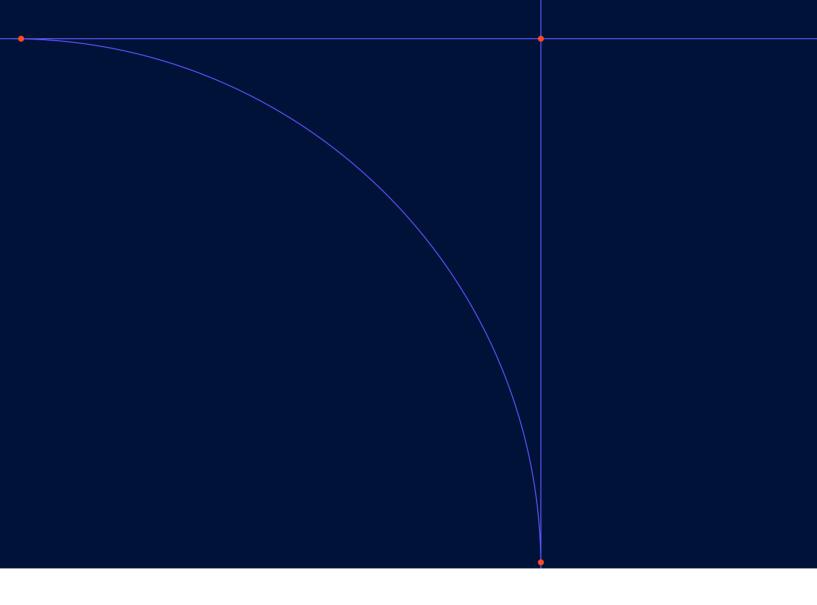
Fits.

Unified back-office as a solution for your transportation needs



dots.

Future Intelligent
Transportation Solutions

No part of this document may be reproduced, transmitted, rewritten or stored in any electronic search system and translated into any language without permission received from WeAreDots, SIA and without complete reference to this document.

© dots.

All trademarks used in the text are the property of their respective owners and can be used only as a reference.

dots.

WeAreDots, SIA, 2018 Elizabetes str. 75, Riga, LV1050

Phone number: +371 67509912 E-mail: info@wearedots.com

Table of Content

About Fits.	04
Traffic Safety and Security	07
Road Pricing and Tolling	09
Traffic and Infrastructure Management	11
Computer Vision Solution	13
How Can We Help?	16
Case Study National Speed Enforcement Back-office Implementation	17
Case Study Automated WIM Enforcement Back-office Implementation	20
Case Study National e-vignette enforcement back-office for trucks above 3.0t	22
Case Study Operational back-office for road-side ITS equipment centralized monitoring and management	24
Case Study Operational back-office for road-side ITS equipment transnational monitoring and management within Baltic Road E67	26
Overall about dots.	28

About Fits.

Our vision is to offer the best and most flexible operational back-office to foster:

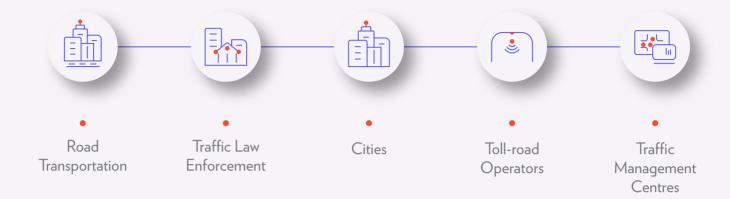
- road safety.
- enforcement in tolling and charging,
- management of road-side ITS sensors and traffic equipment.

Fits. is a neutral software back-office platform that enables efficient and reliable data processing to improve capabilities of Traffic Authorities, Law Enforcement and Traffic Management Centres.

Fits. System Best Serves the Following Use Cases



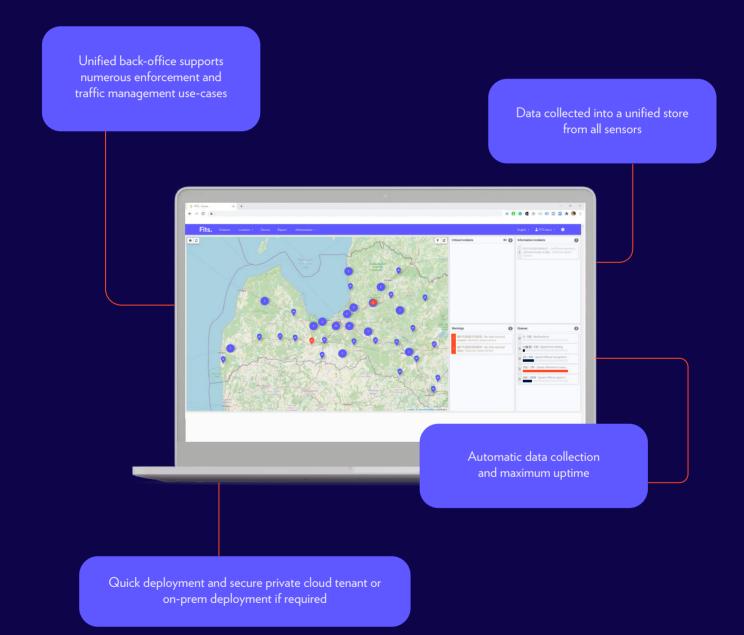
Designed for:



