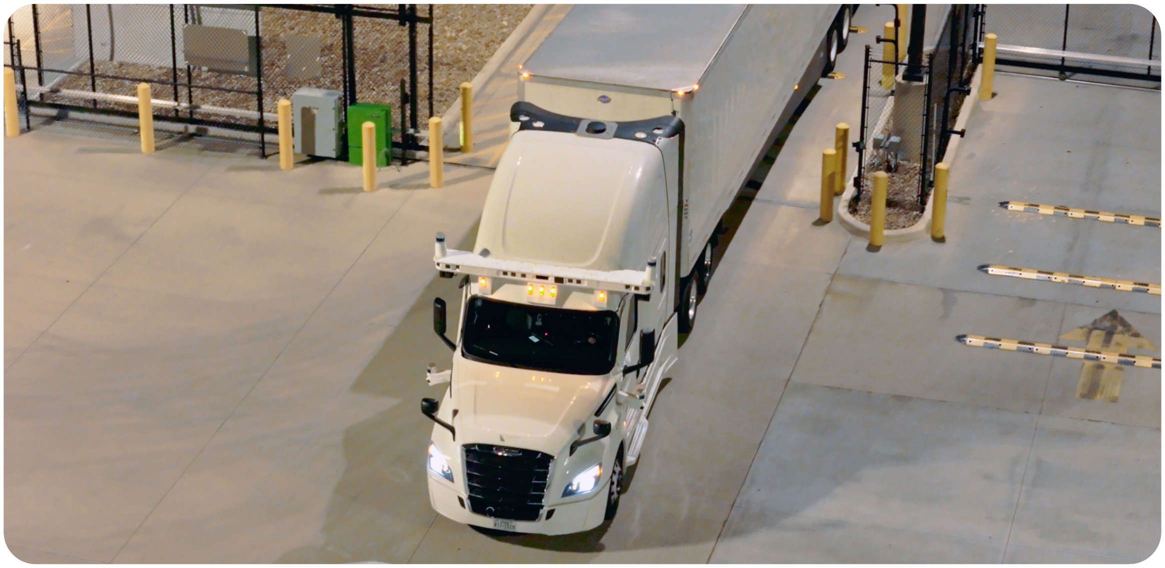
- Unified Safety Protocols: We maintain end-to-end oversight, eliminating handoff risks and ensuring identical safety standards across every vehicle.
- Real-Time Fleet Monitoring: Continuous system-health tracking allows for immediate response and instantaneous, fleet-wide safety updates.

Incentive Alignment

- Performance-Based Safety: Our revenue is tied to the delivery of safe miles, not software seats. This aligns our financial success directly with our safety record.
- Zero-Compromise Standards: By owning the operation, we remove the conflict between an operator's cost-cutting measures and our rigorous safety requirements.

Continuous Operational Intelligence

- Closed-Loop Learning: Every mile driven on our consistent hardware and software stack feeds directly into our validation engine, accelerating our ability to resolve complex edge cases.
- Accelerated ODD Expansion: Unified data collection allows us to expand our Operational Design Domain (ODD) with high-confidence, empirical evidence.



ALIGNMENT TO SAFETY ELEMENTS

This assessment follows USDOT and NHTSA guidelines to ensure all AV 2.0 Safety Elements are addressed. Our reporting is meticulously mapped to these federal standards, reflecting the latest industry methodologies and a modern, disciplined approach to ADS safety.

Automated Driving System (ADS) Safety Elements

- System Safety (Making the Safety Case)
- Operational Design Domain (ODD)
- Object and Event Detection and Response (OEDR) Fallback (Mitigated Risk Condition)
- Validation Methods
- Human Machine Interface
- Vehicle Cybersecurity
- Crashworthiness
- Post-Crash ADS Behavior
- Data Recording
- Consumer Education and Training
- Federal, State, and Local Laws

Our approach is rooted in System Safety, recognizing the complex interdependencies of an ADS platform. We prioritize a structured safety case, breaking down high-level safety claims into verifiable evidence streams. This rigorous argumentation ensures that every technical and operational layer—from hardware redundancy to software validation—works in unison to identify, mitigate, and reduce risk to a minimal level.

SYSTEM SAFETY AND MAKING THE SAFETY CASE

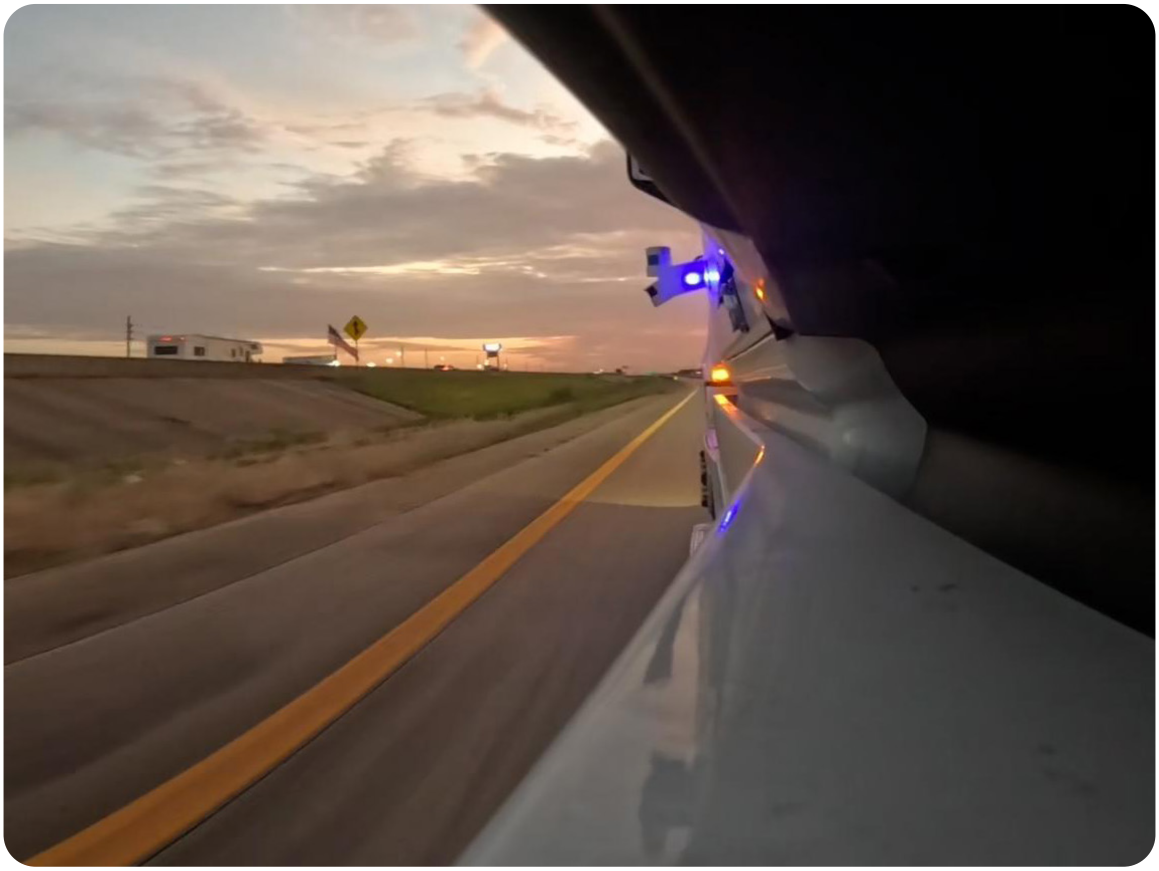
At Bot Auto, we believe that safe and efficient design flows from thoughtful attention to form following intended functions. Safety begins with meticulous integration of the complete 360 degree view of the roadway and environment, key behavioral decisions of the automated driver, and considering all aspects of interactions within the operational envelope.

Comprehensive System Safety Approach

This necessitates a principled approach to design and engineering from the ground up. This also requires rigorous testing of the design as well as validating that the automated truck behaves and reacts in the environment aligned to human driving norms, safe driving rules and practices, as well as interactions with road users encountered.

To ensure progress and continuous improvement, we collect data, monitor performance, and refine the system and supporting operations as the technology evolves.

Through constant attention to and ownership of the enterprise, learning from deploying our vehicles leads to increasing capability, reliability, and safe and secure freight deliveries.



Making the Safety Case

Our Safety Case methodology is the cornerstone of our holistic approach to autonomous truck safety, recognizing it as a compelling and durable framework for demonstrating that our technology is acceptably safe for public road operations.

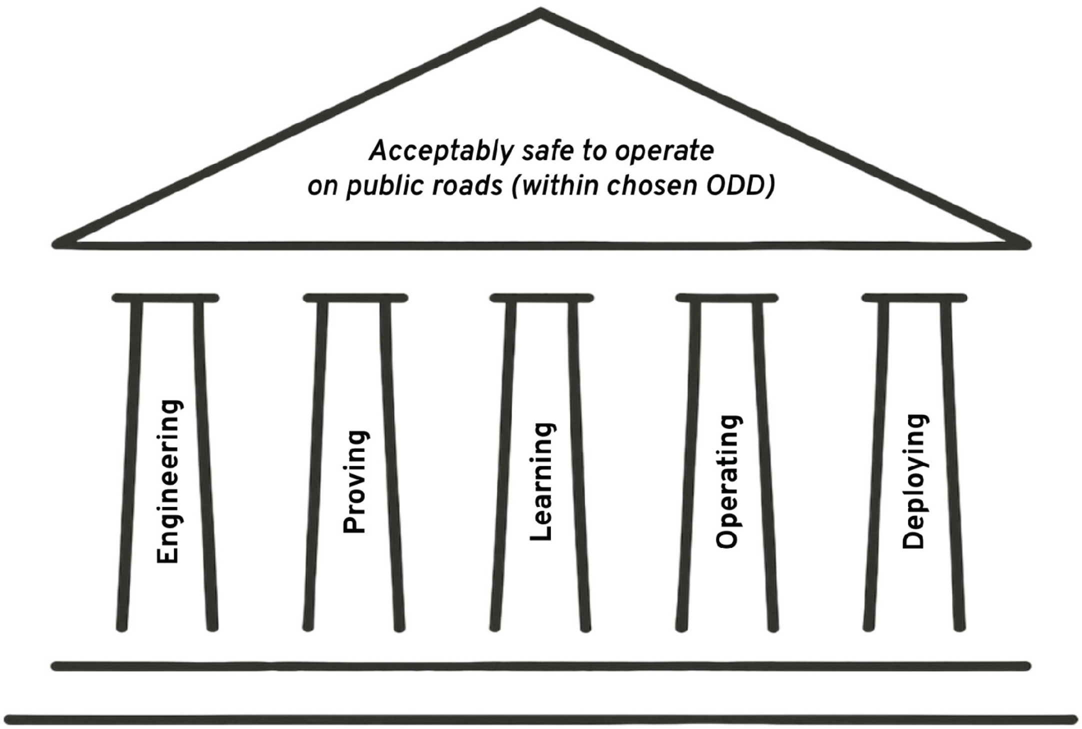


Figure 1: Top safety claims supported by key evidence pillars

Engineering- Functions reliably and safely within its Operational Design Domain without creating unreasonable risk to other road users

Proving- Maintains robust performance in all operating conditions with extensive evaluation of system designs

Learning- Real-time safety assessment and prompt remediation to any potential concerns through comprehensive monitoring

Operating- Identifying appropriate operational controls to address all reasonably foreseeable potential hazards or losses

Deploying- 360 degree safety culture that empowers team members to proactively improve safety daily

A safety case represents far more than traditional compliance documentation; it constitutes a living, structured argument supported by comprehensive evidence that assures our system achieves safe performance within defined operating environments.

