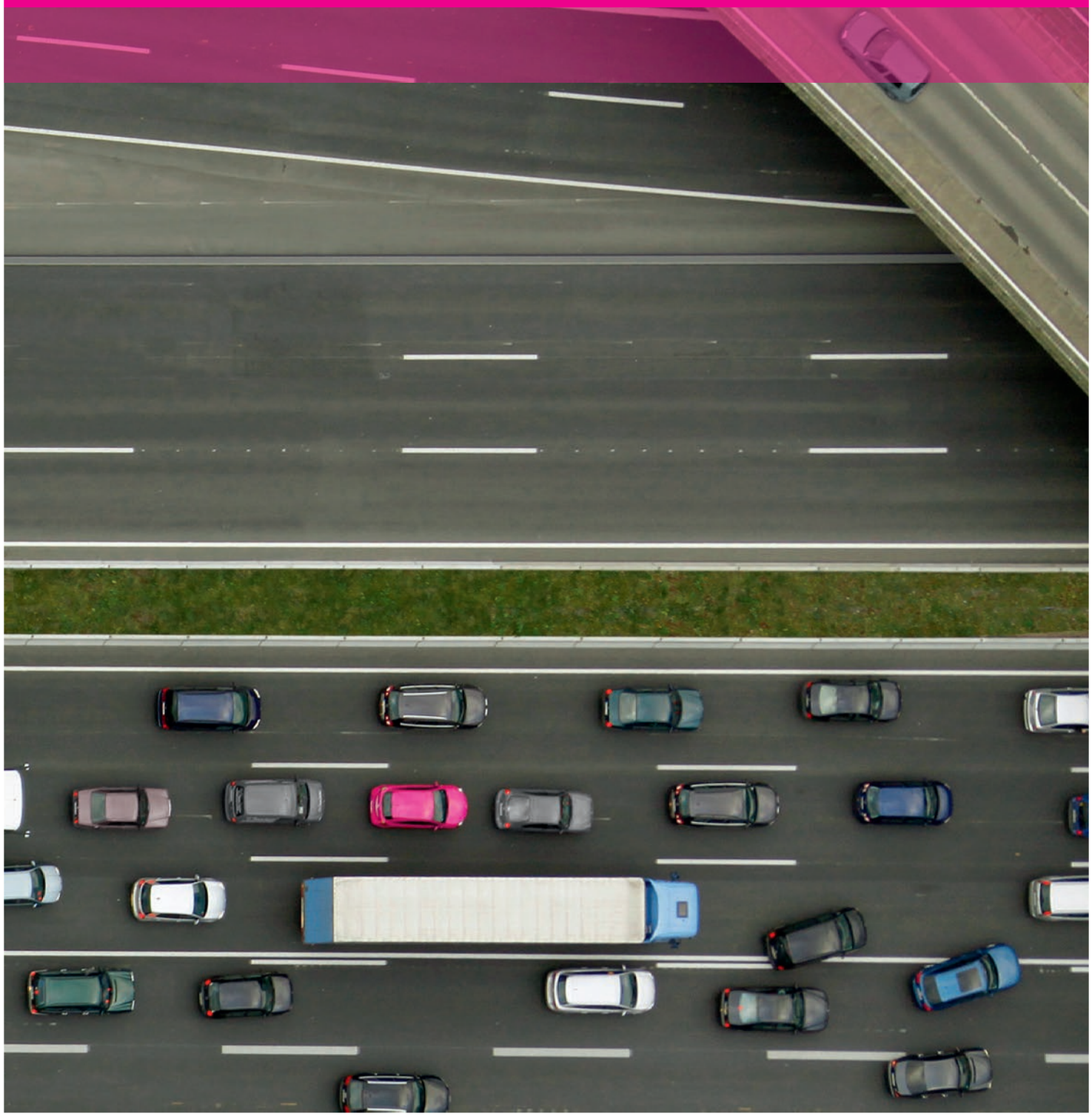
NEXT GENERATION MOBILITY
TOLLING AS A SERVICE



T · · Systems ·

T-SYSTEMS AND SATELLIC – LONG-STANDING PLAYERS IN THE TOLLING INDUSTRY

T-Systems boasts an impressive record when it comes to road charging and telematic services. Already over 15 years ago, we pioneered GNSS tolling technology by designing and implementing major parts of the German HGV (Heavy Goods Vehicle) tolling system. Based on experience gained from the German project, T-Systems then introduced the Satellic brand in 2005 and started the development of a next-generation road charging system using modern and future-oriented technologies. From the beginning, one central goal of the system design was a modular architecture that allows the offering of flexible services as required by the growing international market and its players of different size and background.

In July 2014, T-Systems International signed, as the major shareholder, the contract for the Belgian Road Charging System, erected the system operator Satellic N.V., and successfully launched the system operation in April 2016 – setting a new reference for the implementation of GNSS-based tolling systems.

Road-charging and telematic concepts are a key focus of the strategy in place at Deutsche Telekom AG and T-Systems International GmbH. Based on this claim, T-Systems is therefore following its Tolling as a Service (TaaS) approach to extend its offerings as required by the maturing market of national and EETS operators. T-Systems has grouped its experts for designing, introducing and operating road charging systems in the Satellic Toll Competence Center, offering all functional levels of the road charging-related service hierarchy.