Unique Platform Features and Benefits

Features				Benefits
Unified Back-office		Unified back-office supports numerous enforcement and traffic management use-cases		Cost efficiency and less complexity, no need to maintain multiple back-office systems
One place for all data		Data collected into a unified store from all sensors		Elimination of data silos and possibilities to fuse data to automate variety of sensors
Automated Data Processing		Automatic data collection and maximum uptime		Less manual processing, increased reliability operations services
Quick Deployment		Quick deployment and secure private cloud tenant or on-prem deployment if required		Faster time to delivery, GDPR compliance

Back-office Example



07 • 28

Fits.safety



Traffic Safety and Security

Fits.safety is a unique, web-based traffic violation enforcement back-office system that supports data processing of the most common types of traffic violations. System is designed in a way that allows Authorities to spend less time on manual, monotonous operations, and more time on tasks that add value.

Designed for:



Public Authorities of Transport and Interior



Traffic Law Enforcement



Municipalities

Overview

Use-cases

Sensor Type

Back-office Key Features

01

Speed and Red-light Enforcement Fixed

Mobile

Average Speed

02

Weight Sensors

Weight-in-Motion Enforcement

ANPR

03

ANPR

Bus Lane Enforcement

CCTVs

04

ANPR

Suspicious and Stolen Vehicle Monitoring

CCTVs

Deep neural network powered centralized ANPR and Vehicle Type classification.

Automated violation case preparation and off-loading for further processing.

Violation data evidence management and rich search capabilities.

Configurable Dashboard view of the whole sensor network and KPIs.

Deep-level sensor monitoring and management, encryption certificate management.

Integrations with internal and external systems, e.g. vehicle registration databases, other offence administration systems.

Role-based system access control.

Reporting and statistics, including full traffic flow information if required.

Benefits

Policy Makers

Safety Manager

Back-office System Users

Reduced cost to enforcing safety

Automated traffic surveillance is efficient and requires fewer personnel resources

Adaptability – can be easily introduced as a part of existing safety ITS systems

Centralized visibility into full spectrum of offences

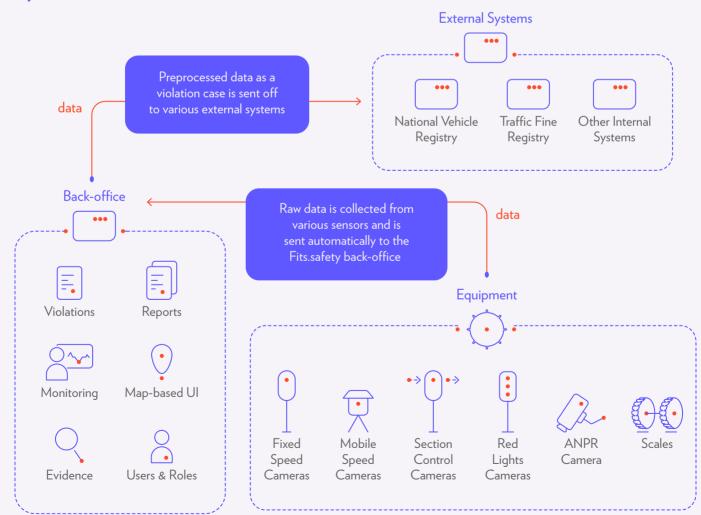
Rich reporting capabilities, complemented by statistics on full traffic flow

Avoiding lock-in with specific hardware vendors due to Fits.safety being hardware agnostic Ease of use and excellent overview of the full sensor network

Increased productivity due to powerful KPI dashboard and monitoring capabilities

Focus on the important work avoiding tedious tasks

How Does the System Work?



Fits.to|| 09 • 28



Road Pricing and Tolling

Fits.toll is a web-based road pricing enforcement back-office system that enables efficient collection and processing of non-payment across most common road pricing schemes such as tolling, low emission zones or congestion charging. System is enriched by Al and is designed in a way that allows integration into existing environments.