Our Safety Case framework draws in basic concepts from use in other safety-critical industries while adapting novel and proven methodologies to the unique challenges of autonomous vehicle deployment. As our operational design domain (ODD) changes, expands and necessary capabilities increase we will revise the safety case and re-evaluate evidence to support the overall claim of safety in all situations.

Safety Lifecycle: Engineering, Validation, and Continuous Learning

Our systematic approach to risk management begins with analysis and risk assessment processes that identify potential safety hazards throughout the entire lifecycle of our autonomous driving system. We employ both traditional system safety methodologies as well as novel approaches to address the full spectrum of potential safety challenges, from random hardware failures (functional safety) to complex scenarios involving artificial intelligence system behavior.

The Safety of the Intended Functionality (SOTIF) methodology is particularly crucial for autonomous driving systems, as it addresses safety challenges that arise not from system malfunctions but from limitations in system performance. Our safety analysis processes systematically examine how our system might behave inappropriately due to performance limitations, environmental conditions beyond our operational design domain, or reasonably foreseeable user interactions. This analysis informs both our system design and our operational constraints, ensuring that identified risks are either eliminated through design or appropriately controlled through operational measures.

Our risk assessment process maps safety analysis to safety requirements development and helps prioritize our engineering efforts. We maintain traceability from requirements to implemented safety measures and validation evidence, ensuring that every identified risk is appropriately addressed.

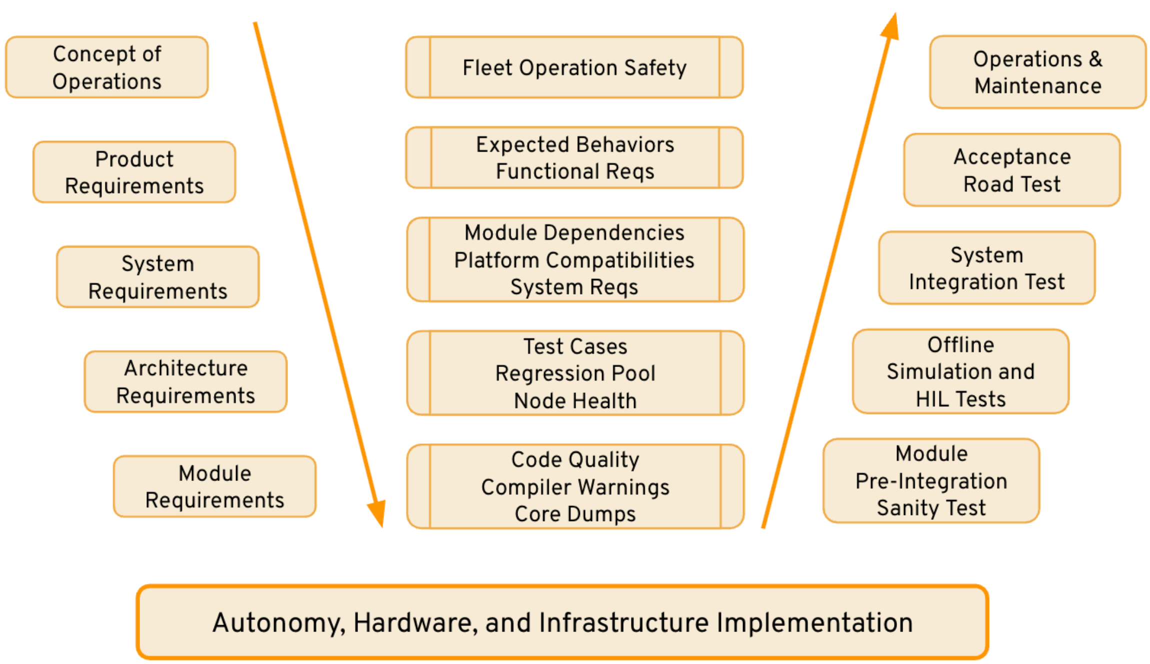


Figure 2: A typical system engineering V-model showing typical validation at software, hardware, vehicle integration, and deployment operational levels

Engineering for Continuous Safety Assurance

Our commitment to safety must extend beyond just automated vehicle design to encompass a comprehensive operational approach based on recognized safety management principles. Bot Auto's Safety Management System (SMS) draws on benchmark quality and operational standards from the automotive and freight industries. This systematic approach ensures that safety considerations are integrated into every aspect of our organization, from high-level strategic decisions to detailed technical implementation.

The leadership structure of our safety organization reflects our commitment to making safety our highest priority. Our Chief Policy Officer reports directly to the CEO and represents an independent reporting chain aligned to all safety-related decisions, ensuring that safety considerations are never compromised by competing business pressures. The Safety Review Board meets regularly to review data-driven safety performance metrics and make critical decisions regarding acceptable risk levels and mitigation strategies.

Deploying with Trust

The foundation of effective safety management lies in establishing and maintaining a strong safety culture that permeates every level of our company.

Leadership commitment to safety extends beyond policy statements to demonstrate consistent prioritization of safety over competing demands, even when such decisions may impact schedule or cost considerations. We maintain open and effective communication channels across all organizational levels, ensuring that safety information flows freely and that all employees understand their roles in maintaining safe operations.

Continuous learning represents a foundational aspect of our safety culture, with systematic processes for capturing lessons learned from both our own operations and industry-wide experiences. We maintain a fair and consistent approach to safety issue resolution, focusing on system improvements and corrective actions. Our work environment is deliberately designed to be safety-conscious, with adequate resources and training provided to support effective safety management at all levels.

OPERATIONAL DESIGN DOMAIN (ODD)

Strategic Approach to ODD Development

The definition and management of our ODD represents one of the most critical aspects of our autonomous vehicle development strategy. Our approach recognizes that the ODD serves not merely as a technical specification but as a fundamental safety boundary that defines the conditions under which our system can operate safely. We have adopted a systematic, evidence-based methodology for ODD development that ensures every expansion of our operational capabilities is supported by comprehensive validation and safety analysis.

The structured nature of highway driving for commercial trucks and limited exposure to access roads provides an ideal foundation for our initial ODD development. Highway environments offer several advantages for autonomous vehicle deployment, including more predictable traffic patterns, reduced interaction with vulnerable road users such as pedestrians and cyclists, and generally more consistent infrastructure characteristics.

Geographically, we operate within pre-mapped highway routes and limited suburban access roads in Texas with testing concentrated in the Texas triangle. These areas have been selected not only for their operational importance but also for their infrastructure quality, including well-maintained roadway surfaces with clear lane markings and functional traffic control devices.

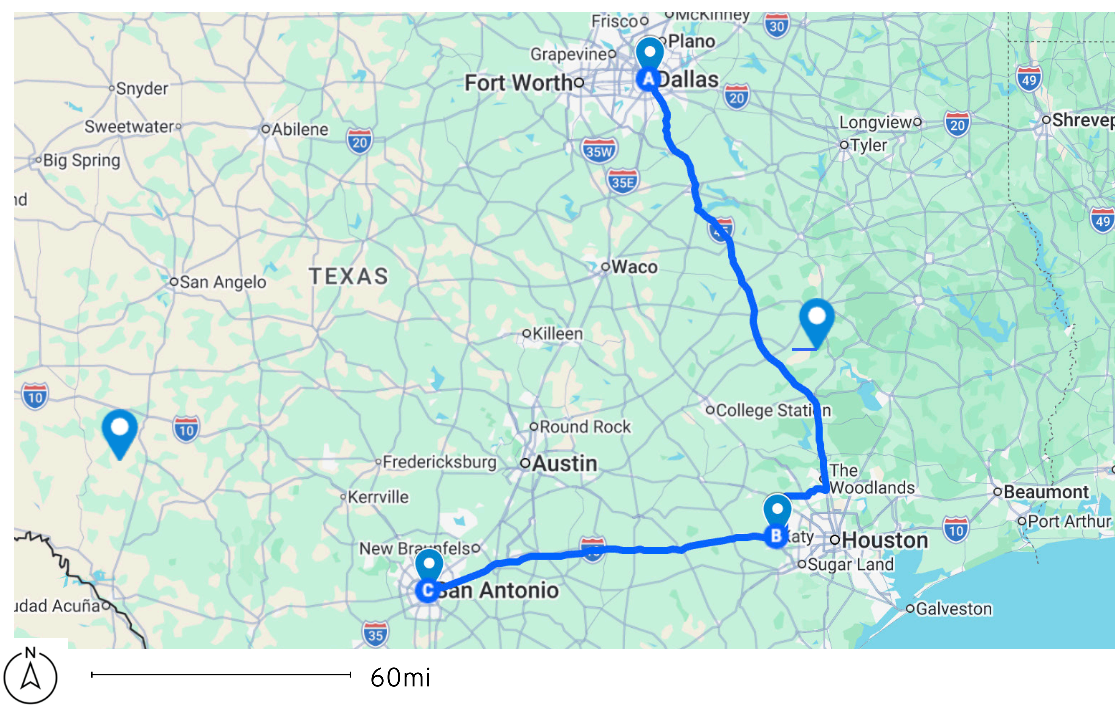


Figure 3: Typical ODD for a commercial freight route along I-10 or I-45 in Texas

We currently operate in clear weather conditions with the ability to continue in moderate precipitation. Our operations span both daylight hours and nighttime conditions in the temperature conditions of all seasons in Texas. Light to moderate wind conditions in Texas are tolerated and operations continue up to the point gusts impact truck and trailer movements adversely.

Traffic and speed parameters within our ODD reflect the structured nature of our target operational environment. We operate in mixed traffic environments at speeds ranging from 0 to 65 mph, with adaptive speed management based on local speed limits, traffic and surface conditions. Our system handles structured intersections with traffic signals and clear right-of-way rules, as well as appropriately managed construction zones where adequate barriers and signage provide clear guidance for autonomous vehicle navigation.