On top of this, T-Systems – together with its partners – is in the process of establishing the registered and certified Satellic EETS provider that enables its clients to offer EETS services to their customers (become an EETS provider) without having to deal and individually contract with the various toll chargers directly.

T-SYSTEMS TOLLING COMPETENCE CENTER – THE ENABLER FOR EUROPEAN TOLLING CHALLENGES

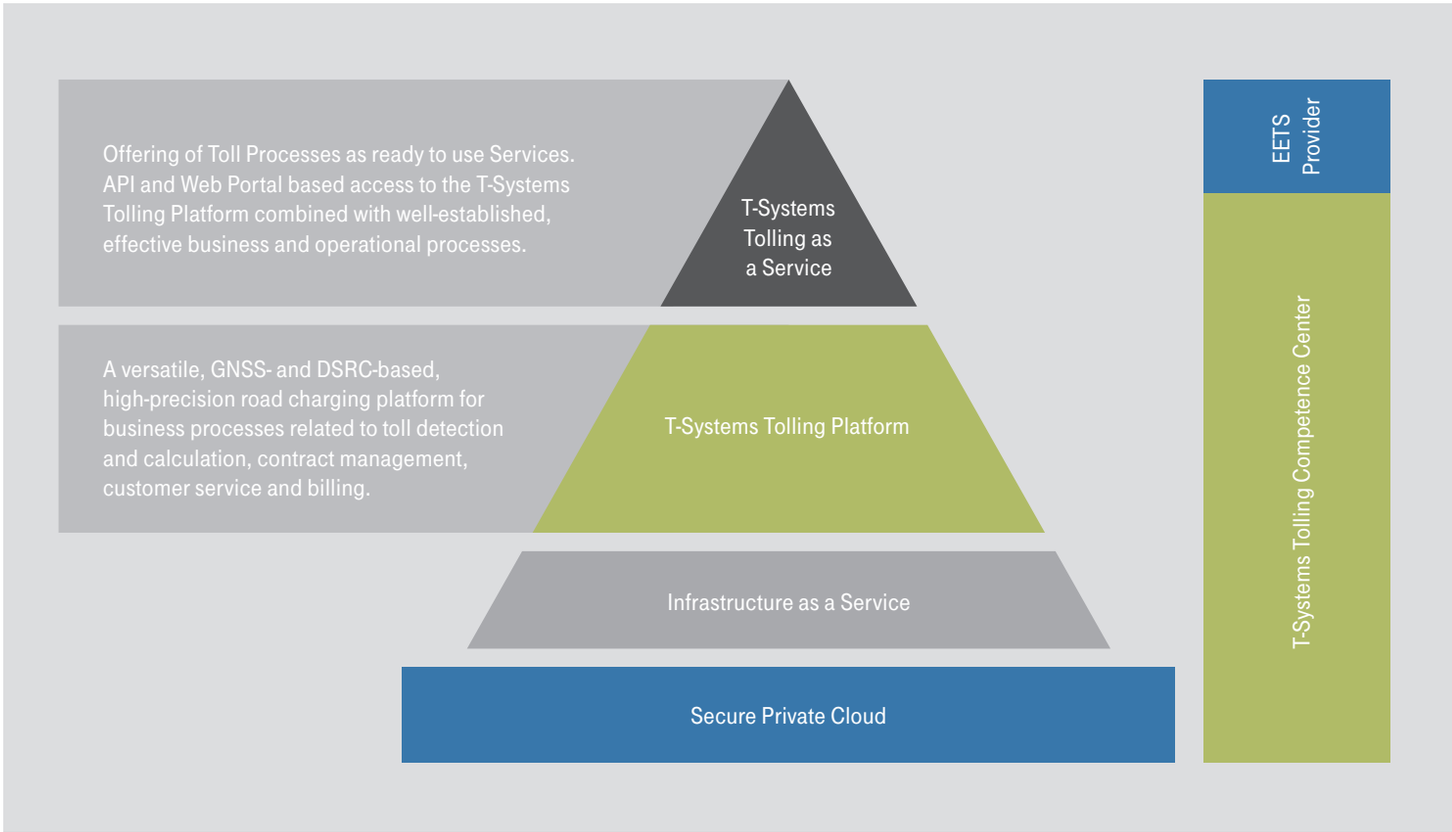
With its extensive experience in road-charging and telematic technology and markets, T-Systems has designed and implemented the T-Systems Tolling Platform perfectly suited to the requirements of the EETS scheme. The result is highly versatile and flexible, meaning that small and stand-alone tolling programs and service providers can also benefit from it.

Closely anticipating the maturing of the European road charging market, T-Systems is prepared to provide valuable services to its partners and clients on all levels of the service stack. To accomplish this mission, T-Systems has established the T-Systems Toll Competence Center, which offers all the necessary building blocks at the technical, operational and service levels required for an EETS provider in a modular and scalable way.

In 2005, T-Systems was already assembling all the experts with backgrounds in road charging in a distinct organizational unit that would bring their collective experience together for the development of a modern tolling and telematic solution – the T-Systems Tolling Platform.

From 2005 to 2008, T-Systems took part in the Road Charging Interoperability (RCI) project, whereby 27 major players in the European road charging market demonstrated the interoperability of existing (DSRC-based) and upcoming (GNSS-based) road charging technologies and thus the feasibility of the European Electronic Toll Service (EETS) approach.