Designed for:









Toll Operators

Concessionaires

Public Authorities

Cities

Overview

Use-cases

Sensor Type

Back-office Key Features

01

E-vignette Enforcement Video

LIDAR

ANPR

02

Weight Sensors

Electronic
Toll Collection
Enforcement

LIDAR

ANPR

03

Low Emission Zones Enforcement **ANPR**

CCTVs

04

Congestion Charging Enforcement **ANPR**

CCTVs

Automated non-payment or invalid payment case preparation and off-loading for further processing

Violation data evidence management and rich search capabilities

Configurable dashboard of defined KPIs, map-based view of the whole roadside sensor network

Al powered secondary ANPR and Video-based vehicle classification

Road-side sensor operational monitoring and management

Standard interfaces allow integrations with internal and external systems, e.g. vehicle registration databases, whitelists, CRMs, etc.

Role-based system access control

Reporting and statistics, including full traffic flow information if required

Benefits

Policy Makers

Project Manager and Enforcement Managers

Back-office System Users

Reduced cost of enforcing road pricing

Adaptability – can be easily introduced as a part of existing road pricing scheme

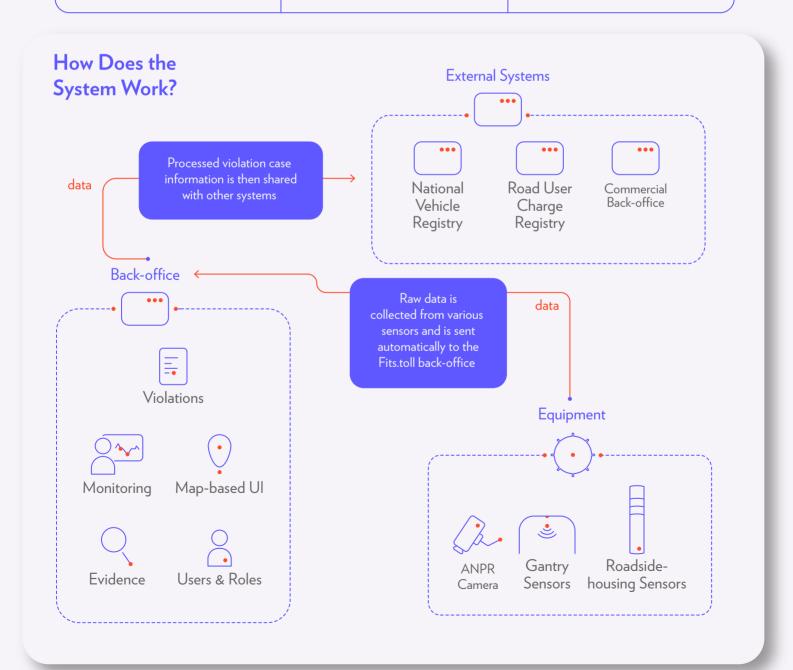
Flexibility – supports enforcement of multiple types of road pricing schemes Flexible IT infrastructure hosted on the cloud or can be run locally

Faster, better decisions - rich reporting capabilities, visibility on data and core KPIs

Avoiding lock-in with specific hardware vendors due to Fits.toll being a hardware agnostic platform User friendly UI for tasks such as violation image review and overall case search

Excellent overview of the full road-side equipment network with monitoring and management capabilities

Dashboard view of the KPIs provide easy access to most important information



Fits.hub 11 • 28



Traffic and Infrastructure Management

Fits.hub is a web-based traffic and infrastructure management back-office system that enables efficient monitoring and management of a complete fleet of roadside ITS equipment. System is enriched by Al to capture traffic flow data and is designed in a way that allows integration into existing environments.

Designed for:







Toll Operators



Cities

Overview

Use-cases

Sensor Type

Back-office Key Features

01

Monitoring of Roadside ITS Equipment Weathe Stations

Variable Message Signs

Traffic Lights

Traffic Counters

Video Cameras

Speed Cameras

02

Management and Automation of VMS

Variable Message Signs

03

Traffic Flow Monitoring

Video Cameras Al powered secondary ANPR and Video-based vehicle classification

Configurable dashboard of defined KPIs, map-based view of the whole sensor network

Easy to observe overview of the overall sensor network operational status

Simple configuration of objects such as new locations, equipment, etc.

Integrated notification workflows with real-time alarm transmission.

Role-based system access control

Reporting and statistics

Support of Datex II data exchange standard.