ODD Expansion and Evolution Strategy

Our approach to ODD expansion follows a rigorous methodology that prioritizes safety while enabling systematic capability development. Each potential ODD expansion undergoes comprehensive analysis including identification of new hazards, assessment of system capability requirements, validation of safety measures, and development of operational procedures. This process ensures that every expansion of our operational envelope is supported by adequate evidence and appropriate risk mitigation measures.

ODD Guardrails and Validation

Our operational design domain implementation incorporates multiple layers of control to ensure that our vehicles operate only within validated conditions. Software-level constraints include comprehensive geofencing systems that provide absolute prohibition against autonomous operation outside approved areas. These systems incorporate configurable routing restrictions based on road characteristics, environmental conditions, and dynamic factors such as weather or temporary road closures.

Real-time ODD condition monitoring represents a critical component of our operational safety architecture. Our systems continuously assess environmental conditions, infrastructure status, and vehicle health parameters to ensure continued compliance with ODD requirements. When conditions approach ODD boundaries, our system provides degraded responses ranging from enhanced monitoring to automatic mitigated risk condition achievement, depending on the severity and nature of the boundary violation.

Operational controls complement our technical systems through comprehensive dispatch procedures and safety driver training. Dispatch teams conduct pre-mission assessment of weather conditions, route characteristics, and any temporary modifications to infrastructure or traffic patterns. Safety drivers receive extensive training on ODD boundaries and limitations enabling them to serve as an additional layer of safety assurance during development operations. Remote monitoring and assistance capabilities provide real-time oversight with specialist intervention capability when unusual conditions arise that require human assessment.

OBJECT AND EVENT DETECTION AND RESPONSE (OEDR)

Sensing and Advanced Perception Architecture

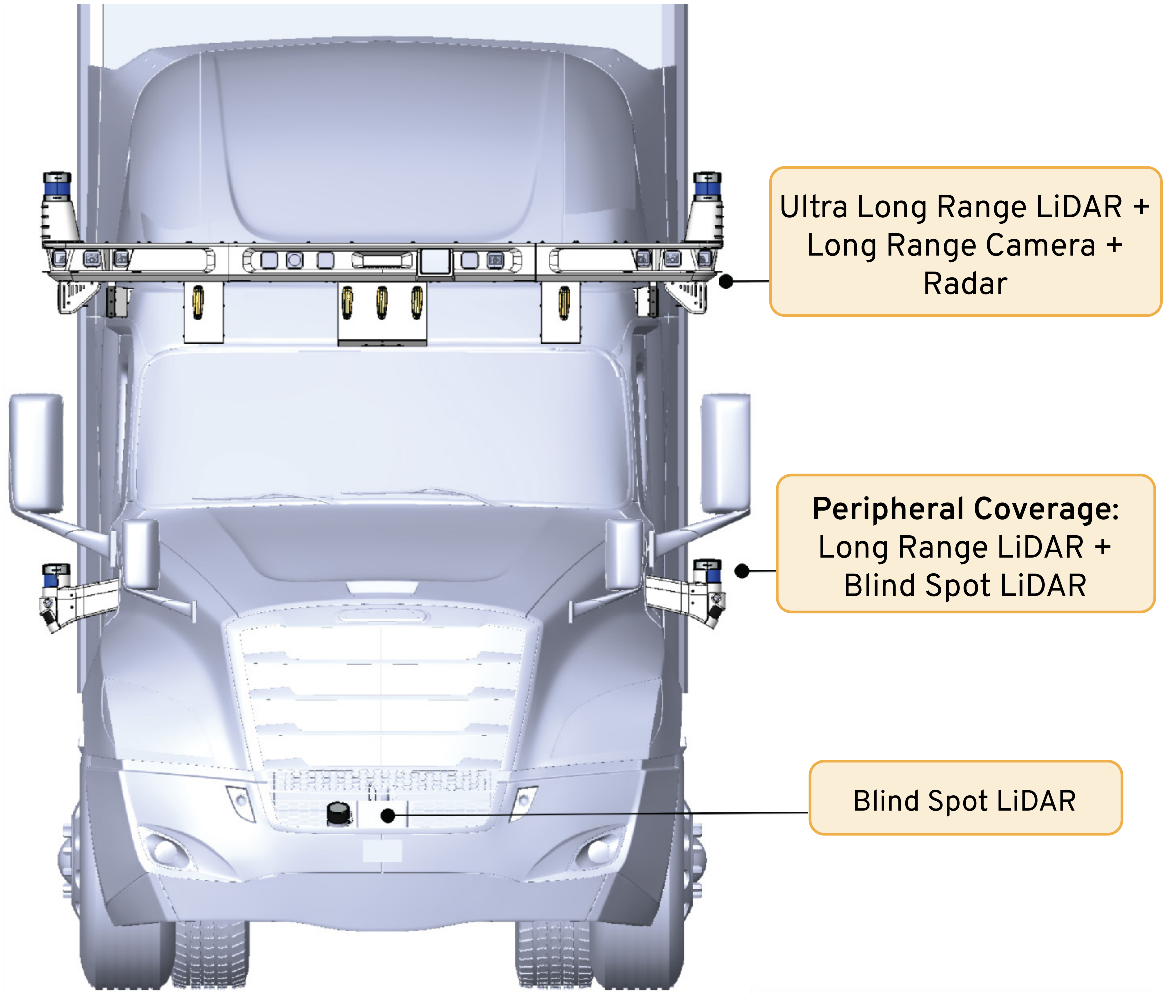


Figure 4: Front view of sensor locations

The integration of our multi-modal sensor data occurs through a sophisticated processing pipeline that transforms raw sensor measurements into actionable understanding of the vehicle's environment. Our approach employs multiple levels of fusion, beginning with raw sensor data integration and progressing through feature-level fusion to decision-level combination of processed information. This multi-stage approach enables optimal utilization of each sensor's capabilities while providing robust performance even when individual sensors experience limitations.

Real-time processing requirements demand that our perception pipeline operate with latency of less than a tenth of a second from sensor data acquisition to actionable perception output. This performance requirement drives both our computational architecture and algorithmic design choices, ensuring that our system can respond rapidly to dynamic changes in the environment.

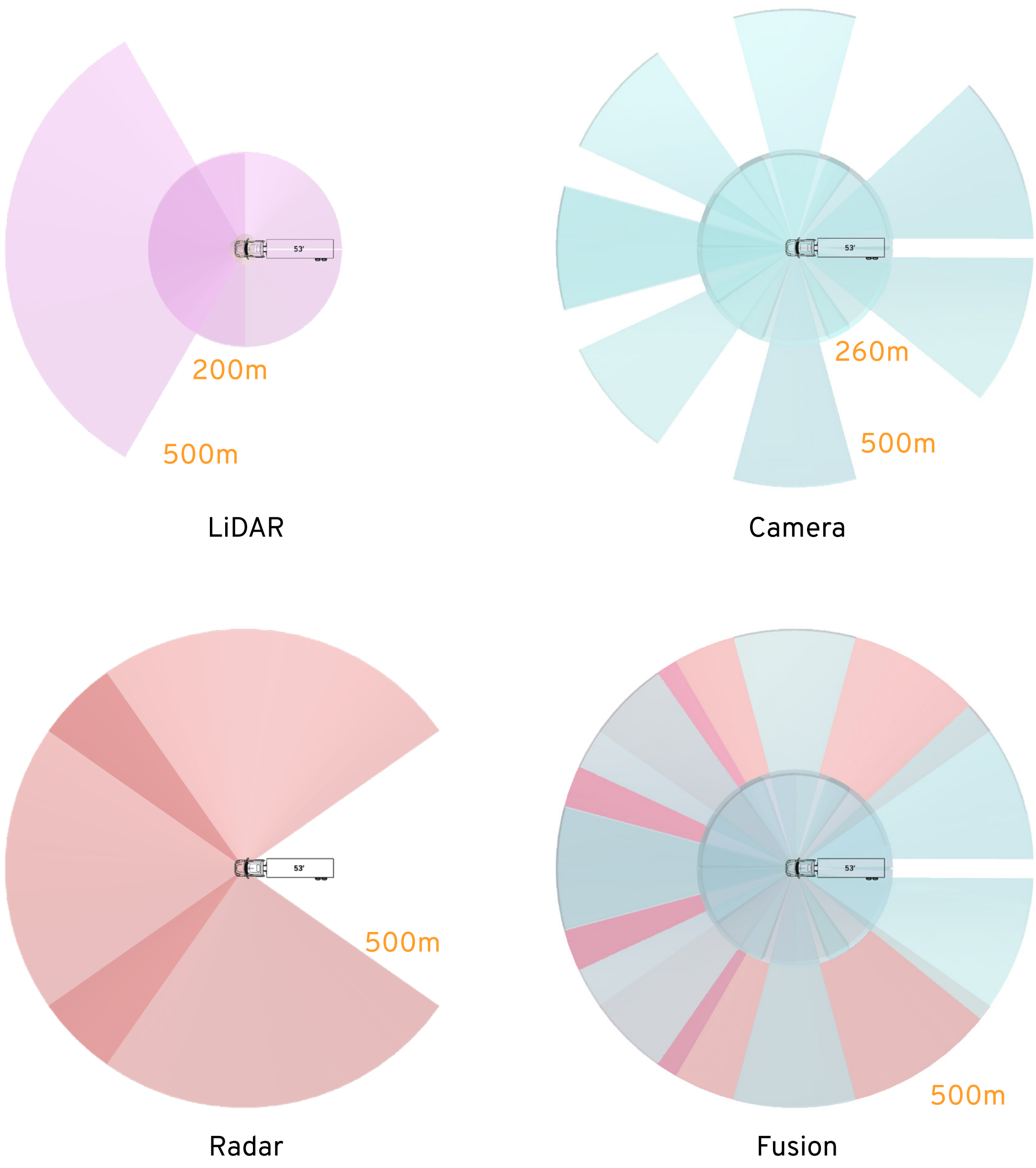


Figure 5: Top view of sensor modality coverage areas and resultant fused field of view

**Truck not drawn to scale*

Machine learning integration represents a crucial component of our perception capabilities, with deep neural networks providing object classification and behavior prediction functionality. These networks are trained on extensive datasets that include both real-world driving data and carefully constructed synthetic scenarios designed to ensure robust performance across the full range of conditions within our operational design domain. Our training methodology combines supervised learning from labeled real-world data with reinforcement learning approaches that enable the system to improve its performance through experience.

