

FREEWAY INTELLIGENCE

Measure every movement. Manage every event.

Real-time freeway analytics and incident management powered by Blue-Band IntegraOS.



IntegraOS™

Operating System for Intelligent Infrastructure

Volume • Speed • Occupancy • Classification • Safety • Response

FREEWAY ANALYTICS & INCIDENT MANAGEMENT

ONE FREEWAY OPERATING PICTURE

Analytics & Incident Management in One Platform

IntegraOS transforms LiDAR, radar, video, and infrastructure data into continuous traffic measures, real-time event detection, automated response, synchronized replay, and actionable reporting.

24/7 Traffic observation	Real time Event decisions	Edge Resilient operation	One Unified interface
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One data stream serves two missions

PERFORMANCE ANALYTICS Understand demand, operating speed, congestion, spacing, classification, dwell, and corridor trends. Support planning, engineering, operations, maintenance, and before-and-after evaluation.	INCIDENT MANAGEMENT Detect wrong-way, erratic, overspeed, and stopped vehicles. Validate conditions, create event evidence, alert people and systems, activate interventions, and monitor clearance.
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Why IntegraOS

- Reuses existing cameras and supported sensors while connecting new LiDAR, radar, controllers, signs, and third-party systems.
- Runs critical detection, rules, recording, and intervention at the edge, even when cloud, cellular, or internet connectivity is unavailable.
- Provides a single visual framework, guided configuration, common health view, and one operator training model across use cases.
- Adds new observers, reports, devices, and corridors without creating another isolated application.

CORE TRAFFIC MEASURES

Volume, Speed & Occupancy

The foundation of freeway operations is a consistent view of how many vehicles arrive, how fast they move, and how much roadway capacity they consume.

Metric	What it measures	How the agency uses it
Volume	Vehicle count by lane, direction, class, zone, and time interval.	Demand profiles • peak-period planning • growth trends • ramp and lane utilization • diversion analysis
Speed	Individual and aggregated vehicle speed by lane, direction, class, and period.	Operations monitoring • congestion onset • compliance • safety screening • travel-condition trends
Occupancy	Share of observation time or roadway detection area occupied by vehicles.	Congestion state • capacity stress • queue formation • detector comparison • traffic-state estimation
Flow rate	Volume normalized to a standard time period, commonly vehicles per hour.	Capacity analysis • performance thresholds • bottleneck comparison • demand forecasting
Density estimate	Vehicles present per unit of roadway, derived from appropriate sensor observations or flow-speed relationships.	Traffic-state classification • shockwave awareness • recurring-congestion diagnosis
Lane utilization	Distribution of traffic across available lanes.	Lane-balance analysis • truck restrictions • managed-lane studies • incident impacts

Context makes the metric useful

- Filter by lane, direction, time, day, vehicle class, speed band, weather, work zone, or event state.
- Compare current conditions with historical baselines, thresholds, and adjacent detection zones.
- Export reports in multiple formats or present user-defined graphs through the Insight app.

15th & 85th Percentile Speeds

Average speed alone can hide risk. Percentiles show how the distribution behaves and help distinguish slower traffic, prevailing traffic, and high-end operating speeds.

Metric	What it measures	How the agency uses it
15th percentile speed	The speed at or below 15 percent of observed vehicles travel.	Identify the lower-speed portion of the stream • examine speed dispersion • detect unusually slow operation
50th percentile speed	The median: half of observed vehicles travel at or below this speed.	Describe the typical center of the speed distribution without being dominated by extremes
85th percentile speed	The speed at or below 85 percent of observed vehicles travel.	Evaluate prevailing upper-end operating speed • screen compliance and speed-management needs
Mean speed	Arithmetic average of all valid observed speeds.	High-level corridor comparison • trend reporting • operating-state monitoring
Speed variance	Spread of individual speeds around the average.	Identify differential-speed risk, unstable flow, platoon disruption, and mixed-vehicle effects
Speed bands	Counts and shares within agency-defined speed ranges.	Overspeed thresholds • slow-vehicle monitoring • enforcement and education planning

IntegraOS Insight

Users define the lanes, time windows, classes, and comparison periods. Insight then creates graphs and downloadable reports for dense real-time data, such as 15th and 85th-percentile trends by lane, weekday, vehicle class, or pre- and post-deployment period.