Benefits

Policy Makers

Traffic Manager

Back-office System Users

Increased road-safety due to faster reaction times to fix faulty sensors

Reduced data silos – road-side equipment infrastructure can operate as a unified system

Decreased overall operational costs and avoidance of lock-in with specific hardware suppliers Automated data collection and data processing decrease manual operational tasks

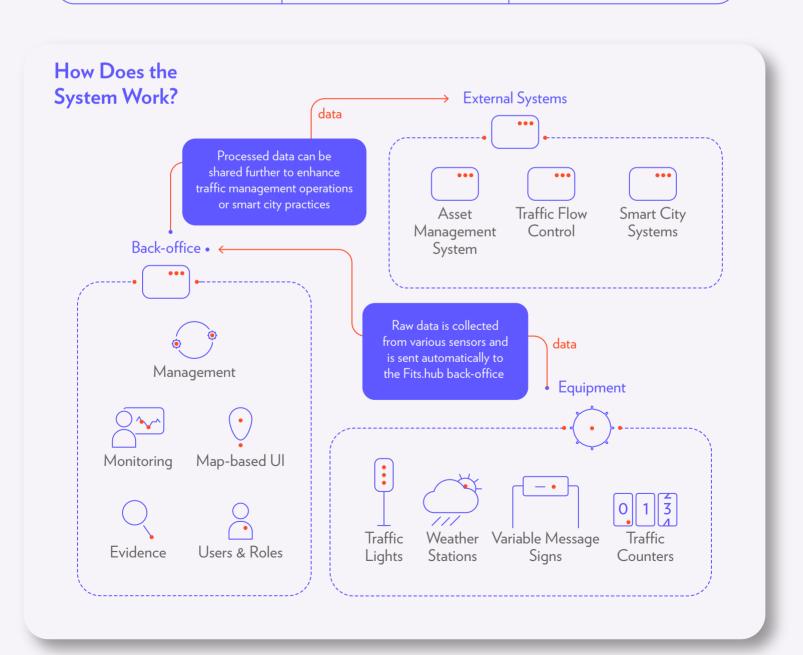
Adaptability and visibility – integrable into existing ITS environment providing full overview of the assets

Operational excellence – improved operational processes and service quality

User friendly UI to monitor operational and non-operational sensors of the whole sensor network

Increased productivity – capability to react very fast to any faulty equipment

Decreased risks associated with maintaining traffic safety and quality of operations



Fits.vision 13 • 28



Computer Vision

Fits.vision is a solution that can make a difference to your efforts of making roads safer and mobility management more efficient. Our software uses videos or images produced by your cameras to see, understand and extract valuable insights from what happens on the roads in order to raise your overall capabilities.

Designed for:







Toll Operators



Law Enforcement

Traffic Management Centres

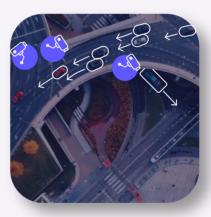


Traffic Flow Counting and Classification

Fits.vision enables the capture of a road traffic flow intelligently and accurately without the need of installing and maintaining in-pavement loop sensors.

We enrich your existing camera infrastructure and enable you to:

- count traffic with high accuracy rate (influenced by image quality factors);
- classify vehicles by type (passenger cars, motorcycles, buses, heavy goods vehicles, etc.);
- feed that data to support smart traffic lights or other decision-making systems in traffic management



Intersection Monitoring

Fits.vision enables the capture and monitoring of a traffic flow on intersections in the city.

We enrich your existing camera infrastructure and enable you to:

- count traffic by direction with high accuracy rate;
- monitor left turn compliance;
- detect stopped vehicles and automate accident detection;
- feed that data to support smart traffic lights or other decision-making systems in traffic management.

Combination of know-how in Computer Vision and novel Deep Learning Al technologies enable dots. to provide tailor made solutions. We empower customers by understanding their unique circumstances and providing an expert opinion that is relevant.



Automatic Incident Detection

System can be trained for incident detection in the **tunnels** and on the **roads**. Incidents such as (but not limited to):

- wrong-way driving
- vehicle gueuing in the tunnels
- stopped vehicles in the tunnels
- trejectory anomalies
- railway level crossing monitoring



Road Asset Management

System can be trained to support your road network asset management effort by automatically identifying road-signs, lane marking condition, potential surface defects and other observable asset types. Maintenance decisions would become more informed and efficient. Such solution would entail:

- automated asset collection
- asset identification and classification
- GPS data to support linear asset management

Law Enforcement



Identification of Suspicious Vehicles

Fits.vision can combine capabilities like automatic number plate recognition, vehicle type classification, make and model recognition to enable Law Enforcement Agencies to identify and deal more efficiently with suspicious vehicles.

By cross-correlating data from central vehicle registries and what can be observed on the roads, it is possible to flag suspicious vehicles in an automated fashion.

Toll Operators



Traffic Flow Counting and Classification

Fits.vision enables the capture of a road traffic flow intelligently and accurately without the need of installing and maintaining in-pavement loop sensors.