With the introduction of the Belgian GNSS-based system in 2016 and the close-by re-tendering of some national first-generation operators, the European environment is finally ready for the actual implementation of EETS. T-Systems is ready to support the stakeholders in all aspects of this process with its Tolling as a Service (TaaS) offering.



With its Tolling as a Service (TaaS) offering, the T-Systems Toll Competence Center enables national road-charging operators, as well as private parties (of all types and sizes) interested in becoming an EETS provider, to participate in the European road-charging scheme. The services are implemented by using instances of the T-Systems Tolling Platform and can be sourced in a modular way according to the needs of the partner or clients.

ENABLING EETS BUSINESS

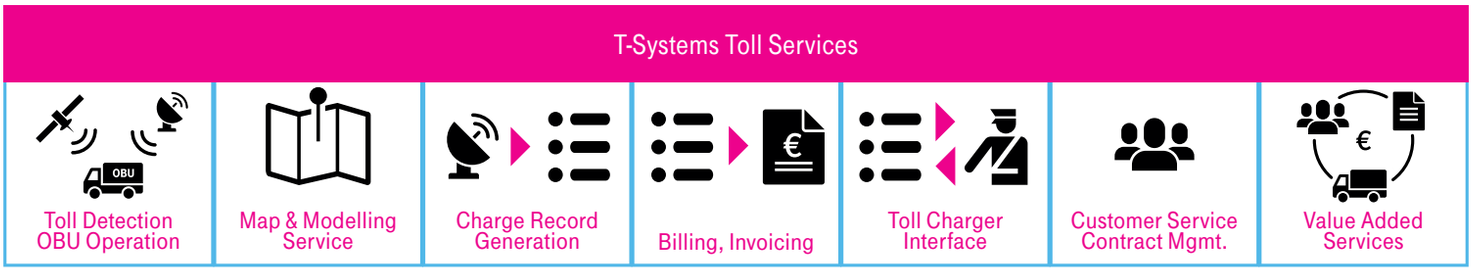
To support service providers with the most challenging point of the EETS ecosystem – the registration as a provider and the certification with toll chargers – T-Systems is operating a certified EETS provider together with partners. This EETS provider applies the T-Systems Telematic Platform as well as the tolling services of the T-Systems Toll Competence Center to allow partners of all sizes and backgrounds to concentrate on their core business and leave the administrative EETS tasks as well as the EETS tolling specific process in the domain of an efficient and high-quality EETS enabler.

COVERING THE BUSINESS LANDSCAPE OF TOLL SERVICE PROVIDERS

The core business processes for toll service providers include detecting and calculating road user charges, managing payments, and maintaining the relationship with roads users and with contracting entities such as public authorities or EETS toll chargers.

MODULAR BUSINESS PROCESS OUTSOURCING CONCEPT

The Tolling as a Service (TaaS) offering from the T-Systems Toll Competence Center is tailored to fit the service provider's needs in a flexible and modular way. It comprises the operation of OBU fields; modelling of toll context data; charge data generation; billing, invoicing and reporting; customer service and contract management and the management of interfaces to toll charger. Of course, the T-Systems Toll Competence Center is also prepared to implement additional value added telematic services as requested by clients.



TYPICAL CORE BUSINESS AND SUPPORTING PROCESSES OF A TOLL SERVICE PROVIDER

SATELLIC NV IN BELGIUM

Chosen as the basis for the Belgian kilometer charging system in 2014, a consortium led by T-Systems International GmbH was awarded the contract for designing, building, financing, maintaining and operating the Belgian Toll Provider Satellic NV for charging domestic and international heavy goods vehicles weighing over 3.5 tones on Belgian roads until 2028. The focus for clients is on the cost-effective and responsible service provisioning as well as the compatibility with the EETS (European Electronic Toll Service) framework.

For this purpose, Satellic NV applies the T-Systems Tolling Platform developed and operated by T-Systems International GmbH, which uses a GNSS/GSM-based smart OBU (On-Board Unit), to start collecting tolls on behalf of the three regions in Belgium in 2016. Exactly that experience, handling three individual regional authorities with their different requirements, shows that the T-Systems Tolling Platform is perfectly suited for the EETS.

The Belgian tariff scheme requires the coverage and toll detection on the entire road network (approx. 154,000 km) and the charge depends on four parameters: the number of kilometers driven, the type of road, the gross combined weight rating (GCWR) and the vehicle's EURO emission class.