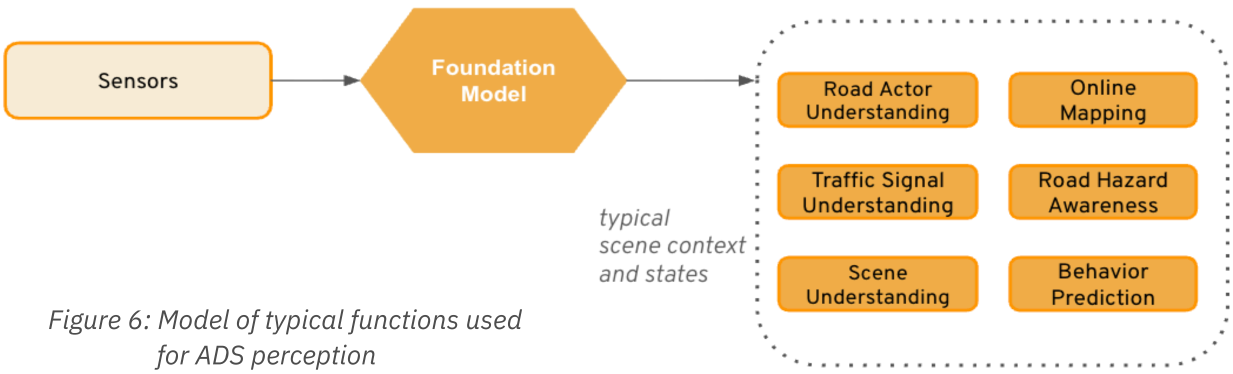
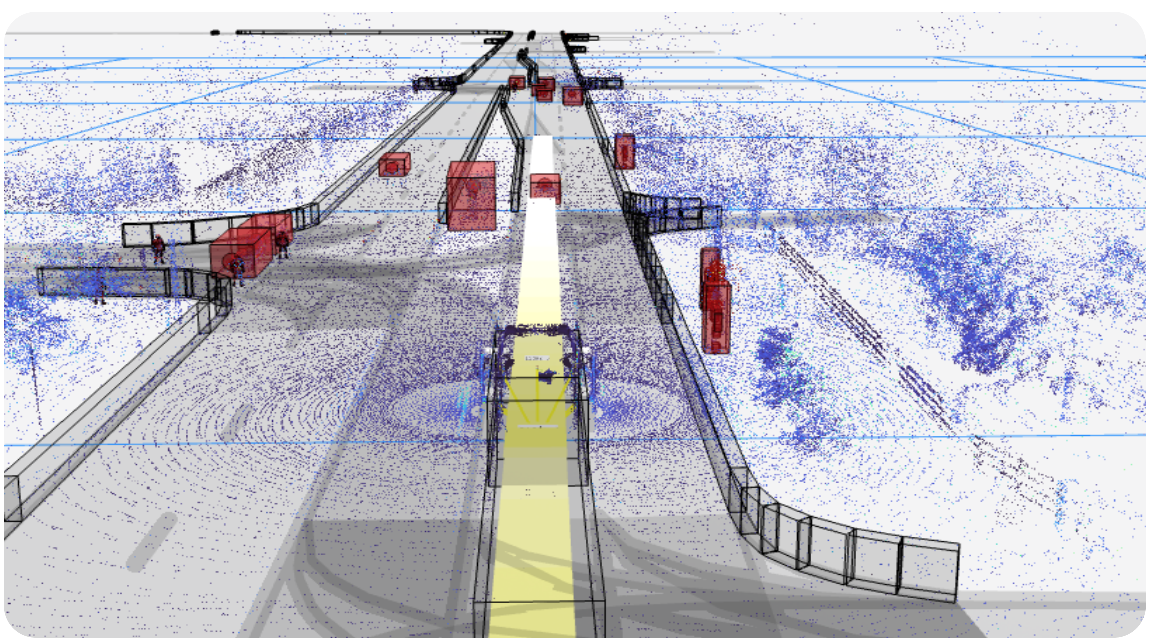


Figure 6: Model of typical functions used for ADS perception

The foundation of safe autonomous driving lies in the ability to perceive, understand, and respond appropriately to the complex and dynamic environment surrounding the vehicle. Bot Auto's perception system represents a state-of-the-art implementation of sensor fusion and machine learning technologies, designed to provide comprehensive situational awareness that matches or exceeds human driving capabilities across all relevant scenarios within our operational design domain.



Detection and Response Capabilities

Our object detection capabilities encompass the full spectrum of entities that an autonomous vehicle must recognize and respond to appropriately. Static object detection includes all types of vehicles, from passenger cars to large commercial trucks, as well as infrastructure elements such as barriers, signs, and construction equipment. Road surface anomaly detection enables identification of debris, potholes, or other hazards that might affect vehicle safety or passenger comfort. Traffic control device recognition encompasses traffic signals, stop signs, yield signs, and various temporary traffic control elements commonly encountered in construction zones.

Dynamic object detection represents a more complex challenge, requiring not only identification of objects but also prediction of their likely future behavior. Our system maintains comprehensive models of pedestrian and cyclist behavior, enabling prediction of likely trajectories and identification of potentially unsafe situations before they develop. Vehicle behavior prediction extends beyond simple trajectory estimation to include assessment of other drivers' likely intentions based on positioning, signaling, and movement patterns.

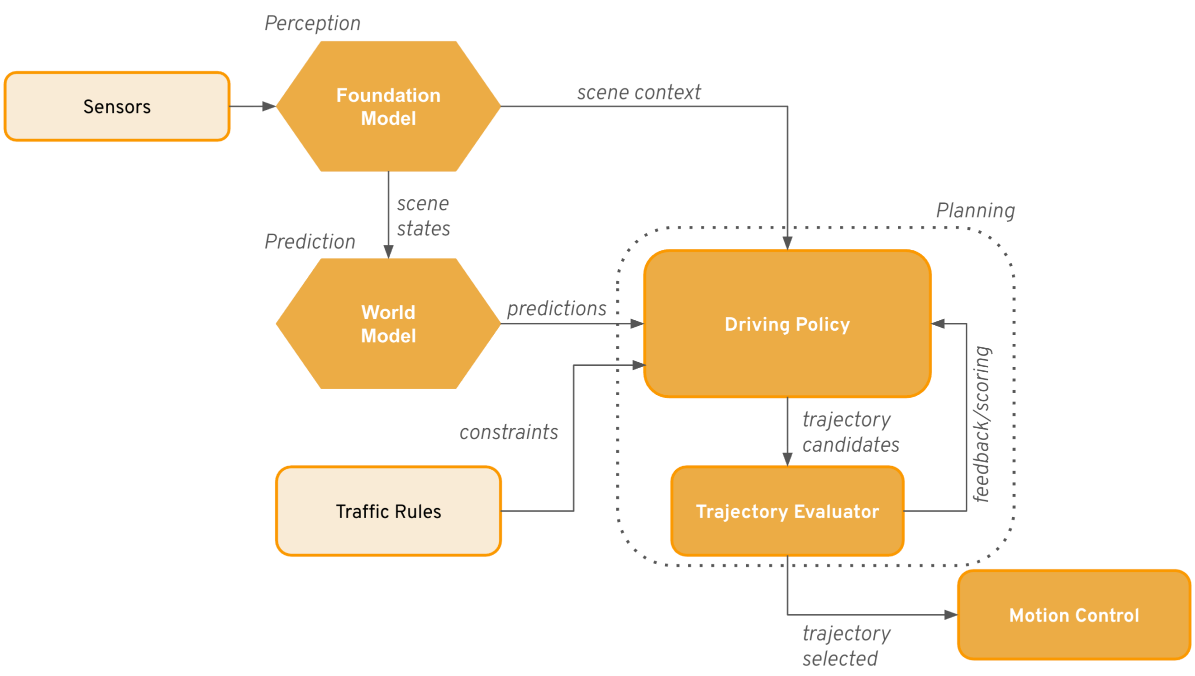


Figure 7: Model of typical functions used for ADS perception, motion planning and vehicle control

Highway operations include sophisticated lane keeping and lane changing behaviors that account for traffic density, relative vehicle speeds, and safe following distances. Merging and diverging behaviors incorporate assessment of gap availability, acceleration profiles of other vehicles, and appropriate signaling to communicate intentions to other road users. Speed management functions provide adaptive cruise control functionality while maintaining appropriate following distances and responding to changing speed limits or traffic conditions.

Truck driving behaviors, applicable within all appropriate portions of our operational design domain, include intersection navigation with full traffic signal compliance, pedestrian and cyclist interaction protocols that provide appropriate safety margins, and construction zone navigation procedures that account for temporary traffic control measures. Emergency vehicle response procedures ensure appropriate yielding behavior when emergency vehicles approach with active warning systems. For objects and situations where uncertainty remains around classification or the prediction of the motion of an object, our systems revert to obstacle avoidance and react accordingly to maintain safe clearances.

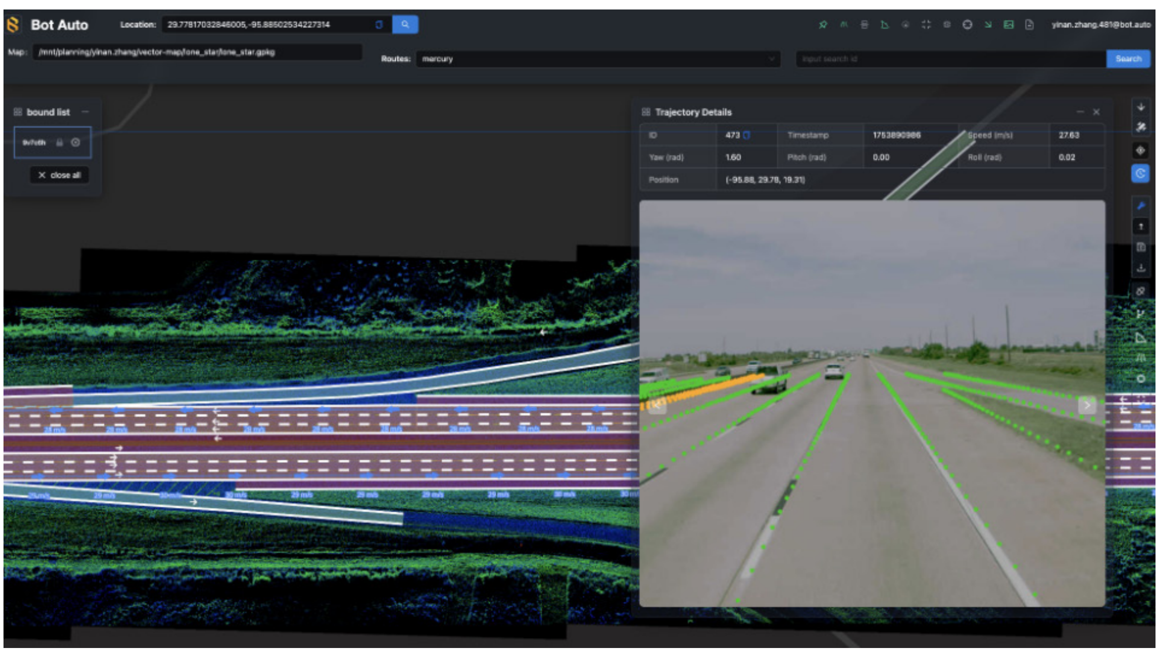


Figure 8: Visualization of vehicle data as collected during ADS development

FALLBACK (MITIGATED RISK CONDITION)

Comprehensive Fallback Strategy

The development of robust fallback capabilities represents one of the most critical aspects of autonomous vehicle safety, as these systems must respond appropriately when the primary autonomous driving functions encounter situations beyond their operational capabilities or experience system failures. Bot Auto's approach to fallback and mitigated risk condition (MRC) achievement draws from extensive analysis of potential failure modes and systematic development of appropriate responses that prioritize the safety of other road users and the broader transportation system.