We enrich your existing camera infrastructure and enable you to:

- count traffic with high accuracy rate (influenced by image quality factors);
- classify vehicles by type (passenger cars, motorcycles, buses, heavy goods vehicles, etc.);
 - feed that data into other systems to support tolling and traffic management efforts



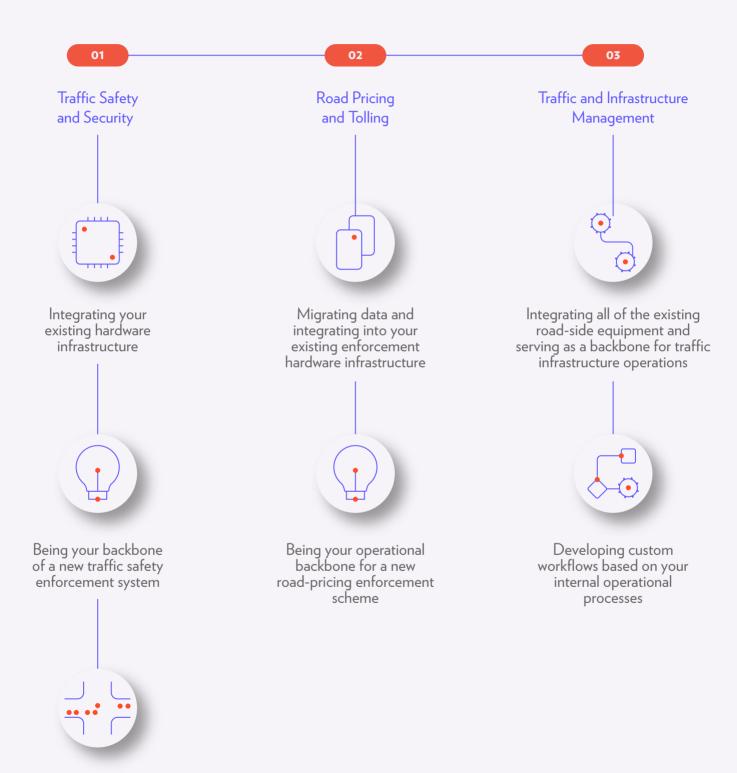
Vehicle Detection, Tracking on MLFF Tolling Lanes

Fits.vision enables vehicle detection and tracking on multi-lane-free-flow tolling lanes to facilitate the Electronic Toll Collection process.

- leverage your existing infrastructure; can complement or even replace expensive LIDAR solutions that are
- being used for tracking and classification purposes;
- provide a flexible software solution that can be adapted to different gantry and sensor configurations

How Can We Help?

implementing new enforcement hardware and integrating existing one



National Speed Enforcement Back-office Implementation



114 speed cameras



>800k enforcement cases per year



3 vehicle classes automatically recognized



98.3% ANPR accuracy rate in realtime



33% less traffic accidents



2.07km/h decrease in average speed

Client

The Challenge

The Solution

The Road Traffic Safety Directorate (CSDD) is a public limited company that deals with vehicle registration, drivers' qualification exams, issuing driving licenses, technical insurance, road safety audits and general monitoring, maintaining the public register as well as educating and informing road users.

Due to the limited number of outdated speed detection devices and the increased number of car accidents caused by speeding, the Latvian demography and economy were suffering considerably. The challenge was to roll-out fast a cost-effective solution that would improve road safety.

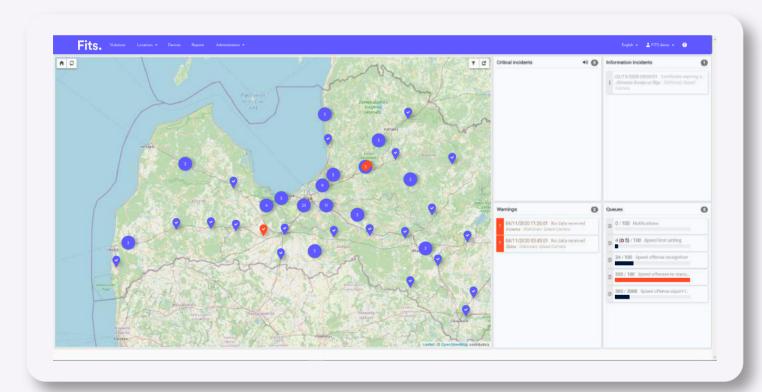
The solution was to deploy a system consisting of an enforcement back-office and 100 stationary and 14 mobile speed cameras, that would be installed on the roads of Latvia.