Percentile interpretations should follow the agency's engineering policy, applicable standards, site conditions, and study method.

Length Height Width & Dwell

Object dimensions and time-in-zone measurements reveal the composition and behavior of the traffic stream, not just how many vehicles passed.

Metric	What it measures	How the agency uses it
Length	Estimated front-to-rear vehicle dimension.	Vehicle classification • long-vehicle screening • freight share • queue and storage studies
Height	Estimated vertical vehicle dimension when supported by sensor geometry and configuration.	High-profile vehicle categories • clearance workflows • class verification
Width	Estimated side-to-side vehicle dimension when supported by sensor geometry and configuration.	Wide-load awareness • lane-position studies • class refinement
Dwell	Time an object remains in a defined roadway zone.	Stopped or slow vehicle detection • shoulder occupancy • queue duration • ramp and checkpoint studies
Classification	Agency-defined class derived from dimensions, movement, and supported sensor attributes.	Passenger/commercial mix • bus and truck reporting • planning • operations • audit and trend analysis
Presence	Confirmed object occupancy in a lane, shoulder, gore, ramp, or custom zone.	Real-time control logic • incident verification • activation of warnings and operational workflows

Designed for the selected sensor stack

- 3D LiDAR supports precise object location, trajectory, dimensions, direction, and simultaneous analytics in suitable deployments.
- Radar contributes robust speed, range, and movement data where its field of view and directional filtering support the use case.
- Video adds visual verification, classification analytics, snapshots, and synchronized replay using existing agency cameras where practical.

Headway & Gap

Spacing measures support capacity, merging, safety, connected operations, and the diagnosis of unstable freeway flow.

Metric	What it measures	How the agency uses it
Time headway	Elapsed time between comparable reference points of successive vehicles, commonly front-to-front.	Capacity and service analysis • platooning • following behavior • lane performance
Space headway	Distance between comparable points of successive vehicles at an instant.	Density and spacing analysis • digital-twin visualization • traffic-state estimation
Time gap	Available time between the rear of a leading vehicle and front of the following vehicle at a reference point.	Following-risk screening • merge opportunity • driver behavior • automation rules
Space gap	Physical clearance between the rear of one vehicle and front of the next.	Queue compression • stopped traffic • following distance • incident context
Accepted gap	Gap used by a merging or lane-changing vehicle.	Ramp merge studies • weaving analysis • work-zone operations • safety evaluation
Rejected gap	Available gap not selected by the entering or changing vehicle.	Driver comfort • constrained operations • ramp-control and geometry studies

High-density data without high-friction review

IntegraOS converts continuous trajectories into usable distributions, exceptions, trends, and event clips. Engineers can inspect a summary graph, then move directly to the synchronized movement and video evidence behind an unusual gap, hard merge, abrupt braking sequence, or queue.

DETECT THE EVENTS THAT CHANGE OPERATIONS

Wrong-Way Erratic Overspeed & Stopped Vehicles

Behavior-based observers detect high-risk movements and sustained roadway obstructions, then provide the context needed for verification, alerting, and response.



Incident observer	IntegraOS response
Wrong way	Confirms prohibited direction and path; tracks ramp and mainline movement; alerts operators and connected systems; supports DMS or other approved interventions.
Erratic driver	Observes unusual weaving, repeated lane changes, abrupt path changes, unsafe speed differentials, or agency-defined movement patterns.
Overspeed	Applies lane-, class-, zone-, and condition-specific thresholds; records supporting speed and trajectory evidence; routes alerts and reports.
Stopped vehicle	Uses presence, speed, and dwell rules to distinguish a sustained stop in a lane, shoulder, gore, ramp, or other agency-defined zone.

