Toll Enforcement
Toll enforcement has become a key component in sophisticated road-user charging schemes. New charging systems based on satellite positioning avoid the need for a fee-collection infrastructure at every road section. Placed only on strategic locations and supplemented by mobile patrols, this new generation of enforcement relies on a lean network of road-side installations. Therefore, enforcement has visibly become a core element. It guarantees the equal treatment of eligible users by ensuring compliance. Thereby, it secures a scheme’s acceptance and revenue streams. Because of its vital importance to every charging scheme, modern procurements have begun to treat enforcement in a class of its own, targeting the best in class providers.

VITRONIC, a vision specialist, addresses the demand for high-performance enforcement of next generation tolling systems. VITRONIC is proud of being the premier dedicated specialist for toll enforcement systems.

Modern road-user charging systems pose specific challenges to the enforcement technology required:

Reliable recognition of license plates and equal treatment of both national and international traffic

VITRONIC builds on more than 15 years of experience in the provision of automatic License Plate Recognition (LPR) systems deployed for police forces and municipal authorities. The proprietary LPR sets the standard with both its international scope and its unsurpassed read performance.

Minimized need for road-side infrastructure, yet undiminished performance

With 20 years of experience in autonomous vehicle guidance and driver assistance projects for the automotive industry, VITRONIC offers versatile technology for the decisive task of vehicle detection and tracking. The cutting-edge laser based detection sensor allows for single gantry/single pole mount installations.

Variation of charging

To facilitate complex charging variations, each vehicle’s class and respective toll rate are assessed through a classification process based on a complete 3-D classification of the entire vehicle. This unique process also allows the system to perform axle counts and trailer detections. It was built using VITRONIC’s award-winning 3-D laser scanning technology.

High economic efficiency

VITRONIC’s toll enforcement technology rose to the top, not only confirming its superior detection, classification and recognition rates, but also setting industry benchmarks. The efficiency in VITRONIC’s toll enforcement technologies leads to superior over-all performance while lowering operational costs. The real-time enforcement leverages the use of mobile units to new levels of efficiency.
VITRONIC covers the entire value chain of enforcement, from service design, provision and commissioning through systems integration and ongoing service.

To facilitate efficient servicing, VITRONIC offers last-level expert support and operates its own service desk. This concept combines continuous remote service with on-site service performed by well trained and educated personnel.

In particular, Germany’s TollChecker operation has integrated remote monitoring facilities that enable the detailed analysis of all key components and the overall system’s status. All enforcement systems are monitored continuously to ensure consistently high availability, and short response times to any incidences.

Based on a quality management system certified to ISO 9001 standards, VITRONIC has established a track record of delivering projects on time and meeting all required specifications.

VITRONIC has long term experience in project management of various scope and size. For example, postal applications in the US have had individual contract values of up to $25 million, while in Europe, contract values for the German TollChecker project alone have exceeded €100 million.

Successfully managed projects in Europe, North America, Australia and Asia demonstrate VITRONIC’s broad experience. Thanks to this, VITRONIC is fully prepared to contribute its unique enforcement expertise to customers worldwide.

For both the enforcement infrastructure on the road-side and mobile systems, VITRONIC’s toll enforcement is prepared for seamless integration with central backoffice systems.
Among most road networks, motorways and trunk roads shoulder the majority of traffic, particularly from heavy vehicles. TollChecker is VITRONIC’s solution designed for the efficient enforcement of high volume traffic on the roads of today and tomorrow.

In order to facilitate complex differential charging, TollChecker assesses each vehicle’s class and respective toll rate through a classification process based on a complete 3-D classification of the entire vehicle. This unique process allows the system to perform axle counts and trailer detections. Developed as the backbone for German truck toll enforcement, TollChecker sets a new standard by working in conjunction with a charging scheme based on both satellite positioning and Dedicated Short Range Communication (DSRC).

TollChecker – In Action
With 1000 lanes of traffic monitored in the German truck toll system, assembled and operated by Toll Collect, VITRONIC’s TollChecker is by far the largest enforcement system worldwide with 300 gantries located throughout the German Motorway Network.

In this project, TollChecker provides fully automated enforcement of more than one million road users daily: It employs international LPR for the equal treatment of users all over Europe.

Since vehicles are enforced in a matter of seconds, TollChecker’s real-time enforcement facilitates manual checkpoints, allowing officers to selectively pull over suspected violators. This creates an effective operation while maximizing deterrence.

In the Toll Collect project, VITRONIC covers the entire value chain of enforcement from service design, provision and commissioning, through systems integration and ongoing service.

