



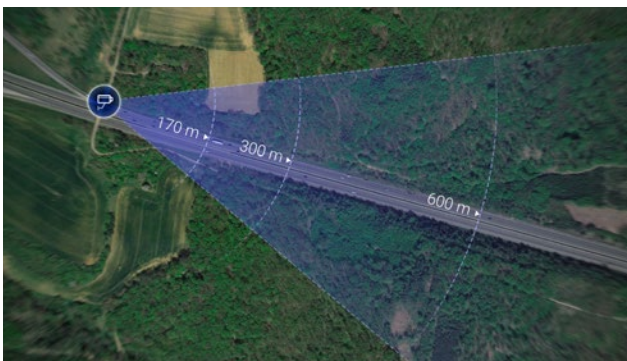
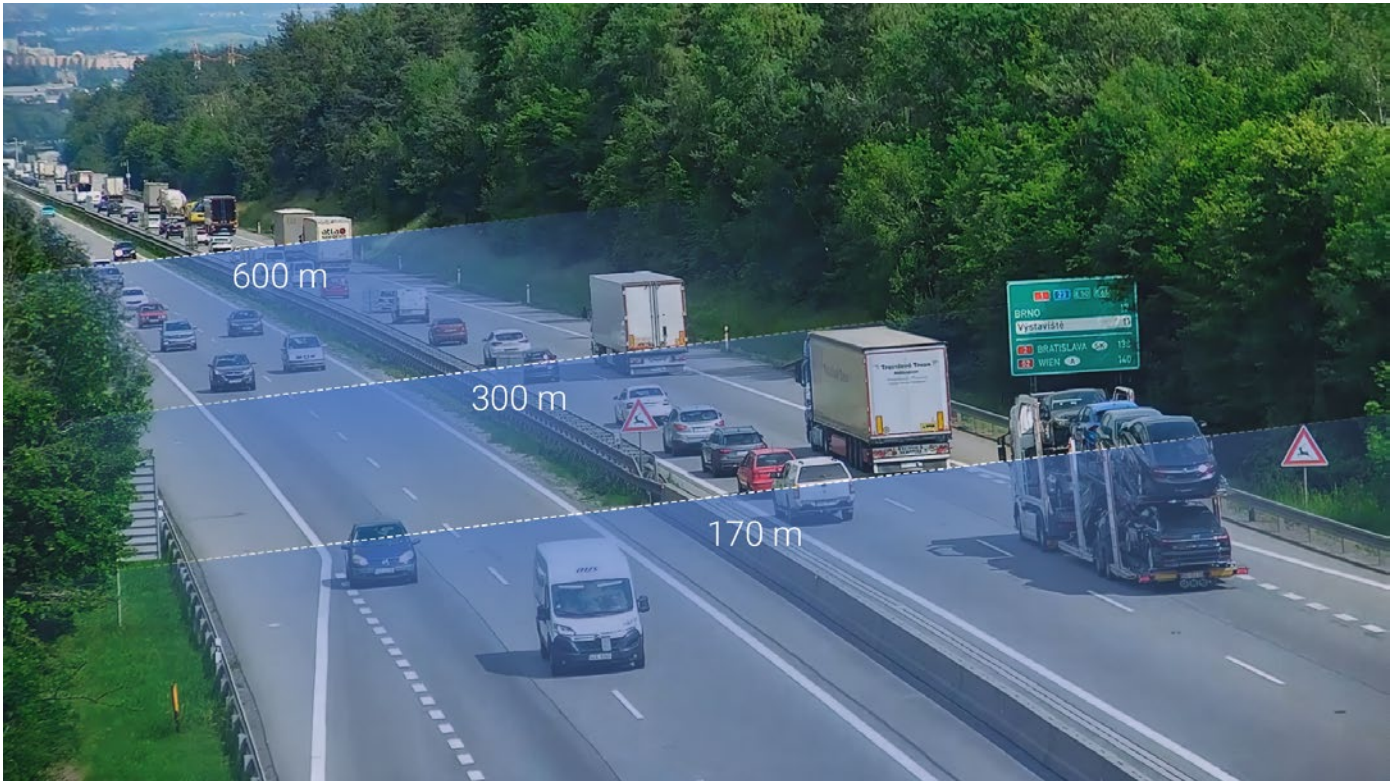
Long-Distance Monitoring on Highways Using Video Analytics

Highways are vital components of national and regional transportation networks, enabling the movement of people and goods across significant distances. Ensuring the efficiency and safety of these key routes is essential for the smooth operation of modern societies. The cost of infrastructure for frequent sensor installation would be prohibitive. Therefore, monitoring often requires covering up to 600 meters from a single sensor point, and occasionally, this coverage is demanded in just one direction.

Current Technologies and Limitations

The technologies deployed in traffic monitoring include laser rangefinders, radars, and camera systems. Laser rangefinders and radars, which are active sensors, emit radiation and capture the signals reflected back to them, boasting

effective ranges of approximately 150 meters and up to 500 meters, respectively. Cameras function as passive sensors with detection ranges defined by the optical system configuration. Proper setup allows these cameras to detect the first vehicle from distances exceeding 800 meters. All sensors are susceptible to environmental factors; however, radars tend to exhibit the lowest sensitivity to such conditions



One camera covered approximately **800 meters**. We conducted control measurements at **170, 300, and 600 meters**.