Our fallback strategy recognizes that autonomous vehicles must be capable of achieving safe states across a broad spectrum of potential challenges, ranging from minor sensor degradation to complete system failures. This comprehensive approach ensures that our vehicles can respond appropriately regardless of the nature or severity of the situation that triggers fallback behavior. The fundamental principle underlying our approach is that the vehicle must always be capable of achieving a state that poses no unreasonable risk to safety, even if that state prevents completion of the intended journey.

The mitigated risk condition concept serves as the cornerstone of our fallback strategy, representing the safest achievable state under given circumstances. We recognize that the specific characteristics of an appropriate mitigated risk condition depend heavily on the immediate environment and the nature of the situation that triggered the fallback response. Our system is designed to assess available options dynamically and select the most appropriate mitigated risk condition based on current circumstances rather than defaulting to a single predetermined response.

Fallback Triggering and Assessment

The identification of situations requiring fallback response occurs through comprehensive monitoring of system health, environmental conditions, and operational performance. Our fault monitoring systems continuously evaluate the status of all critical vehicle systems, sensor performance, and environmental factors that might affect safe operation. When any monitored parameter indicates degraded performance or approaches operational limits, the system initiates a graduated response designed to maintain safe operation while attempting to resolve the underlying issue.

Environmental factors that might trigger fallback responses include weather conditions that exceed our validated operational envelope, infrastructure conditions that cannot be safely navigated with current system capabilities, or traffic situations that present unusual complexity beyond our current behavioral repertoire. The assessment process considers both immediate safety implications and the vehicle's ability to maintain safe operation over the time required to achieve an appropriate mitigated risk condition.

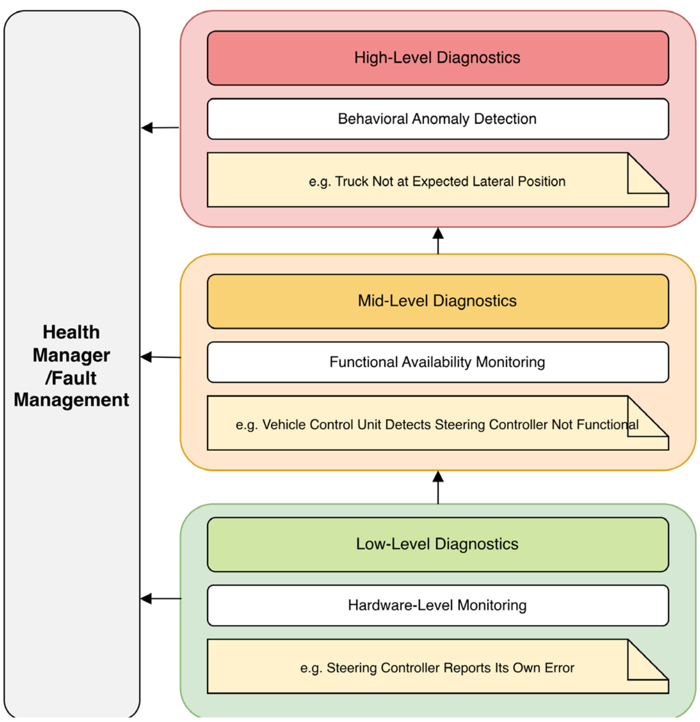


Figure 9: Example of multiple layers of fault monitoring and detection

System health monitoring encompasses all components critical to safe vehicle operation, including sensor performance, computational system status, communication links, and vehicle platform systems such as braking, steering, and propulsion. Degradation in any of these systems triggers appropriate assessment of remaining capabilities and determination of whether continued operation is safe or whether fallback to a mitigated risk condition is required.

The sophistication of our monitoring systems enables early detection of developing problems, often allowing for graceful degradation rather than abrupt failure.

Our analysis of potential mitigated risk conditions recognizes two primary categories based on the vehicle's remaining capabilities and environmental constraints. The preferred mitigated risk condition involves safely exiting the travel lane and positioning the vehicle in a location that does not impede traffic flow while ensuring occupant safety and providing appropriate warnings to other road users. This approach requires sufficient remaining vehicle capability to execute steering, braking, and positioning maneuvers necessary to reach a safe location such as a highway shoulder or designated parking area. We design our vehicles to have remaining failover functionality to conduct MRC, exiting the travel lane in all but the most catastrophic situations.

The stop-in-path mitigated risk condition represents the fallback option when the vehicle cannot safely exit the travel lane due to either system limitations or environmental constraints such as heavy traffic, infrastructure limitations, or severe weather conditions. While this condition is less desirable because it may impede traffic flow, it provides a safe alternative when lane-exit maneuvers would present greater risk than remaining in position. Even in stop-in-path scenarios, our system activates appropriate warning systems including hazard lights and, where available, emergency communication systems to alert other road users and emergency services.

The execution of mitigated risk condition maneuvers requires careful consideration of traffic conditions, infrastructure characteristics, and vehicle capabilities. Our motion planning algorithms generate appropriate trajectories for mitigated risk condition achievement while considering the safety implications of various possible actions. For example, when exiting to a highway shoulder, the system must balance the benefits of removing the vehicle from traffic flow against the risks associated with the lane change maneuver itself, particularly in dense traffic conditions.

Integration with Vehicle Systems and Emergency Response

The successful achievement of mitigated risk conditions requires close integration between our autonomous driving system and the underlying vehicle platform systems. Our fault management architecture includes comprehensive interfaces with vehiclebraking, steering, propulsion, and electrical systems to ensure that mitigated risk condition maneuvers can be executed reliably even when primary autonomous driving functions are compromised. Redundant system architectures provide backup capabilities for critical functions, while emergency power systems ensure continued operation of essential systems during power system failures.

Communication systems play a crucial role in mitigated risk condition scenarios, providing automated notification to emergency services, fleet operations centers, and relevant authorities when vehicles cannot complete their intended journeys. These systems transmit essential information including vehicle location, nature of the problem requiring fallback, current vehicle status, and any special circumstances that emergency responders should be aware of. The integration of these communication capabilities with existing emergency response infrastructure ensures that appropriate assistance can be dispatched rapidly when needed.

VALIDATION METHODS

Requirements-Driven and Real-world Proven

Requirements-driven testing ensures that every safety requirement derived from our hazard analysis and risk assessment process receives appropriate validation through testing. Comprehensive traceability links each requirement to specific test cases and validation evidence, ensuring that our safety case is supported by concrete evidence rather than theoretical arguments.

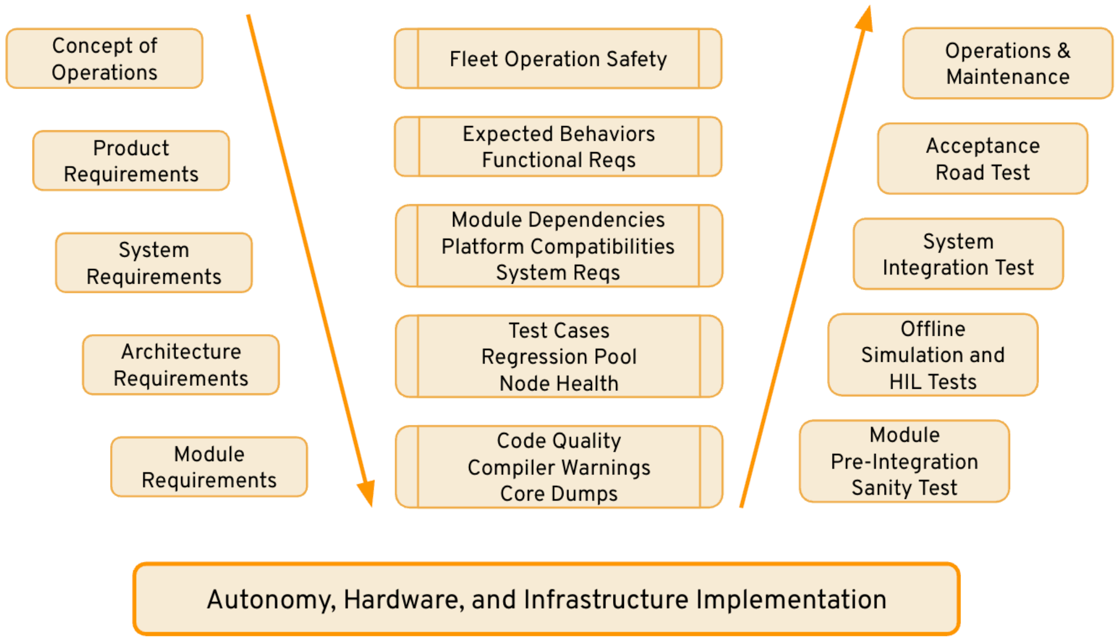


Figure 10: A typical system engineering V-model showing typical validation at software, hardware, vehicle integration, and deployment operational levels

Exposing the system to real-world usage cases and plausible and yet borderline or edge cases provides additional assurance that our testing methodology is sound and our conclusions are justified.

Comprehensive Multi-Domain Testing Strategy

The validation of autonomous driving systems presents unprecedented challenges that require innovative approaches extending far beyond traditional automotive testing methodologies. Bot Auto's validation strategy recognizes that the complexity and variability of real-world driving scenarios demands a comprehensive approach that combines large-scale virtual testing with carefully structured physical testing in both controlled and public environments. Our methodology ensures that every aspect of our autonomous driving system receives thorough validation across the full spectrum of conditions and scenarios it may encounter during operational deployment.

Our testing philosophy emphasizes the fundamental principle that virtual testing must serve as the primary mechanism for capability development and safety validation, with physical testing focused on verification of virtual testing accuracy and exploration of scenarios that cannot be adequately simulated. This approach enables us to achieve testing coverage that would be impossible through physical testing alone while maintaining the rigor necessary to demonstrate safety in real-world conditions. The integration of virtual and physical testing creates a comprehensive validation ecosystem where each testing modality reinforces and validates the others.