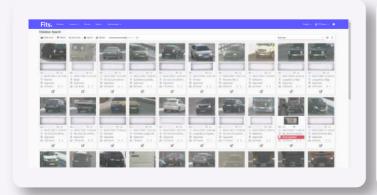
dots. was responsible for the development, implementation and operation of the central back-office system that would process, prepare and offload an enforcement case to external Fine Administration and Violation system. Integration of the speed enforcement sensors enabled automated data ingestion over a mobile network establishing a very efficient violation processing practice.

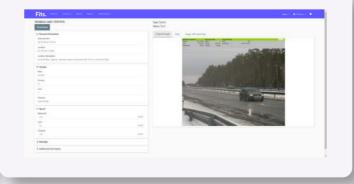
As part of the service, dots. provided 24/7 monitoring and maintenance of the camera network, resolution of any network issues (with any of the involved parties, including power utilities and mobile network operators). To achieve strong back-office performance, maximum accuracy and to minimise the number of manual tasks, dots. implemented a deep neural network based on:

- ANPR (Automatic Number Plate Recognition), including country issuer recognition
- automatic vehicle typology classification (passenger vehicles, motorcycles, HGVs)

Al workloads in the back-office facilitated pre-processing of speeding violations.







The Outcome



Every year 1M people worldwide die due to car accidents. That makes half of the population of Latvia. And if we can change this atrocious statistic by improving the road environment, it's our number one priority!

In 2019, 3 729 car accidents were recorded in Latvia, but by implementing new technology speed cameras, we were able to significantly decrease these numbers, allowing us to believe that the cameras are doing their job properly.



CSDD

The Road Traffic Safety Directorate

As a result, Latvia could start small, installing just a few speed cameras at first, and then was able to scale up as quickly as necessary without additional investment in IT capabilities. More importantly, having control over the complete data lifetime – from camera network availability to speeding ticket export for law enforcement agencies – ensures high data quality and strict adherence to the predefined service-level agreement.

The whole process can take as little as a few minutes, from the detection of a violation, to an enforcement case that is ready for export. Not only is data automatically imported from the cameras, it is also pre-processed using deep neural networks to segment, classify and recognize vehicles, doing so with previously unattainable granularity and precision.

As an example, while many speed cameras can classify only trucks and passenger vehicles, the Latvian solution can discern, motorbikes, buses, and can be extended to other vehicle classes as well.

These new capabilities improve the flexibility of speed enforcement (for example, allowing for more granular thresholding of different vehicle classes, and applying various thresholds based on visually detectable weather conditions), while also increasing the productivity of back-office workers, making it possible to process a much larger amount of cases (applying different workflows for emergency vehicles, bikes with no license plate facing the camera, etc).

In 2014-2018, the number of traffic accidents in the locations where speed cameras have been placed has dropped by 33% and serious traffic accidents - by 36%.

During this time period, the average speed has been also decreased from 91.76 km/h to 89.69 km/h. Moreover, ETSC has calculated that by reducing the average speed by 1 km/h possible to decrease the number of deaths by 2100 yearly.

Automated WIM Enforcement Back-office Implementation



Available rich traffic flow data



25% decrease in amount of vehicles above 52t



Enforcement processes made more efficient



System ready for direct enforcement

Client

The Challenge

The Latvian State Roads performs the management of the state road network, administration of the State Road Fund and organisation of public procurement in order to provide the publics with profitable, durable, safe and environmentally friendly state road network.

It's a common understanding that overweight vehicles pose risks to road infrastructure and safety.

Total weight, axle loads and spacing of the vehicle is crucial for road structures such as bridges and others, while axle and axle group loads are crucial for pavements.

Almost a third of the full traffic flow on the main Latvian roads come from the Heavy Goods Vehicles and the problem with overweight vehicles on the national roads became evident.

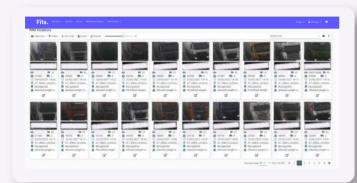
Periodically organised manual traffic controls confirmed that the laws were not abided by a large number of carriers but the scope of the issue was hard to estimate precisely due to a lack of automated and efficient approach towards monitoring the full traffic flow for overweight vehicles.

The Solution

dots. was contracted to implement a Fits.back-office solution that would integrate Kistler's WIM sensors and Siemens Sicore II ANPR cameras to automatically capture photographic evidence of all of the overweight vehicles (recording gross vehicle weight and axle loads).

The solution also provided information on the full traffic, which enabled the client to evaluate the overweight vehicle data in the context of the complete traffic flow.

Fits.safety system is used to facilitate the pre-selection process and to gather necessary evidence data. It is then prepared for delivery to the responsible road-safety authority for further violation processing purposes.





