ASTRA
TRAFFIC ENFORCEMENT CAMERA

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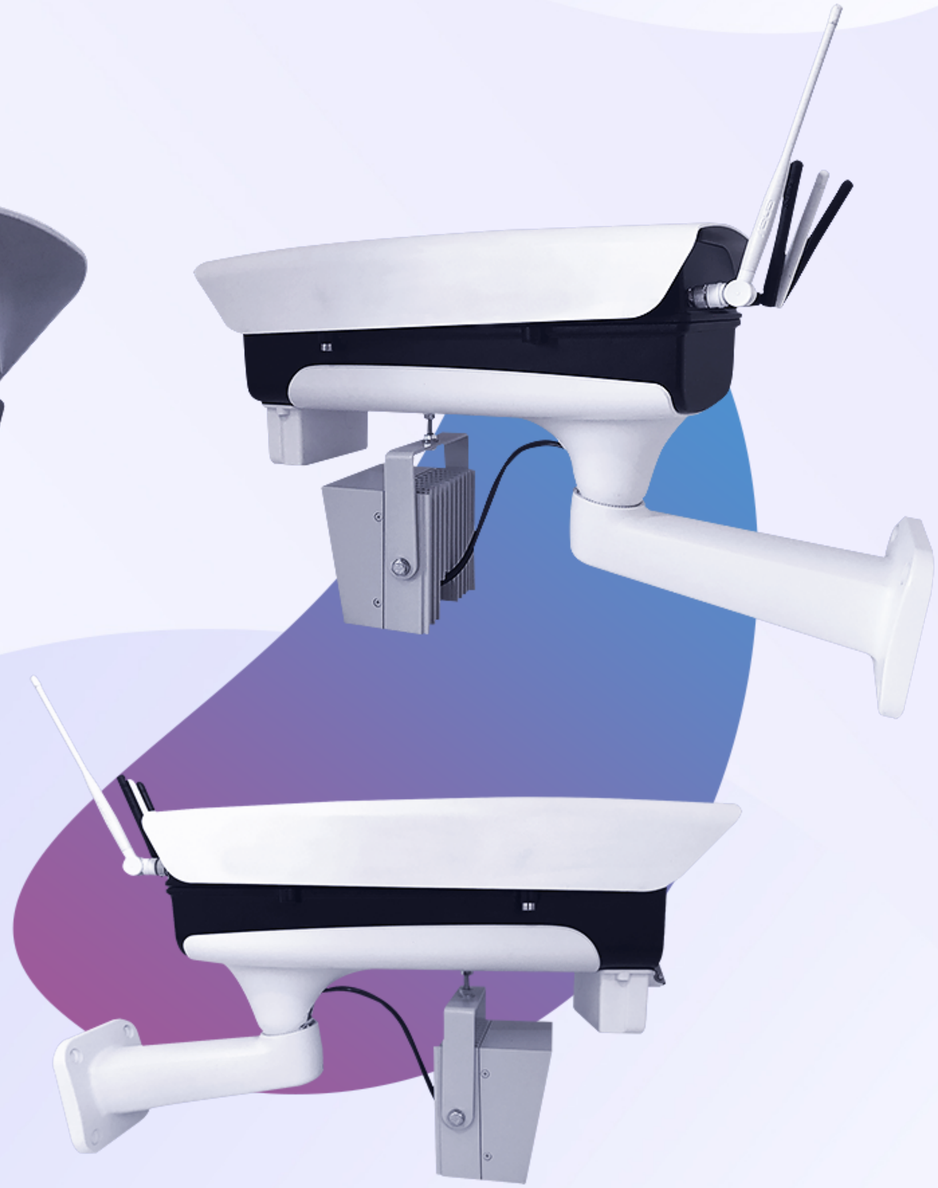

Intelligent Transport Technologies for improving Safe Driving Culture

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Traffic Enforcement Systems

- Speed limit enforcement
- Number plate recognition systems
- Bus lane enforcement
- Red light enforcement
- Stop sign enforcement

Save Lives #SlowDown

An adult pedestrian has less than a 20% chance of dying if struck by a car at less than 50 km/h but almost a 60% risk of dying if hit at 80 km/h*

* Source: World Health Organisation, Global status report on road safety 2015

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Innovative Traffic Enforcement Technologies

Energy independent, compatibility with alternative energy sources

Camera works from solar panels (or wind turbines). It can be installed in places not connected to electricity networks (including on remote sections of roads)