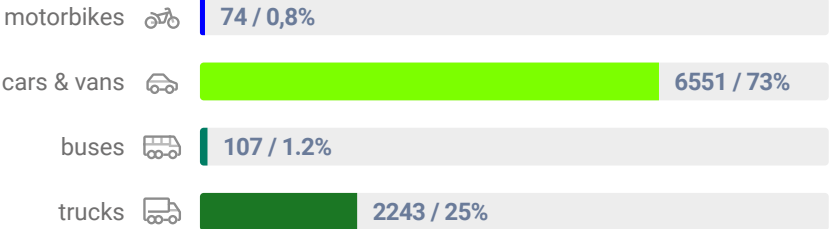
compared to cameras and lidars. A major challenge for all these sensors is static and dynamic occlusions. These can significantly hinder the tracking of multiple moving objects, especially in dense traffic conditions.

Why Video Analytic for Highway Monitoring?

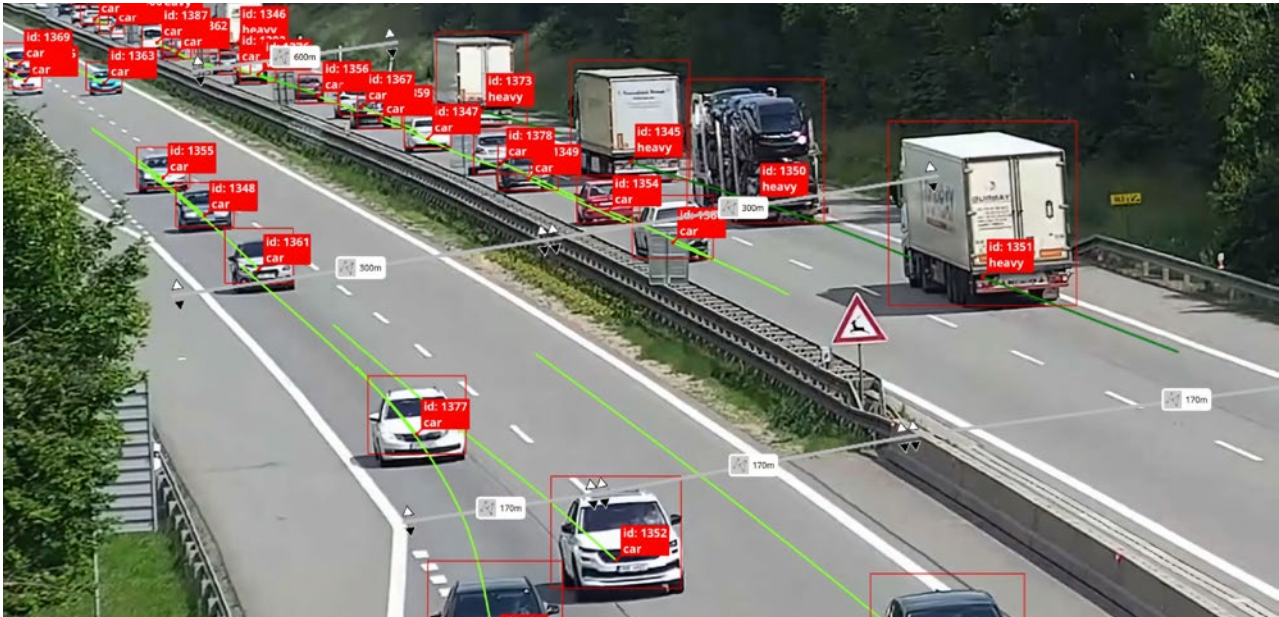
Camera systems offer several advantages, including cost-effectiveness, multipurpose capabilities when paired with suitable software (e.g., smoke and fire detection, traffic data and incident detection, obstacle recognition, license plate reading, and operator visual checks), and extensive detection ranges customized through optical configurations. However, they depend heavily on the lighting conditions of the observed scene.

Testing Scenario – Heavy Traffic on Highway

To understand these dynamics in practice, we conducted a test at the Kyvalka Exit on the D1 Highway, Czech Republic, using the B2M7-55F70V1 IP camera with Full HD resolution and 60 FPS, mounted 15 meters above the highway. During a one-hour testing period, we manually counted vehicles at distances of 170, 300, and 600 meters from the camera, recording a passage of **8,974** vehicles.



The control measurement lasted one hour during heavy traffic with occasional traffic jams.



Accuracy of Video Analytics

Using FLOW Video Analytics, we evaluated the traffic flow at these distances and compared the data with manually obtained counts. The results were impressive:

accuracy	← towards the camera	against the camera →
at 170 m	99.27%	98.19%
at 300 m	98.57%	94.11%
at 600 m	77.95%	hidden by the trees

The system demonstrated better accuracy for traffic moving towards the camera due to the angle reducing the effect of dynamic occlusions. FLOW's ability to recover from classification errors using new data makes the slight differences between detection accuracy and classification almost negligible. At a distance of 600 meters, the accuracy dropped by about 22%, primarily due to occlusions among objects. However, in less congested traffic, accuracy at 600 meters could exceed 90%, and for clearly visible vehicles, it could surpass 95%.

FLOW: Your New Solution to Traffic Monitoring

Reliable detection and tracking of objects are foundational for sophisticated traffic flow analysis and data collection. FLOW offers a modern video analytics framework with built-in detection of traffic incidents such as wrong-way driving, traffic jams, stopped vehicles, smoke emergence, and road obstacles. It provides real-time traffic statistics such as classified vehicle counts and service level evaluations. FLOW features a specialized user interface for defining highway monitoring tasks, significantly speeding up

system configuration across multiple cameras. Integration with VMS like Milestone and data/event transmission in various formats, including OPC UA, WEBHOOKS, REST API, etc., are standard. FLOW offers centralized data processing on powerful servers with AI accelerators and failover system configuration, as well as on-camera image data evaluation for compatible camera types. It can process the data even from PTZ cameras supporting the ONVIF protocol.



Are you looking for a **video analytics solution for monitoring highways or tunnels**? Contact us to try this market-validated innovative solution, and see how **FLOW** can enhance your traffic monitoring systems.