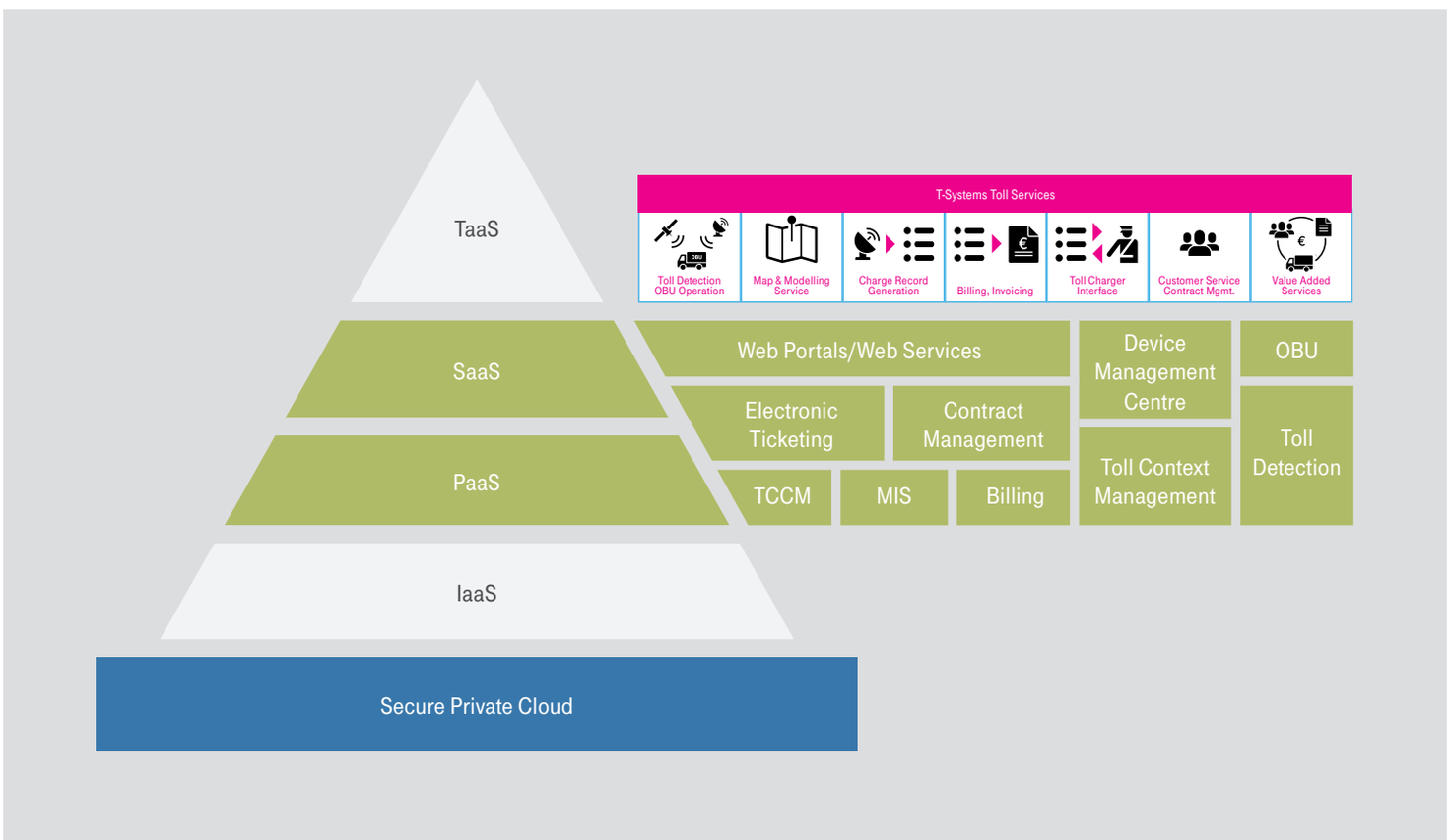
For more information, visit www.satellic.be.

TOLLING AS A SERVICE: THE ONE-STOP SOLUTION

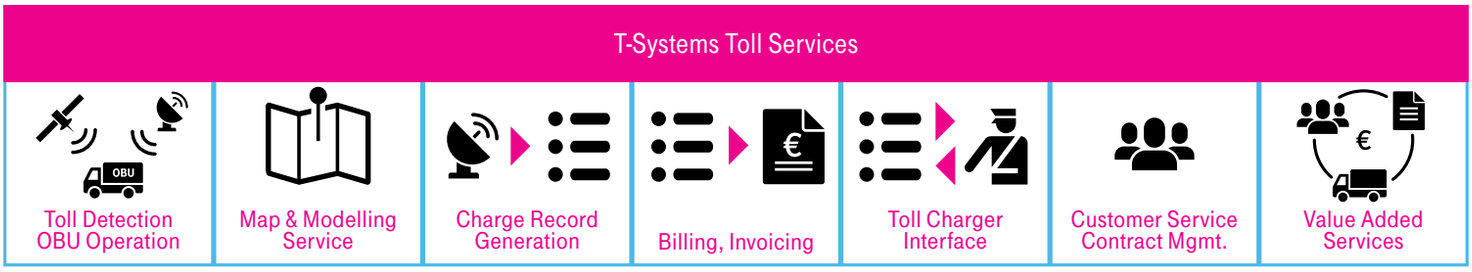
The Tolling as a Service (TaaS) offering of the T-Systems Tolling Competence Center is a one-stop business process outsourcing solution for toll service providers. TaaS combines components of the innovative T-Systems Tolling Platform with well-established, effective business and operational processes. By opting for TaaS, toll service providers can leave tolling tasks to the systems operations specialists and focus on their core business. For standard components, the multi-vendor strategy pursued by T-Systems guarantees high quality at a reasonable price. Solution and industry-specific system components are designed and implemented in collaboration with leading expert partners, providing the most reliable, high-performance and up-to-date applications.

Thanks to its modern modular and flexible architecture, the T-Systems Tolling Platform is compatible with modern web service-based interface technologies and provides the versatile T-Systems API, which makes the integration with third-party systems possible. As a result, the Tolling as a Service modules can also be easily integrated with toll service providers' existing business process landscapes and third-party offerings at the business process level. And of course, it's also possible to provide client-specific value-value added services as required.

TOLLING AS A SERVICE



T-SYSTEMS TOLLING AS A SERVICE – THE TOLL SERVICES IN DETAIL.