Remote control and maintenance, strong cybersecurity

Most of the operational tasks are solved remotely. This gives a significant reduce of operating expenses. Every remote operation is highly secured and trusted

Compact dimensions and low weight

Camera weight is less than 6 kg. This gives a way for easy and quick installation. No additional reinforcement of the pillar is required

Affordable price

New technologies allow to make Traffic Enforcement cameras essentially cheaper than the most of classical analogs. This gives a significant reduce of capital and operating expenses

Neural network algorithms for traffic recognition

Using of neural network technologies gives a way to quickly transform the logic of a camera work and add new features to the same device without changing it

High physical protection

Dust and water tightness of camera body, compliance with IP67 standard

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Real night shots samples (quality of recognition)

Brightness and clarity of shots are close to daylight level

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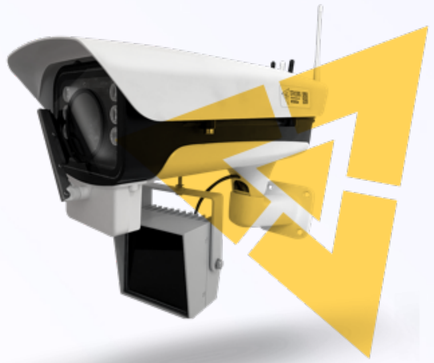
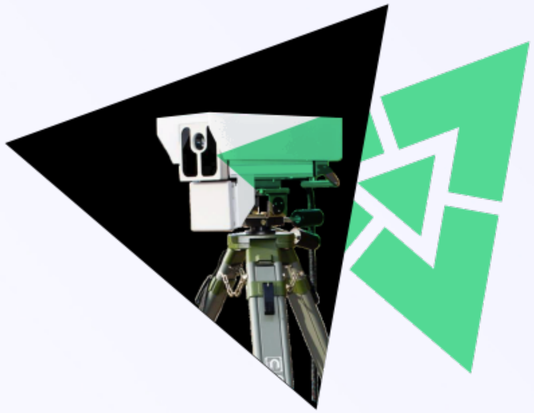
Our company in 2018-2019 plan to develop a multifunctional complex of intelligent transport systems

Astra S



Stationary optical version is aimed [for] recognition of traffic violations at the crossroads, speeding, searching and identification of vehicle, monitoring of traffic situations including road condition.

Astra P



Portable version is aimed for recognition of speeding and monitoring of vehicle, searching and identification of it

Astra M

Patrol vehicle version is aimed for identification of parking rules violations, searching and identification vehicle

Astra R

Radar version - aimed speeding and monitoring vehicle, searching and identification of it

- metering of vehicle speed and recording of speed violations
- enforcement of following traffic rules of regulated crossroads
- Enforcement of following rules stated by:
- Road signs and markings
- Public transport lanes

Fixing including:

- crossing into the oncoming traffic lane or crossing of continuous line
- Illegal U-Turn
- enforcement of proper intersection on railway crossings
- cooperation with connected federal bases and collecting of statistic data

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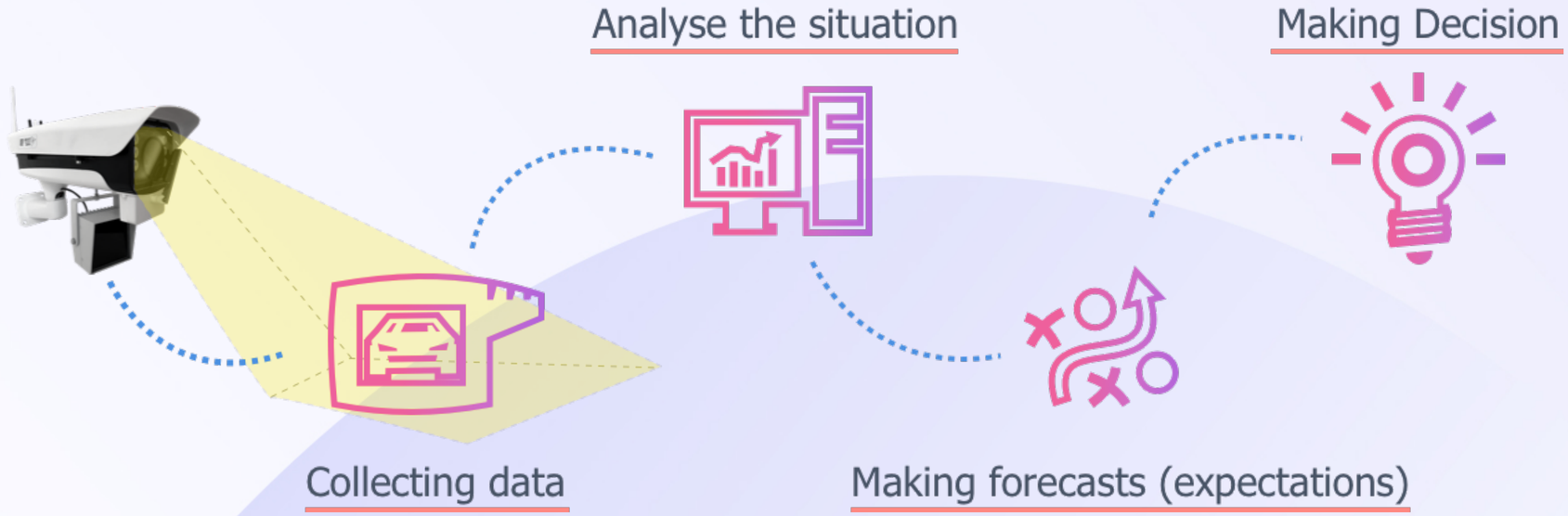
Collecting and analyse of date about vehicle moves info (parameters) on the urban road network as a part of system of photo video recording of traffic rules violations complex “Astra”