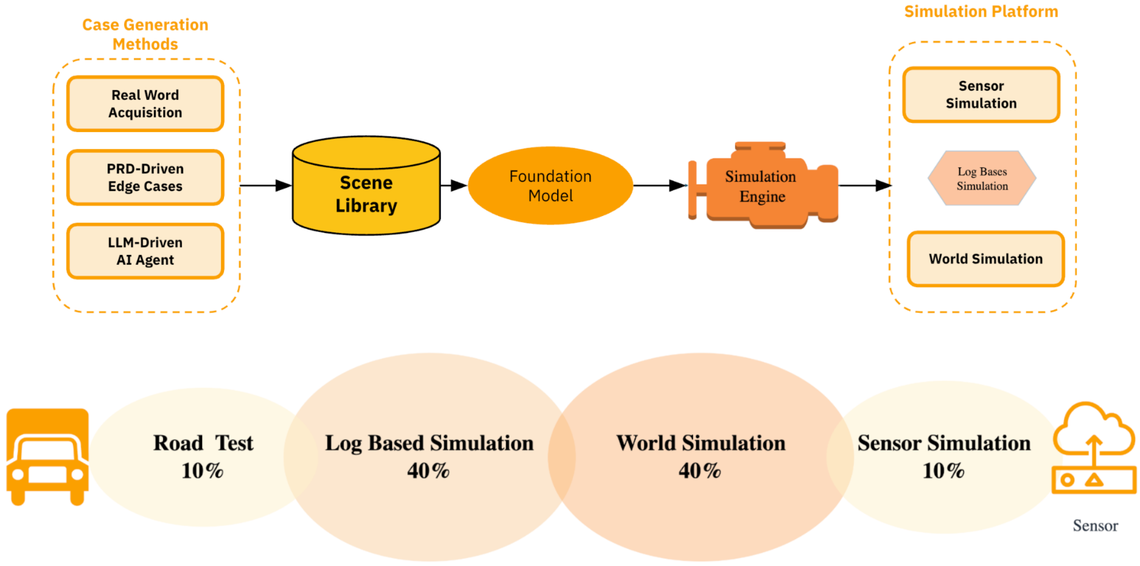


Figure 11: Typical validation model showing simulation and road testing components

The scale of our virtual testing operations reflects the enormous complexity of autonomous driving validation requirements. With many millions of virtual miles completed annually, our virtual testing program explores scenarios and edge cases that would require decades to encounter through physical testing alone. This massive simulation capability enables us to validate system behavior in rare but safety-critical scenarios while providing statistical confidence in our system's safety performance across the full operational design domain.

Advanced Virtual Testing Implementation

Our Virtual Testing Suite is designed to provide high-fidelity recreation of real-world driving conditions while enabling systematic exploration of scenario variations and edge cases. The simulation environment incorporates detailed physics modeling, realistic sensor simulation, and comprehensive behavior models for other road users, creating a testing environment that accurately reflects the complexity of real-world driving scenarios.

Procedural scenario generation capabilities enable automated creation of millions of unique test scenarios based on systematic variation of environmental parameters, traffic configurations, and road conditions. This approach ensures comprehensive coverage of our operational design domain while identifying potential gaps in our system's capabilities. The automated nature of scenario generation enables continuous expansion of our testing coverage as new scenarios are identified through real-world operations or emerging safety research.

Perception testing within our virtual environment employs both synthetic sensor data generation and replay of real-world sensor data collected during physical testing operations. Synthetic data generation enables testing of sensor performance under conditions that would be difficult or dangerous to recreate in the physical world, while real-world data replay ensures that our simulation environment accurately reflects actual sensor characteristics and performance limitations. The combination of these approaches provides comprehensive validation of our perception algorithms across all relevant operating conditions.

Behavioral competency validation represents a critical component of our virtual testing program, with systematic evaluation of our system's behavior across all driving scenarios within our operational design domain. These tests compare our system's planned actions against expert human driver behavior in similar situations, ensuring that our autonomous driving system behaves in ways that are predictable and appropriate for other road users. Manual driving evaluations provide benchmarks for natural and safe driving behavior that guide the development of our behavioral algorithms.

Physical Testing and Real-World Validation

Our closed-course testing program provides controlled environments for validating specific system capabilities and exploring scenarios that require physical validation but pose too much risk for testing on public roads. With six dedicated testing facilities offering diverse environmental conditions, our closed-course testing enables systematic exploration of vehicle dynamics, sensor performance under various weather conditions, and human-machine interface functionality. These facilities provide essential capabilities for testing emergency maneuvers, mitigtated risk condition achievement, and other safety-critical functions under controlled conditions.

The progression from closed-course to public road testing follows rigorous protocols designed to ensure safety while providing comprehensive real-world validation of our autonomous driving capabilities. Our public road testing program has accumulated millions of miles of operation across diverse geographic regions and traffic conditions, providing extensive validation of our system's performance in real-world environments. This testing is conducted with highly trained safety drivers who undergo comprehensive training programs and maintain continuous readiness to assume vehicle control when necessary.

Safety driver training and qualification programs ensure that our physical testing operations maintain the highest safety standards while providing valuable feedback for system development.

Our safety drivers possess commercial driving licenses with extensive experience in heavy vehicle operations, undergo rigorous selection processes including comprehensive background checks and driving assessments, and participate in ongoing training programs that keep them current with system capabilities and limitations. The multi-level certification program ensures that drivers are qualified for specific types of testing operations based on their training and experience levels.

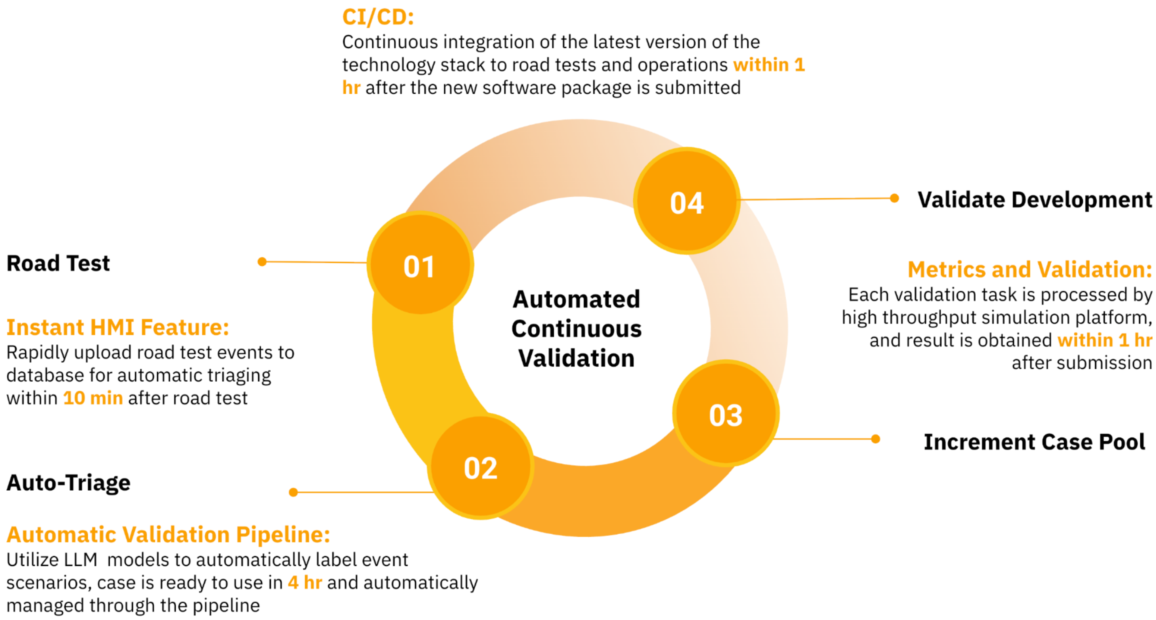


Figure 12: Continuous validation lifecycle model integrated into CI/CD development cycles

Safety Performance Measurement and Safety Case Development

Safety Performance Indicators (SPIs) provide continuous monitoring of system performance and early warning of potential safety issues. These metrics encompass both leading indicators that provide early warning of developing problems and lagging indicators that measure actual safety outcomes. The integration of these metrics into our safety management system enables proactive identification and resolution of safety issues before they can affect operational safety.

The integration of objective validation evidence into our safety case framework creates a comprehensive argument for system safety that can be evaluated by regulatory authorities, customers, and other stakeholders. This evidence-based approach provides transparency regarding our system's capabilities and limitations while demonstrating our commitment to safety through rigorous validation processes. Regular updates to our safety case ensure that new evidence and operational experience are incorporated into our safety arguments as our system continues to evolve and mature.

HUMAN MACHINE INTERFACE (HMI)

Design Philosophy and User-Centered Approach

The design of effective human-machine interfaces for autonomous vehicles presents an enabler for those still requiring interaction with autonomous trucks without human occupants. The design shifts primarily to enabling (1) test operations with fall-back-ready drivers to enhance and enable the drivers to perform their duties supervising the automation and (2) providing common sense interfaces to the truck for external inspection, law enforcement, or other fleet operations users to interact with the automated vehicle safely. Bot Auto's approach to HMI development prioritizes clarity, simplicity, and intuitive operation while accommodating the complex information requirements associated with autonomous vehicle operation. Our design philosophy recognizes that users of autonomous vehicles range from technically sophisticated early adopters to members of the general public who may have limited familiarity with advanced vehicle technologies.

Central to our design approach is the principle that the human-machine interface should enhance safety rather than create additional complexity or distraction. This philosophy drives design decisions that prioritize essential information while minimizing cognitive load on vehicle occupants and operators. During current development operations with safety drivers, the interface focuses on providing clear, unambiguous information about system status and capabilities while enabling rapid response to changing conditions that may require human intervention.

Our modular interface architecture enables adaptation to these different operational requirements while maintaining consistency in fundamental design principles and user interaction paradigms.

HMI Design for Fallback-Ready Drivers and Test Engineers

Our human-machine interface serves the critical function of enabling effective communication between our autonomous driving system and the safety drivers who oversee vehicle operation during development and testing activities. The interface design emphasizes immediate comprehension of system status through both visual and auditory channels, ensuring that safety drivers can quickly assess system condition and respond appropriately to any situation requiring human intervention.

Visual status indication employs a prominent light bar positioned on the center instrument panel, providing clear visual feedback that is immediately apparent to both the primary safety driver and any additional personnel in the vehicle. The color-coded system uses intuitive associations: white indicates system not ready with manual control active, blue indicates ready state with manual control maintained, green indicates healthy autonomous operation, and red indicates an error or disengagement state.

HMI Design for External Users during Autonomous Operation

In addition, the overall vehicle HMI must provide intuitive and standardized interfaces for fleet operations personnel as well as a variety of external stakeholders including law enforcement, first responders, and personnel requiring safety status and compliance information. These interfaces are engineered to facilitate secure and efficient interaction with the autonomous truck, thereby enabling critical functions such as emergency shutdowns, status diagnostics, and data retrieval, all while upholding the paramount objective of ensuring the safety of individuals engaging with the vehicle and precluding inadvertent operations.