TOLL DETECTION

The reliable detection of toll objects is, of course, the core service of all road charging systems. In the case of DSRC schemes, this business process typically lies within the domain of the toll charger. In the case of GNSS-based systems, the service provider has to perform the detection with high-quality targets and potentially high penalties (both imposed by toll chargers). The T-Systems Toll Competence Center offers the GNSS-based detection of toll objects with exceptionally high quality on all types of road networks by providing a map matching-based solution that can be implemented directly on smart OBUs. This offers the highest level of data privacy for setups using thin OBUs and central toll detection as well. Of course this system also supports DSRC-based tolling.

OBU OPERATION

Operating large fields of OBUs with excellent quality is one of the most challenging business processes since the highest priority is to not bother the road user with any technical or logistics complications. In addition to process excellence, a high automation level is essential for reducing costs to a competitive level. Monitoring routines allow for early indication of potential problems and the setup of timely measures.

The T-Systems Toll Competence Center offers an OBU including software as part of its T-Systems Toll Services. However, the operation of third-party OBU fields can also be implemented if requested.

MAP & MODELLING

To ensure good performance of map matching-based toll detection, the availability of an accurate and up-to-date reference map is very important.

The T-Systems Toll Competence Center has extensive experience in transferring the – typically descriptive – toll domain statements into toll object definitions referencing standard navigational maps. Also, a continuous monitoring process ensures the detection and elimination of model imprecisenes (e.g. due to changes in the road network). In the same process, the tariff table of the domain statement is also modelled, the toll objects being linked to the applicable rates, to be able to generate charge records on usage.

The resulting map and model is used by the T-Systems Toll Competence Center to deliver its other services and can also be made available to clients as stand-alone data set.

CHARGE RECORD GENERATION

The Charge Record Generation service is usually bundled with toll detection and/or the billing service. In this service, detected toll objects (either GNSS or DSRC-based) are rated by the application of toll domain and customer-specific tariffs and aggregated and enriched according to the domain-specific requirements. The resulting charge records are then input for all customer usage information, such as billing, invoicing and accounting services, for both the toll service providers and toll chargers.

BILLING, INVOICING, REPORTING

A major task for the commercial implementation of EETS providers is the handling of toll-related accounting, billing, invoicing and reporting (to both toll chargers and business partners). The exact accounting and payment modes (defining formats, periods, payment means and clearing, commissioned data processing, taxes vs. fees, VAT rules, etc.) are highly dependent on the toll charger as well as on the background of the service provider. The same applies to the generation of customer-directed documents as tax and fee statements as well as detailed trip statements. The T-Systems Toll Competence Center has a rich experience in implementing accounting schemes that meet the requirements of toll service providers, integrating payment service providers and external ERP systems keeping the general ledger. If required, T-Systems can of course offer the complementary hosting or implementation of an ERP system for toll service providers.

TOLL CHARGER INTERFACE

Although the EETS framework tries to clearly define the interfaces between service providers and road charges in ISO 12855, the exact interpretation is surprisingly domain dependent and not easy to accommodate. Moreover the standard is not binding and other frameworks as e.g. EasyGo® or TIS-PL are relevant too. The T-Systems Tolling Platform provides a component that concentrates the technical interface with the toll chargers in an abstract and flexible a way, making integration with a new toll charger less extensive and less complicated compared to individual extensions.

On top of the technical operation of these interfaces by the T-Systems Toll Competence Center, the T-Systems EETS provider is in the process of certifying with the major toll domains and for those offers the full operation and management at the business process level.

CUSTOMER SERVICE

The operation of an EETS-enabled road charging system requires some technical components for the road user, which leads to support efforts for handling technical customer queries on various levels.

For the technical and procedural aspects of the services offered to its clients (toll service providers), the T-Systems Toll Competence Center offers complementary second and third-line support that can be used as an escalation line when the client's first-line support identifies a request targeting the domain of T-Systems Toll Competence Center.

In addition, the EETS provider maintains an ongoing relationship with the toll chargers and bundles all issues resulting from customer and service provider requests concerning toll chargers.

CONTRACT MANAGEMENT

The management of master data for customers and vehicles as well as the management of active contracts is a service that supports billing and invoicing. The T-Systems Tolling Platform provides the versatile T-Systems API to maintain all this data and the T-Systems Toll Competence Center offers a related service to the degree a client is not managing its client's contracts on its own.

Due to its open architecture, the T-Systems API allows for the flexible integration of all tolling-relevant functions like registering and maintaining customer and vehicle master data, ordering and returning OBUs, ordering or terminating contracts for certain toll domains or accessing usage data and documents with the existing ICT landscape and business processes at client side. Clients that don't want to use a deep technical integration benefit from the browser-based Business Partner Portal accessible through the public internet.

VALUE-ADDED SERVICES

Of course, both the T-Systems Toll Competence Center and the EETS provider can offer the implementation and operation of additional value-added services specific for service providers.

Some general value-added services are already available but the modular approach of the T-Systems Tolling Platform allows for the cost-effective and fast implementation of additional services without the risk of unintended side effects.

Examples for such services would be tracking and tracing, driver messaging, vehicle bus integration, driving style analysis and much more.