The Outcome



Overloaded trucks damage the carriageway, and over time, even on a newly built road, disruption can rapidly occur, becoming an overwhelmed threat to road safety and a costly issue that needs to be repaired as quickly as possible. Therefore, the control of such cars is utterly important.



The Latvian State Roads

Latvia could start with a modern back-office system in place that would easily support a further expansion of the WIM locations across the main highways as well as providing direct enforcement capabilities as soon as the changes in the law would permit such enforcement method.

The current installation at one of Latvia's most important highways (A7) provides necessary data and valuable insight into the proportions of overweight vehicles. Recent measurements have indicated that on average:

- 44 % of all vehicles are above 3.5t.
- 5.6% of vehicles are above 44t.

Data shows that pre-selection of the vehicles has not only made the work of law enforcement officers more efficient but also the amount of heavily overweight vehicles is steadily decreasing.

National e-vignette enforcement back-office for trucks above 3.0t



Vignette income from 2017 to 2019 increased by 12%



+110 speed cameras network



Monitoring of vehicle insurance and inspection status



Non-payment compliance reduced from 16% to 4% at the control locations

Client

The Challenge

Ministry of Transport, the leading institution of state administration of transport and communications, whose mission it is to improve and implement the state policy of Latvia in the fields of transport and communications, to maintain and develop an effective, safe, competitive, environmentally friendly and flexible transport system and create a liberalized and harmonious legal and economic environment of the communications sector.

Roads and means of transport make a crucial contribution to the economic development and growth, bringing important social benefits with it.

Poorly maintained roads constrain mobility, significantly add to vehicle operating costs, increase accident rates and the costs associated with them. Seeking for an automated go-to solution, the Ministry of Transport decided to introduce the Road User Charge - a payment for using the main state and regional Latvian roads to facilitate their maintenance and development, as well as to promote the use of environmentally-friendly vehicles.

However, after an in-depth examination, they noticed that the toll is often not paid according to the vehicle's gross weight. Moreover, if the Latvian border could be crossed within 3 hours of driving, both domestic and international drivers predominantly chose not to purchase the toll at all. Thus, in 2016, around 30% of the planned (> 4M EUR) revenue from the Road User Charge wasn't collected and couldn't be applied to improve the road environment.

The Solution

The Outcome



Thanks to advanced technologies, we have accessed valuable data and gained information transparency regarding vehicles on our roads.

Today, as the system is fully automated, we have diminished human involvement in the administrative tolling process and are now able to focus on strategically more important tasks - how to further improve the road environment and maintenance so that every road user feels safe while driving.





The Ministry of Transport

With that in mind, The Ministry of Transport decided to deploy a long-term, cost-effective smart e-vignette enforcement system and assigned Latvian State Roads to implement the project.

dots. delivered a Fits.toll back-office system which was connected to tolling enforcement sensors that automatically scanned the traffic flow and collected data regarding the:

- Vehicle's type,
- Time.
- Location,
- Country.

Within the set time frame of 4 months and owing to a close collaboration of all stakeholders, a fully automated and integrated te-vignette enforcement system was installed.

Today, the Ministry of Transport is able to gather valuable traffic flow information and facilitate the e-vignette compliance processes.

It has been established that within 2 months the total sum of violation protocols drawn up regarding the Road User Charge has surpassed the investments allocated to the implementation of Fits.toll. Everything being fully automated means less human intervention in administrative processes and lesser overall costs, but most importantly – the Ministry of Transport can claim full transparency and instant information regarding the overall traffic flow situation at the monitoring sites so that calculated and adjusted road improvements can be made.

Operational back-office for road-side ITS equipment centralized monitoring and management

>200 sensors monitored in a single system:

Weather Stations
Variable Message Signs
Weight-In-Motion Scales
ANPR Cameras
Traffic Lights
Weather Cameras
Street Light
Traffic Counters
Vehicle Activated Sign
Gantry, Tower Tolling
Equipment

Client

The Latvian State Roads performs the management of the state road network, administration of the State Road Fund and organisation of public procurement in order to provide the public with profitable, durable, safe and environmentally friendly state road network. Maintenance and development of parish, company and household roads are supervised, as well.

The Challenge

The Latvian State Roads focuses on three fundamental principles: sustainability, mobility and technological advancement.

In order to boost the road users' safety and effectively advance the road environment state authorities sought the ways how to achieve these goals as efficient and cost-effective as possible. Unfortunately, problems originated due to outdated systems that were too expensive to replace and difficult to improve. Large amount of unsorted (raw) data gathered manually from mutually independent systems caused uncertainty in operations and errors in decision making.

The Solution

dots. designed a solution, in which all road-related sensors (road cameras, traffic lights, weather stations, variable message signs, traffic counters, weight-in-motion etc.) were centralized, monitored and managed from one complete system for 24/7 and in real-time.