FROM DETECTION TO MANAGED RESPONSE

Sentinel Turns an Event into an Operational Workflow

An alert is only valuable when it arrives with context, reaches the right systems, and supports action. IntegraOS manages that chain at the edge and coordinates it across the enterprise.

1 OBSERVE	Fuse sensor and infrastructure inputs. Apply agency-defined zones, directions, thresholds, timing, and multi-condition logic.
2 VALIDATE	Use persistence, trajectory, sensor agreement, classification, and context rules to reduce nuisance events.
3 RECORD	Create a timestamped event with video, snapshots, object tracks, speed, direction, location zone, and pre/post-event history.
4 ALERT	Notify operators, traffic-management software, maintenance, public safety, and other authorized recipients or systems.
5 INTERVENE	Activate approved DMS messages, beacons, signs, gates, lighting, signal logic, or third-party technology.
6 TRACK	Continue path monitoring across ramp and mainline zones; update state, escalation, correction, and clearance.
7 REPLAY	Review synchronized existing-camera video and a 2D digital twin on one timeline; preserve evidence for reporting.

IntegraOS Sentinel

Resilient by design

Critical detection, event creation, recording, rules, and local outputs can continue without cloud, cellular, or internet connectivity. Enterprise and optional SaaS layers add systemwide management without making the edge dependent on them.

OPERATE UNDERSTAND SUSTAIN

IntegraOS:

Sentinel, Insight, Health & AI Bridge

SENTINEL Defines observers, identifies events, creates real-time replays, sends alerts to multiple devices, and produces outputs for approved intervention technology.	INSIGHT Creates user-defined graphs for at-a-glance understanding and produces reports and downloads from high-density real-time data.
HEALTH Displays component health, uptime, communications, faults, recording state, and overall system working status in real time.	AI BRIDGE Connects agency-selected AI models and tools so authorized users can ask operational questions in standard language and receive tables, graphs, and explanations.

Questions become operational answers

- “What were the 15th and 85th percentile speeds by lane during the morning peak?”
- “Which stopped-vehicle alerts occurred during rising occupancy and shrinking gaps?”
- “How many wrong-way vehicles reached the mainline, self-corrected, or required intervention?”
- “Which sensors have declining uptime or incomplete data during peak periods?”

No more fragmented systems

IntegraOS provides one modular, multi-vendor operating framework for analytics, incident management, visualization, reporting, system health, and automation, reducing duplicated integrations and expanding the value of every sensor deployment.

START WITH ONE CORRIDOR SCALE WITH CONFIDENCE

A Practical Deployment Path

Deploy the analytics and incidents that matter now, validate performance, then reuse the operating model across the network.

Phase	Action	Outcome
1	Discover	Confirm lanes, ramps, zones, available sensors, existing cameras, outputs, data needs, retention, and success criteria.
2	Design	Select sensor roles; configure volume, speed, occupancy, dimensions, dwell, headway, gap, percentile, and incident observers.
3	Validate	Compare measurements with accepted ground truth; tune thresholds; test alerts, replay, interventions, failover, and health monitoring.
4	Operate	Train operators in one interface; monitor incidents and system status; schedule reports and approved data exports.
5	Expand	Replicate configurations; add locations, sensors, analytics, observers, reports, and enterprise workflows without replacing the platform.

Value from the same deployment

Analyze Traffic performance	Detect Safety events	Automate Agency response	Verify Replay and report
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The result

- A consistent freeway data source for operations, planning, engineering, and safety.
- Real-time analytics provide quick event awareness with evidence attached and response status visible.
- More value from existing cameras and a future-ready choice of LiDAR, radar, video, and third-party systems.
- Single-platform training, configuration, monitoring, and reporting from edge to enterprise.

Ready to Deploy IntegraOS™? Choose one corridor or high-risk safety zone, validate performance, and scale across your network.

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