THE VERSATILE FOUNDATION: THE T-SYSTEMS TOLLING PLATFORM

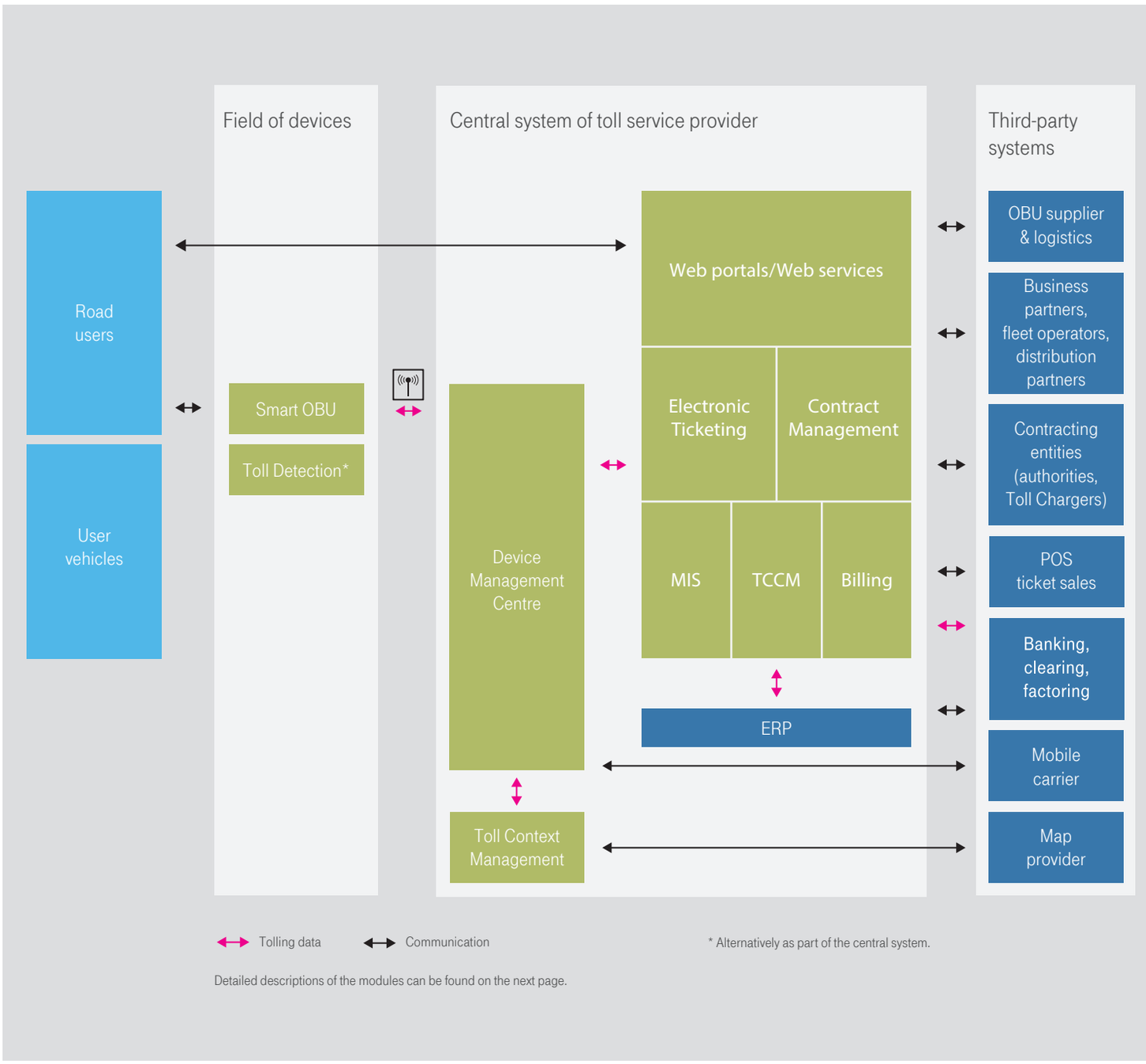
Over the last few decades, electronic toll collection has become increasingly significant in the financing and operation of transport infrastructures. At the same time, key technologies like mobile communications (GSM/UMTS/LTE) and global navigation satellite systems (GNSS) have become robust and affordable. This development has made it possible to overcome the systemic and commercial limitations of traditional charging approaches such as paper vignettes, toll plazas and short-range communication systems (DSRC).

The T-Systems Tolling Platform (TTP) from the T-Systems Toll Competence Center is a versatile and modular road charging platform that supports high precision GNSS-based tolling as well as legacy DSRC Schemes. It's suitable for toll service providers currently entering the market against the back-drop of the European Electronic Toll Service (EETS) and for established toll service providers looking to add EETS offerings to their portfolio as well. It's also the basis for the business services provided by the T-Systems Toll Competence Center and the T-Systems EETS provider.

MAXIMUM EFFICIENCY AND FLEXIBILITY THANKS TO A MODULAR APPROACH

The T-Systems Tolling Platform is designed to provide efficient support for business processes related to toll detection and calculation, customer service and billing – by means of a modular solution design.