The Outcome

As a result, the Latvian traffic system management has been updated, modernized and automated according to today's standards. For road authorities, it means a unified system for data transparency, reduction in manual work, agile sensor maintenance and rapid and quick replacement of the outdated sensors.

For road users, it means a better managed road and a safer environment with fewer hazards.



By developing a mobile, safe and environmentally friendly transport system, cities not only rejuvenate the road infrastructure but also lessen the time spent staring out the windshield and prolong the time spent with the family, friends or doing something more content.





The Latvian State Roads

Operational back-office for road-side ITS equipment transnational monitoring and management within Baltic Road E67



Client

The Latvian State Roads performs the management of the state road network, administration of the State Road Fund and organisation of public procurement in order to provide the public with profitable, durable, safe and environmentally friendly state road network. Maintenance and development of parish, company and household roads are supervised, as well.

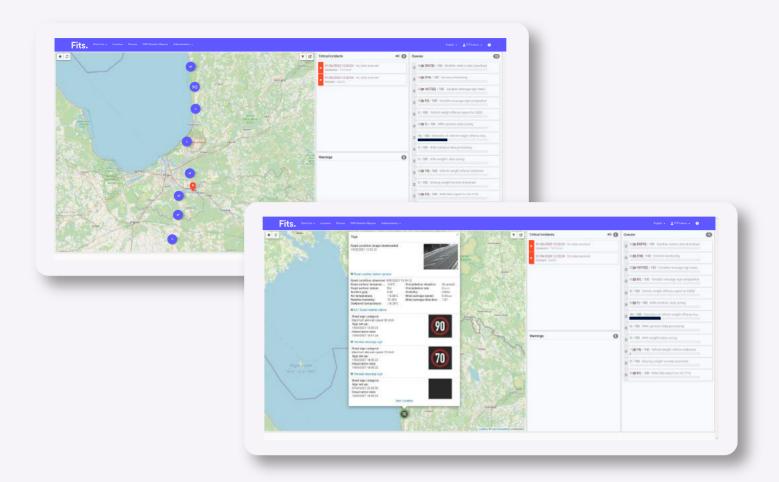
The Challenge

Efficient road network is a key to economic activity and mobility of people and goods. While basic road infrastructure (road surface) was modernized on E67 transport corridor in Latvia and Estonia, traffic information systems needed considerable improvements to facilitate passenger safety and to ensure efficient and environment friendly cargo transportation.

The Solution

SMART E67 project aims to increase efficiency and safety of passenger and cargo mobility in the Central Baltic region by introducing Intelligent Transport Systems (ITS) on E67 transport corridor – a key transport corridor in Estonia and Latvia (North-South direction). Project was implemented in close cooperation between Latvian State Roads and Estonian Road Administration.

dots. was responsible for the delivery of the central ITS management platform to Latvian State Roads. Fits. back office solution would connect in a unified fashion Variable Message Signs, Road Weather Stations, Traffic Video Monitoring Points, Traffic Lights to enable efficient and automated traffic operations on the corridor whilst ensuring the traffic data exchange acros the corridor in a Datex II supported format.



The Outcome

Implementation of Fits.hub back-office enabled Latvian State Roads to unify multiple ITS sensors into a single management platform, this capability ensured that the project goals were met. Average travel times across the corridor decreased, traffic safety was increased, and vehicles generated less emissions.

Within Ex-Post analysis it is now known more precisely that:

- SMART E67 project is economically feasible, with B/C ratio 4,4, which is very good according to the ROSEBUD WPS scale;
- Average driving time on the Via Baltica route sections has been reduced by 2,05 minutes/ vehicle;
- Average total travel time on Via Baltica route sections has been decreased by 0,747%;
- The annual total travel time savings on Via Baltica route sections is 192 000 hours/year.

Overall about dots.

dots. was founded upon the fundamental belief that structured yet facile data-driven solutions can rapidly lead digitalization and growth of any industry.

We are a technology company with a 20-year experience in complex software development, IT infrastructure, cybersecurity services and R&D.

We take pride in having built unique solutions that leverage Artificial Intelligence and solve various challenges across the transportation sector domains of:

- Road safety,
- Road pricing and tolling,
- Traffic and infrastructure management

dots, is an active member of ERTICO.

Partnerships

Our solution platform is flexible and integrates with a variety of ITS systems, it can be adjusted to work as a part of a larger ITS system or easily integrated with existing solutions.

We are actively cooperating with ITS sensor supplier and ITS integrator partners across Europe and we are open to new cooperation opportunities.



wearedots.com info@wearedots.com +371 67509912