Automated processing of evidential records

High-resolution license plate imaging
Key Features

**Single gantry, multi-lane free flow solution for toll enforcement**

Seamless integration with GPS and DSRC tolling systems

Smart single gantry solution
- setup in 4–6 hours at night, requiring just 15 minutes of carriageway shut-down
- no sensor loops needed

Supports advanced enforcement
- support of manual checkpoints and real-time alerts
- operation through on-line communication, such as for handling special bookings

Safety
- no interruption of traffic, multi-lane free flow operation
- no visible lighting, even during the night

Fairness of toll collection
- ALL liable vehicles – with or without on-board equipment – are subject to verification
- no systematic loopholes (e.g. emergency lane / inter-lane driving)

Determination of permissible weight / axle count / trailer detection
Reliable vehicle classification through complete 3-D measurement
- measurement of accurate length, height, width, axle count, trailer detection etc.

International license plate recognition
- for all of Europe, with built-in expandability for recognition beyond Europe
- determination of country of origin
- retro and non retro-reflective plates
- regular and inverse plates

Evidential robustness / Compliance with data protection rules
- encrypted transmission of signed evidence data

Designed for easy service and maintenance
- sophisticated systems monitoring and management scheme
- design with pre-calibrated sensor boxes, no tools needed for on-site service
- easily serviceable over flowing traffic
- specially coated sensor box windows for operation in poor weather conditions

Automatic operation thanks to outstanding classification and recognition rates
- several benchmarks confirmed superior detection, classification and recognition rates of TollChecker
- superior performance in all weather and all traffic conditions, even at high speeds

Examples of recognized international license plates

Axle count and trailer detection through complete 3-D measurement
City-TollChecker gave proof of the following key features in a series of new technology trials:

- unobtrusive design for single pole mount covering multiple lanes and blending into the cityscape
- digital short range imaging for seamless integration with DSRC technology
- successful adaptation to city traffic conditions
- benchmark-setting performance

Combining these features and TollChecker’s tried-and-tested foundation, VITRONIC’s City-TollChecker offers the following key benefits:

- proven reliability and easy serviceability
- enables the extension of schemes to wider areas
- successfully integrates with both DSRC and GPS
- addresses strict demands regarding evidential integrity
- supports future enhancements, such as differential charging

City-TollChecker — Next Generation Enforcement For The City

ONE Future-Proof Enforcement For All Charging Technologies

Road-user charging in urban areas is a top priority for proactive cities. For example, policy makers are considering urban charging systems to effectively manage congestion and air quality.

In terms of the technology for fee-collection, cities are confronted with technical solutions that incorporate elementary camera/LPR based booking schemes to more advanced DSRC charging or GPS (Global Positioning System) tolling solutions. All of these charging technologies share a common factor: Enforcement is necessary in order to guarantee equal treatment of users and to secure revenues, resulting in the scheme’s acceptance by the users.

To address this need for urban toll enforcement, VITRONIC has launched City-TollChecker. Based on the solid background of TollChecker, the state-of-the-art technology from motorways is now being put into action in the urban environment.
Evolved Enforcement For All Road Categories
Lean, Mobile And Customized Solutions

For evolved systems, a key quality of TollChecker is the modular design with standardized subsystems. The successful evolution from a design for motorway conditions to a solution for the urban environment demonstrates how the key elements of enforcement can be reassembled for specific scenarios.

Each individual key component: detection, license plate recognition and classification, can easily integrate with any type of modern road-user charging system, opening up a boundless field of new applications.

Next generation tolling systems will likely cover entire road networks. As for the enforcement, VITRONIC has the solution to close the gap between systems dedicated to urban roadways and those dedicated to motorways. The state-of-the-art 3-D classification supports possible moves to charge further vehicle types according to different categories.

VITRONIC envisages evolved enforcement for larger road networks to be guided by two principles:

• alternative assemblies of the TollChecker and City-TollChecker modules scaled to different traffic volumes
• supplemental use of efficient mobile solutions to maximize deterrence

Flexible component architecture

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Alternative assemblies

Apart from motorways and trunk roads with dual carriageways, large road-networks typically comprise of a number of A-roads exhibiting high traffic volumes. For these roads, the enforcement infra-structure can be scaled to match requirements.

Two lane country roads are covered from pole mounted equipment similar to the City-TollChecker design. Making use of cantilevers, wider roads can be monitored and issues with vehicle obstruction on outer lanes are reduced.

These lean installations are designed for maximum efficiency but with minimal visual impact and still offer the requested performance for the core detection and identification rates.

Portable and mobile systems

At its core, each efficient enforcement policy of a road-user charging scheme relies on deterrence. To assure compliance, random checks may be carried out throughout the entire road network. These enforcement activities must be risk driven, unpredictable in nature and designed to encourage compliance by all users.

Primarily, portable and mobile enforcement is designed to facilitate the work of officers and shift it to advanced and automated levels of efficiency. The enforcement equipment built into the mobile units records vehicle passage and performs crosschecks in real-time with a database of non-compliant activity. This technology enables officers to selectively check questionable vehicles leading to a higher level of deterrence.