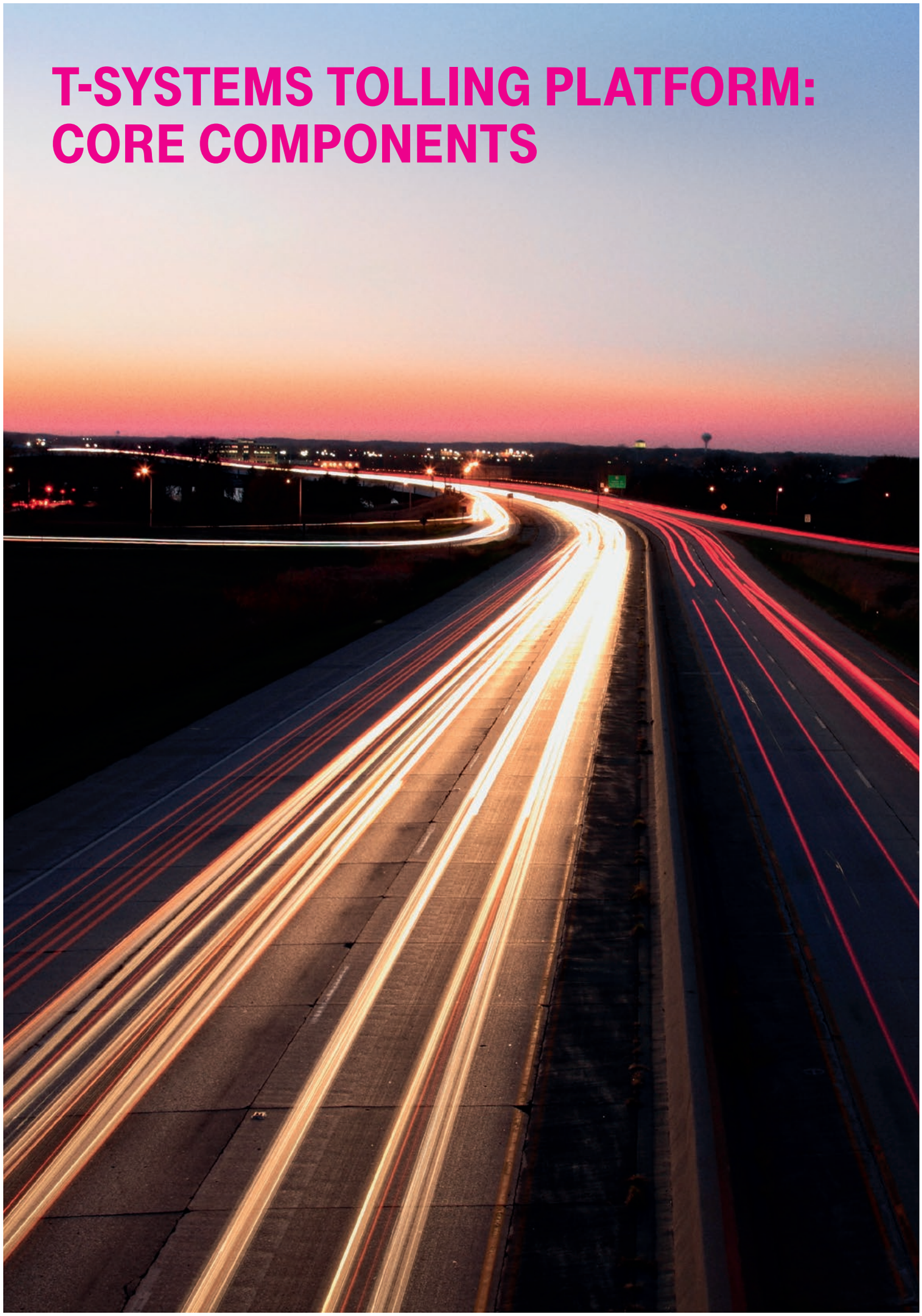
CORE COMPONENTS OF THE T-SYSTEMS TOLLING PLATFORM



Detailed descriptions of the modules can be found on the next page.

The diagram does not portray a complete toll service provider system landscape, but rather focuses on the core components as provided by the T-Systems Tolling Platform.

T-SYSTEMS TOLLING PLATFORM: CORE COMPONENTS



T-SYSTEMS TOLLING PLATFORM: CORE COMPONENTS

T-SYSTEMS SMART OBU

An on-board unit (OBU) is a device which is mounted in a vehicle and automatically detects toll roads. Our specific software environment for OBUs enables secure and reliable remote management of devices in the field, as well as excellent GNSS and map-based autonomous toll detection and support of DSRC compliance checks and tolling.

The smart OBU approach provides exceptional user transparency and data privacy, reducing user complaints and thus operating costs.

The OBU software environment provides a platform for toll service provider-specific value added services, such as tracking and tracing, insurance applications and logistics and fleet management functionality. In conjunction with selected hardware partners, we offer an integrated software and hardware solution that can easily be adapted to client-specific needs. Of course, the OBU also supports tolling in DSRC-based domains.

T-SYSTEMS DEVICE MANAGEMENT

One of the most challenging tasks for toll service providers is the operation of a large number of active OBUs mounted in vehicles. Robust OBU software/hardware design backed by effective remote management is essential to avoid expensive recalls. Other core operational requirements are the optimization of communication costs, and the maintenance and documentation of valid configurations for each device, in case of software or operational data changes.

The T-Systems Tolling Platform offers a device management system that fulfils all these needs. Additionally, the system offers important reporting and operational functions such as the management of device groups, various software versions, mixed hardware fields and much more.

T-SYSTEMS TOLL CONTEXT MANAGEMENT

In addition to managing the OBU field, toll service providers need to maintain a high-quality set of charging rules, which are mainly determined by the definition of toll objects (e.g. street sections, city zones, bridges, tunnels, etc.) and related tariff sets.