VEHICLE CYBERSECURITY

Cybersecurity is integral to the safety case for autonomous vehicles. At Bot Auto, we take a defense-in-depth approach, layering multiple safeguards to ensure that no single failure, compromise, or vulnerability can jeopardize vehicle control or safety.

Vehicle Control Gatekeeping

Every motion command inside the truck, such as steering, propulsion and braking, passes through a gateway control unit that performs strict integrity checks before acting. The gateway checks for message consistency, verifies integrity using cryptographic methods, and compares redundant data sources to detect anomalies. It acts as a secure gatekeeper accepting commands only from healthy systems that match expected vehicle behavior.

This verification process is both a safety and security measure. It protects the vehicle from malfunctions, misconfigurations, and malicious tampering.

Autonomous by Design, Not Reliant on Remote Assistance

Our autonomy system is built to operate safely and independently, even in the event of degraded or lost connectivity. While remote assistance is available, it's never required for core functionality or safety-critical decisions.

When remote commands are issued, they are scoped, logged, authenticated, and run through the same validation layers as onboard commands. These inputs direct what to do, not how to do it. The autonomy stack retains full authority over execution.

Secure Software Development and Deployment

We strictly control access to all systems, from development environments to deployment infrastructure and remote assistance, through centralized identity management. Every system requires strong, phishing-resistant credentials to best safeguard them.

This protects the entire software lifecycle and onboard systems: who can change code, who can ship it, and who can interact with deployed systems in the field.

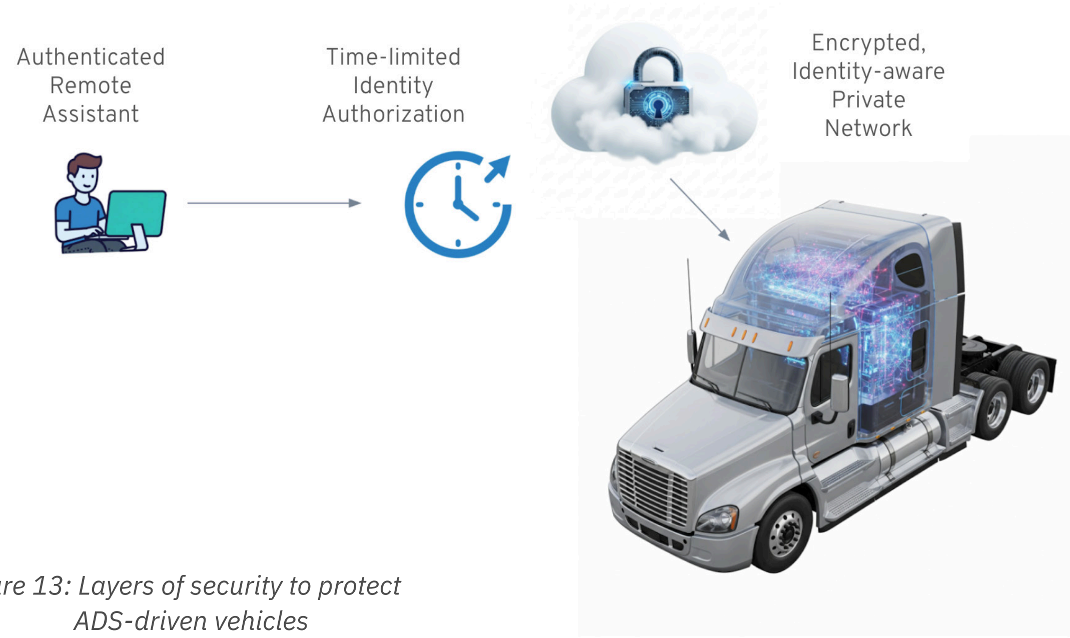


Figure 13: Layers of security to protect ADS-driven vehicles

We develop software using a controlled, auditable workflow. Engineers submit changes for review, which are then built into versioned images. These images include only pre-approved components and are deployed through secure pipelines.

Our security practices adhere to ISO 27001 (information security) and ISO 21434 (automotive cybersecurity). We've adopted key elements from these standards, including:

- Risk assessment
- Role-based access control
- Secure development practices
- Continuous monitoring

Following these principles strengthens our internal processes and helps build trust with regulators, partners, and the public.

CRASHWORTHINESS

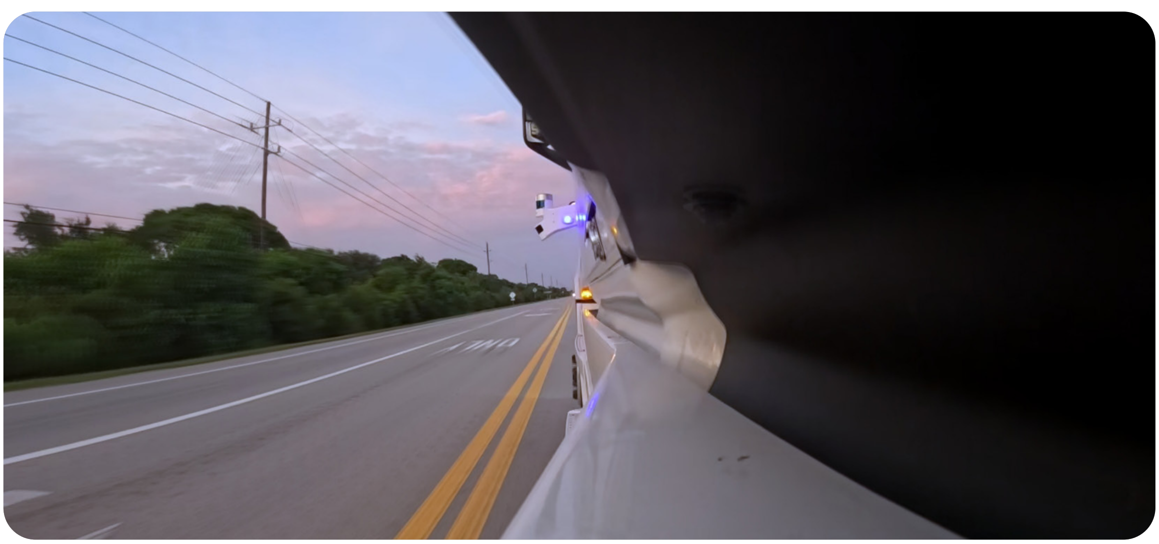
Integrated Vehicle Platform Crashworthiness

Our crashworthiness strategy is built upon using established original equipment manufacturers who possess extensive experience in developing vehicles that meet or exceed all applicable Federal Motor Vehicle Safety Standards. The added autonomous driving systems are integrated into vehicle platforms with proven crash protection capabilities without compromising the prior crashworthiness or certification.

The integration of autonomous driving systems into crashworthy vehicle platforms requires careful consideration of sensor placement, computational system mounting, and power system design to ensure that these critical components remain functional throughout crash events or fail in predictable and safe ways. Our approach to component protection employs multiple strategies including strategic placement in protected areas of the vehicle, robust mounting systems designed to withstand crash forces, and backup systems that can maintain essential functions even when primary systems are damaged.

Active Safety System Integration

Our autonomous driving systems are designed to integrate fully with advanced safety features including automatic emergency braking, collision avoidance systems, and adaptive occupant protection systems. This integration allows the autonomous driving system to contribute actively to crash avoidance and mitigation. Our perception and prediction capabilities enable earlier detection of potential collision scenarios providing additional time for evasive maneuvers or pre-crash preparation measures.



POST-CRASH ADS BEHAVIOR

Immediate Crash Response Protocol

The behavior of automated driving systems in the immediate aftermath of crash events represents a critical safety consideration that requires sophisticated system design and extensive validation to ensure appropriate responses across a wide range of potential scenarios. Bot Auto's approach to post-crash behavior recognizes that the seconds and minutes immediately following a crash are crucial for human safety, emergency response effectiveness, and preservation of essential information for investigation and analysis purposes.

Bot Auto’s post-crash response protocols are designed to operate reliably even when primary vehicle systems have been damaged or compromised by the crash event. This requirement drives the use of redundant power systems, communication pathways isolated from vehicle power, and distributed system architectures that can continue to operate even when centralized control systems are damaged. The protocols prioritize scene stability and human safety above all other considerations while ensuring that emergency responders receive accurate and timely information about the incident.

Primary autonomous driving functions cease immediately upon crash detection to eliminate any possibility that damaged sensors or computational systems might cause inappropriate vehicle behavior. However, essential safety systems including emergency communication, warning lights, and power management functions continue to operate.

This selective shutdown approach balances the need to deactivate potentially compromised systems with the requirement to maintain essential safety functions.

Vehicle securing measures ensure that the disabled vehicle presents minimal ongoing risk to traffic flow and emergency responders. When possible, automated systems attempt to position the vehicle to minimize traffic obstruction while ensuring human safety and emergency responder access.

First Responder Coordination and Support

The integration of autonomous vehicles into existing emergency response infrastructure requires careful coordination to ensure that first responders can effectively and safely manage crash scenes involving autonomous vehicles. Our emergency response support systems provide first responders with immediate access to essential information and/or reach back support about vehicle status, potential hazards, and appropriate safety procedures while ensuring that autonomous vehicle involvement does not complicate emergency response operations.

Bot Auto's vehicles are easily recognizable as autonomous vehicles, and our external autonomy indicator light allows first responders to quickly determine the status of the autonomous driving system. Likewise our external document solution allows first responders to quickly access relevant safety information using non-technical methods that do not require access to the automated driving system. Emergency responder training materials provide comprehensive guidance on safe interaction with autonomous vehicles, including proper procedures for system shutdown, hazard identification, and evidence preservation. These materials are regularly updated to reflect system-improvements and lessons learned from operational experience.

Communication protocols ensure that our vehicles and/or remote assistants can effectively communicate with emergency response dispatch personnel or systems and provide accurate location and status information to facilitate rapid response. These communication protocols can provide real-time information about crash severity, number of occupants, and potential hazard conditions to help emergency responders prepare appropriate resources and approach strategies.

Ongoing collaboration with emergency response organizations ensures that our emergency response support capabilities continue to evolve in response to first responder needs and operational experience. Regular training exercises provide opportunities for first responders to gain hands-on experience with autonomous vehicle emergency procedures while providing valuable feedback for improving our emergency response support systems. These collaborative relationships ensure that autonomous vehicle deployment enhances rather than complicates emergency response effectiveness.

Long-Term Safety and Investigation Support

The preservation of crash-related data represents a critical function that supports both immediate safety needs and long-term safety improvement through comprehensive accident investigation and analysis. Our data preservation systems are designed to capture and protect essential information about the crash sequence while ensuring that this information is available to appropriate investigative authorities and can contribute to broader safety improvement efforts across the autonomous vehicle industry.