Providing automated enforcement of urban road network

Main features

- Collecting, processing and storage of driving data and types of vehicles
- Automated detection of emergency situations and informing about it
- Creating of data analysis with short-term forecasts
- Accounting and parameterisation of transport movements by algorithms of analysing streams

Output data will be used by other traffic control systems



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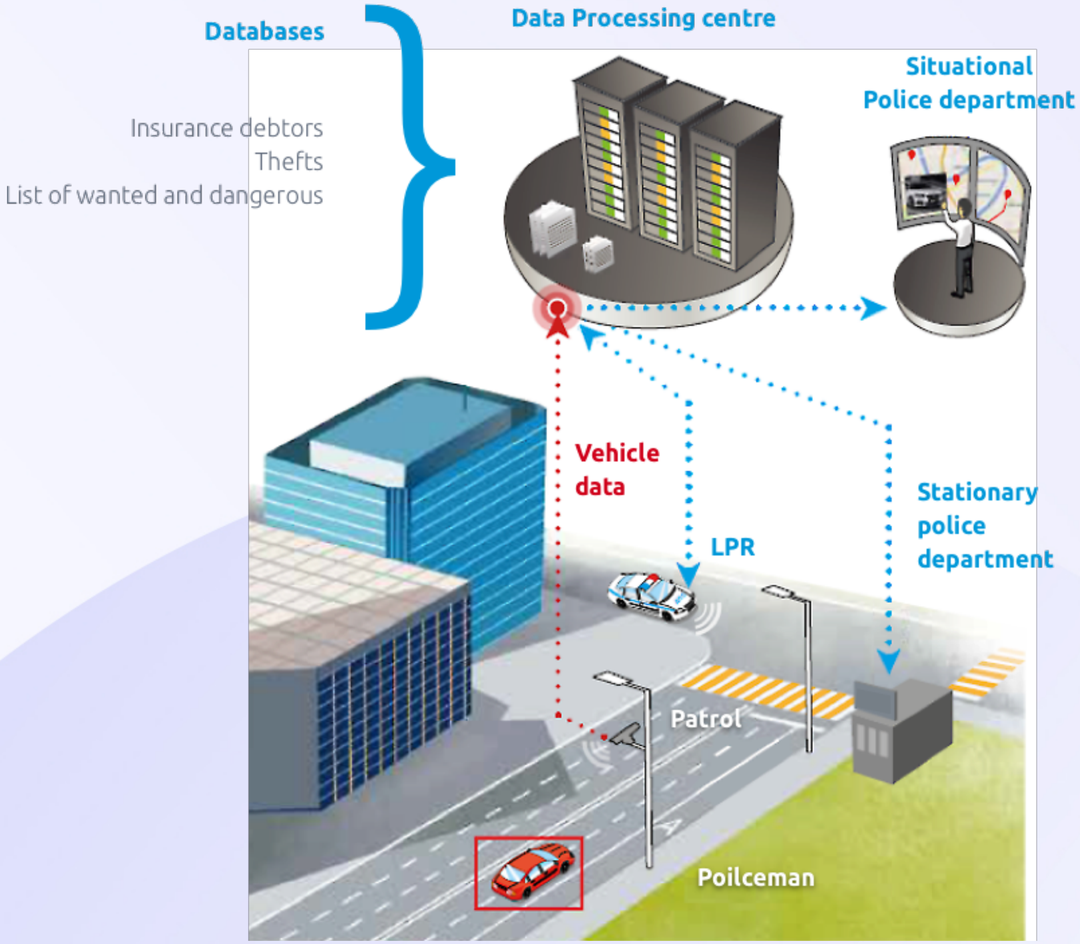
Building up a vehicle searching and detention system bay for “Astra”