T-Systems Toll Context Management supports the integrated management of geo objects, toll objects and tariffs for multiple toll domains (such as toll chargers with individual tariff schemes). The system also allows version-controlled management of all data, and supports all relevant standards for quality assurance and documentation when toll data modifications are performed.

T-SYSTEMS CONTRACT MANAGEMENT AND BILLING

The management of road user relationships is one of the main value chain elements expected to be implemented by toll service providers. The T-Systems Tolling Platform offers an integrated module for contract management, billing and web portals, specifically tailored to manage all business entities and customer processes related to road user charging. This includes management of customer and vehicle master data, OBU management and pairing, (value added) service management, pre- and post-payment options and much more.

Because standard software is used for the application platform, it's easy to seamlessly integrate toll service provider specific enhancements and processes, and to add value-added services.

A web portal for road users features a state-of-the-art UI and reduces

customer service costs (agents, mailings, etc.). A second web portal for toll service providers and business partners offers a business dashboard in addition to master data management with all necessary operational and commercial functionality – generating performance reports for external contracting entities, for example.

Toll service providers with a higher integration demand can benefit from the well-structured, complete and web service-based T-Systems API that can be easily extended to additional client needs.

The system can be readily integrated with the T-Systems Device Management and Toll Detection System. But it can also be used with other (additional) data sources such as billing data records from toll chargers with DSRC schemes, value-added services, and so on.

T-Systems Contract Management and Billing can be integrated with a standard ERP system for certified accounting in line with the toll service provider's implementation policy.

T-SYSTEMS ELECTRONIC TICKETING

The T-Systems Contract Management and Billing system is complemented by an electronic ticketing system. This is specifically designed for road-user charging scenarios such as backup systems for GNSS- or DSRC- based tolling schemes (short flat rate tariffs for foreign and occasional users, broken OBUs, etc.) or as a standalone system in booking models (i.e. for passenger car tolling, city tolling, etc.). The T-Systems Electronic Ticketing application maintains a white list of all valid or cancelled bookings and provides these to compliance-checking systems. It also delivers access options for registered and non-registered users, as well as web portals optimized for high-resolution (desktop/laptop/tablet) hardware and mobile devices.

T-SYSTEMS TOLL CHARGER COMMUNICATION MODULE

Although standardized by the EETS framework the commercial, procedural and technical interfaces to the toll chargers owning the toll domains vary drastically due to domain specific conditions and requirements. To reduce the impact on the platform architecture and to allow fast technical integration with multiple toll chargers, the communication functions (technically largely governed by ISO 12855) are bundled in the T-Systems Toll Charger Communication Module (TCCM) which contains multiple connectors specifically adapted to toll chargers.

T-SYSTEMS MANAGEMENT INFORMATION SYSTEM

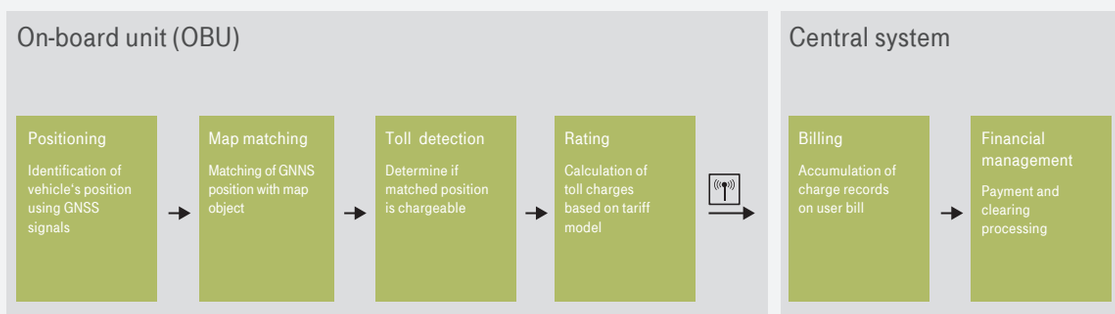
Toll service providers have to fulfil various obligations concerning reporting mostly required by toll charges but also for internal purposes. The T-Systems Tolling Platform provides a comprehensive Management Information System (MIS), which collects and provides all essential tolling and customer data and implements continuous monitoring. It also reports functionality, which enables toll service providers to identify operational deviations on short timescales and to produce required basic reports.

SMART OBUS FOR HIGHEST POSSIBLE DATA PRIVACY

T-Systems has created the T-Systems Tolling Platform to provide maximum robustness and highly effective detection. But it's also designed to comply with existing and potential future European data privacy standards.

In today's increasingly information-based society, privacy is already one of the most critical features affecting consumer decisions, acceptance and cooperation. Its importance will certainly continue to grow in the future. Toll service providers are directly affected by this, given that vehicle positions and routes of vehicles are regarded as personal data.

One of the main objectives of EU Directive 95/46 is to reduce the use of personal data and, accordingly, to encourage the design of business processes that require only a minimum of sensitive data. In other words, the sensitivity of the data used should decrease along the processing chain: only information that is actually necessary for the relevant financial transaction is passed on. The design philosophy of the T-Systems Tolling Platform reflects this: only the data needed for further processing leaves the OBU. Other steps, including the aggregation of tolling events, are performed on the OBU. Users have complete transparency, as they have access to detailed data on their OBU and can opt in to transfer journey data – in case an in-depth journey statement is required in addition to the invoice document.



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