Coordination with investigative authorities ensures that our post-crash data preservation and vehicle behavior is always supportive of accident investigation and emergency response. We maintain established relationships with relevant investigative agencies including NHTSA, state police crash investigation units, and other authorities that may be involved in investigation.

DATA RECORDING

Safety-Related Data Management

Safety-related data management represents one of the most important aspects of our data recording operations, ensuring that information essential for safety analysis and incident investigation is captured, preserved, and made available to appropriate authorities when needed. Our approach to safety-critical data management recognizes that this information may be required for legal proceedings, regulatory investigations, and safety improvement activities that extend far beyond our immediate operational needs.

Vehicle dynamics recording captures comprehensive information about vehicle motion, control inputs, and system responses that enable detailed reconstruction of vehicle behavior during any time period of interest. Sensor data recording encompasses outputs from all perception sensors including cameras, LiDAR, radar, and ultrasonic systems, providing comprehensive documentation of environmental conditions and system awareness during vehicle operation. Critical event periods receive complete sensor data recording while routine operations include periodic snapshots and reduced-resolution data that maintains situational awareness information while managing data volume requirements. System decision recording documents the complete decision-making process of our autonomous driving system, including perception outputs, prediction calculations, planning decisions, and control commands. Data recording capability supports both safety analysis and system improvement activities while providing the transparency necessary for regulatory oversight and public confidence.

Data Privacy and Storage

The protection of personal privacy and sensitive information represents a fundamental responsibility that influences every aspect of our data recording and management operations.

Access control systems ensure that sensitive data is available only to authorized personnel with legitimate needs for the information. Role-based access controls limit data access based on job responsibilities and analytical requirements while comprehensive audit logging documents all data access activities. These controls ensure that personal information and safety-critical data receive appropriate protection while remaining available for legitimate safety and operational purposes.

Data retention policies balance the need to maintain information for safety analysis and regulatory compliance with privacy protection objectives and practical storage limitations.

Our data recording and management practices are designed to support comprehensive regulatory compliance while providing the transparency necessary for effective oversight of autonomous vehicle operations. We maintain active engagement with regulatory authorities to ensure that our data collection practices meet current requirements while anticipating future regulatory developments that may affect data recording and reporting obligations.

CONSUMER EDUCATION AND TRAINING

Strategic Approach to Stakeholder Education

The successful deployment of autonomous vehicles requires more than technological excellence; it demands comprehensive education and engagement strategies that build public understanding, confidence, and appropriate expectations regarding autonomous vehicle capabilities and limitations. Bot Auto's approach to public education recognizes that different stakeholder groups have distinct information needs and concerns, while maintaining consistent messaging about safety and system capabilities.

Our educational philosophy emphasizes transparency and honesty. This approach builds sustainable trust relationships that will support long-term successful deployment of autonomous vehicle technology.

Public Education and Awareness

Public education represents the foundation of our outreach efforts, designed to build general awareness and understanding of autonomous vehicle technology among community members who may encounter these vehicles on public roads. Our public education programs employ multiple communication channels and engagement strategies to reach diverse audiences with varying levels of technical knowledge and interest in transportation technology. These programs emphasize safety benefits, operational limitations, and appropriate expectations for autonomous vehicle behavior.

Community demonstration events provide hands-on opportunities for community members to experience autonomous vehicle technology in controlled settings while learning about safety features and operational characteristics.

Media engagement and communications provide broad-reach educational opportunities through both traditional and digital media channels. Our media strategy emphasizes proactive engagement with journalists and content creators to ensure accurate reporting about autonomous vehicle technology while providing expert perspectives on industry developments and policy considerations.

Collaborations with organizations such as the Texas Transportation Institute at Texas A&M and the Center for Transportation Research at the University of Texas allow us to greatly extend our reach in regards to public-facing outreach.

Professional and Industry Education

Professional education programs address the specific needs of transportation professionals, emergency responders, fleet operators, and other stakeholders whose work will be directly affected by autonomous vehicle deployment. These programs provide detailed technical information and practical training necessary for effective integration of autonomous vehicles into existing transportation and emergency response systems while addressing professional concerns about liability, operational procedures, and system limitations.

Emergency responder training programs ensure that fire, police, and emergency medical personnel can safely and effectively respond to incidents involving autonomous vehicles. These programs provide detailed information about system shutdown procedures, guidance on safe approach and handling of autonomous vehicles during emergency situations.

Transportation professional engagement includes collaboration with traffic engineers, transportation planners, and infrastructure operators whose work affects the environment in which autonomous vehicles operate. The collaborative approach ensures that autonomous vehicle deployment supports broader transportation system objectives.

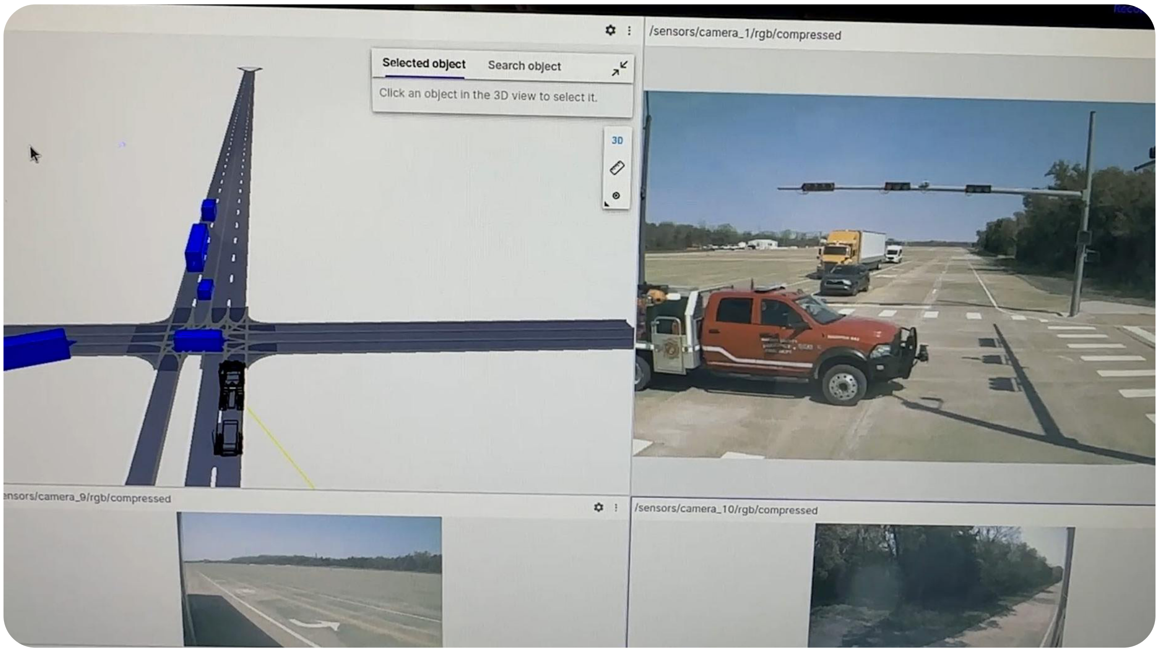


Figure 14: Visualization of staged first responder test scenario conducted with partners at Texas A&M closed test track

Regulatory and Policy Education

Engagement with regulatory authorities and policymakers represents a critical component of our educational efforts, providing technical expertise and operational experience that supports informed policy development and regulatory oversight. Our regulatory education activities focus on providing accurate technical information, sharing operational data and experience, and collaborating on policy development that balances innovation encouragement with appropriate safety oversight.

Policy maker education programs provide elected officials and government staff with comprehensive information about autonomous vehicle technology, deployment strategies, and policy implications. These programs include briefing sessions, technical presentations, demonstration events, and ongoing consultation availability that ensures policymakers have access to accurate information when making decisions.

Regular data sharing and technical consultation support effective regulatory oversight while contributing to policy development based on real-world operational experience. Standards development participation ensures that our experience and expertise contribute to industry-wide standards that will guide autonomous vehicle deployment and regulation.

Figure 15: Test runs at Texas A&M closed test track with first responder partners to characterize emergency vehicles

FEDERAL, STATE, AND LOCAL LAWS

Proactive Policy Development Participation

Policy development participation represents a critical component of our regulatory strategy, enabling us to contribute technical expertise and operational experience to policy discussions while ensuring that emerging regulations reflect practical understanding of autonomous vehicle capabilities and limitations. Our policy participation includes testimony at legislative hearings, submission of technical comments on proposed regulations, participation in regulatory working groups, and collaboration with industry associations on policy development initiatives. Legislative engagement includes monitoring of relevant legislative developments at federal, state, and local levels while providing technical expertise to lawmakers considering autonomous vehicle legislation. Regulatory rulemaking participation includes active engagement with regulatory agencies during comment periods for proposed rules affecting autonomous vehicles. Our regulatory comments emphasize technical accuracy, operational feasibility, and safety effectiveness while providing specific suggestions for regulatory improvement based on our technical expertise and operational experience. The systematic nature of our regulatory engagement ensures consistent participation across relevant regulatory proceedings while maintaining focus on constructive contributions to future regulatory effectiveness. Industry collaboration on policy development includes participation in trade associations, standards development organizations, and other industry groups that engage collectively on regulatory matters affecting autonomous vehicles. This collaborative approach enables more effective industry engagement with regulatory authorities while ensuring that our individual perspectives contribute to broader industry positions. The collaborative approach also provides opportunities to learn from other industry participants' regulatory experiences and approaches.

Adaptive Compliance

Our adaptive compliance approach includes systemic monitoring of regulatory developments, scenario planning for potential regulatory changes, and development of flexible operational procedures that can accommodate various regulatory requirements without response.

Compliance system flexibility enables rapid adaptation to new regulatory requirements without requiring fundamental changes to our technical systems or operational procedures.

CONCLUSION

Bot Auto is dedicated to a transportation revolution that fundamentally enhances the safety, efficiency, and accessibility of global mobility. This Voluntary Safety Self-Assessment (VSSA) serves as a formal declaration of our commitment to a safety-first culture. By integrating the collective experience of industry leaders with our own specialized, high-reliability innovations, we have built a framework designed for the rigors of real-world transportation.

Safe deployment requires more than technical excellence; it demands a holistic operational philosophy. Our framework ensures that safety is not a post-script, but the primary driver of our organizational culture—influencing everything from high-level strategic planning to daily fleet operations. By aligning our Transportation-as-a-Service (TaaS) model with rigorous US-DOT and NHTSA standards, we ensure that every mile driven is backed by an uncompromising duty of care.

This assessment also reinforces our commitment to transparency. We believe that building public trust requires proactive communication regarding our system's capabilities, performance metrics, and operational boundaries. By providing clear, evidence-based insights to regulators, customers, and the communities we serve, Bot Auto is not just deploying technology—we are building the foundation of trust necessary to move the world forward safely.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