Moving vehicles, fixed LPR HW

- All vehicles are detected by LPR HW
- All the vehicle data is transferred to situational center
- Checking vehicle date using connected data bases
- ATL (wanted) vehicles is detected automatically
- Decision about detecting and detention of vehicle is made by police officer
- Detecting vehicle is performed by complex
- Online forecasting of vehicle ritinerary
- Detention and arresting vehicle in certain location
- Documentation of the accident
- Information of detecting can be transferred directly to portable or stationary police departments and patrol vehicles



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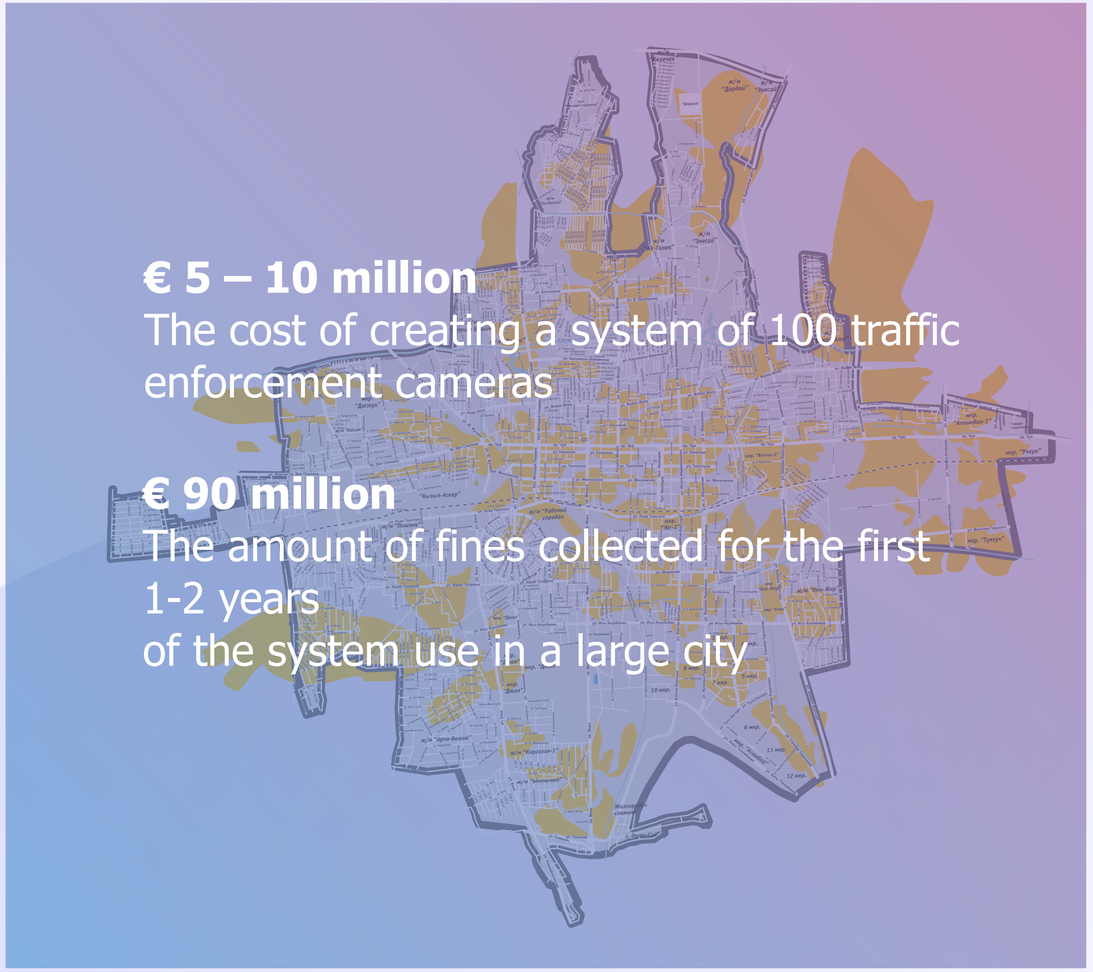
Traffic Enforcement Systems: Budget Income*

200
Speeding violations daily for one traffic enforcement camera in a large city

€ 50
The minimum fine for speeding in most of European countries

> € 900 000
Annual additional income to the city budget from one traffic enforcement camera



€ 5 – 10 million
The cost of creating a system of 100 traffic enforcement cameras

€ 90 million
The amount of fines collected for the first 1-2 years
of the system use in a large city

* Source: Data on the use of Traffic Enforcement Systems in European countries

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Financial models for the development of Traffic Enforcement Systems

Model	CAPEX source	OPEX source	The main beneficiary
Direct purchase	State (municipal) budget	State (municipal) budget – operational expenses	The state (municipality) – immediately begins to receive all the income from fines
Leasing / credit	The lessor / lender	State (municipal) budget – operational expenses and credit servicing	The state (municipality) – immediately begins to receive all the income from fines, part of the income is directed to credit servicing
Concession (private investment)	The concessionaire (private investor)	The concessionaire (private investor) – operational expenses	The concessionaire receives a basic income for 10-12 years. After that, the entire income is received by the state, but by this time the culture of driving increases, fines are collected significantly less
IaaS (Infrastructure-as-a-Service)	The concessionaire (private investor)	The concessionaire (private investor) – operational expenses	The concessionaire receives a fixed income from issued and paid fines. Minimum penalties is a big part of income, the maximum is smaller. According to our experience, the main amount of fines has minimal penalties

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Cooperation options

For End user

- Consulting (project design, financial model, legal registration)
- Supply of ready-made kits
- Installation and operation management at the customer's facilities
- Solving specific recognition challenges using neural network technologies
- Learning

For System Integrator

- Supply of ready-made kits
- Solving specific recognition challenges using neural network technologies
- Consulting (project design, financial model, legal registration)
- Learning

For Distributor

- Supply of ready-made kits with basic functionality
- Improvement of technologies for solving the challenges of a particular customer (special conditions)
- Learning

For OEM-partner

- Supply of ready-made kits under the partner’s brand name (special conditions)
- Learning

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Technical characteristics

SPECIFICATIONS

Characteristics	Nominal values
Amount of traffic directions no less than	2
Amount of traffic lanes of each direction no less than	4
Probability of license plate recognition in case of optical visibility no less than (in %)	98
Operation state	24 hours
Frequency of snapshots of video recording (FPS) no less than	25
Resolution of videocamera no less than (in pixels)	1920x1080 (full HD)
Information on violations time about traffic violations no less than (in days)	180
Amount of stored information and violations no less than	50 000
Setting and transmission of information via LTE, GSM and Wi-Fi channels	Available
Circular overwriting mode	Available
Setting of operating modes based on days of the week and time intervals	Available
Average lifespan no less than (in years)	5
Minimal lifespan (in hours)	35 000
Warranty period no less than (in months)	24
The degree of preservation according to government standards (GOST) 14254-96 / IP66	IP66
Dimensions of the system elements no larger than (in mm.) • The governing controller • IP-videocamera	 400x300x210 400x127,5x128,7
Weight of the system elements no heavier than (in kg.)	20

METROLOGICAL CHARACTERISTICS

Characteristics	Nominal value
Measured speed range of vehicles (in km/h) • Measured by using video frame • Measured within a segment between two devices	 from 0 to 250 from 0 to 250
Tolerable absolute error thresholds for measured vehicle speed (in km/h) • Measured by using video frame — Within a range from 0 to 100 km/h — Within a range from 100 to 250 km/h • Measured on a segment between two devices within a range from 0 to 250 km/h — Within a range from 0 to 100 km/h — Within a range from 100 to 250 km/h	 ±1 ±1 ±1,5 ±1,5
Minimal distance for measuring vehicle speed on a segment between two devices (in m.)	250
Measured time interval range (in hours)	from 5 to 24
Tolerable absolute error thresholds for measured time intervals in relation to UTC (US) scale (in ms)	±1
Tolerable absolute instrumental error thresholds (with confidence probability 0,95) for determining coordinates for coordinate systems (in m)	±2
Setup time for operating mode, min, no more than: • Outside temperature higher than 10 °C above zero • Outside temperature from 40 °C below zero up to 10 °C above zero	 1 1
Supply voltage of the system from the alternate current circuit (in V)	from 110 to 242
Power consumption of the system, V-A no higher than*	30
Recommended temperatures (in °C)	from - 40 up to +50