Electronic Toll Solutions

Major project examples. All over the world
Technology that makes sense. Every day

Electronic tolling has many different facets and Siemens masters them all. Whether you want to introduce road pricing in large urban areas or congestion charging in cities (City Tolling): a common toll system for freeways, roads and bridges (Single Lane Tolling): or a barrier-free toll system that is implemented on motorways or as a nationwide system (Open Road Tolling), we will leverage our extensive experience to make sure you achieve the expected results.

On the following pages we present a number of examples of major projects that – in spite of their variety – have one important thing in common: They work perfectly. All over the world.

Cover photo: Bratislava, the capital of Slovakia. Here, Siemens created a satellite-based nationwide tolling system.
Camera-based congestion charging works! Just how well is illustrated by the Congestion Charge in London, where we are currently involved in the third project. Read more on pages 8 to 11.

Satellite-based tolling systems are the technology of the future. Where and how this future has already started is described on pages 12 to 15.

Toll plaza solutions: Efficient stop & pay on motorways, tunnels and bridges. For examples from Norway, Austria and Portugal, go to pages 4 to 7.
The Brenner motorway in Austria. In 1993, we equipped it with a turnkey toll solution.
Toll plaza solutions: Efficient stop & pay on motorways, tunnels and bridges

Toll plaza solutions are typically used at motorways, tunnels and bridges. While offering fast return on investment, toll plazas can only be installed where sufficient space is available. We have been realizing such solutions for many years. Our clients are benefitting in particular from the mature Siemens IT solution for tolling and our range of payment automation features contributing to a significant reduction in processing times at the toll plaza.
Oslo Toll Ring Project, Norway, 1990–2007: The world’s largest toll ring paid for itself within the first year

The Oslo toll ring covers the network of roads that serve as the main arterials to the city center. In 1990 Siemens was contracted to provide a turnkey toll solution, including planning, engineering, supply of goods, installation, commissioning and maintenance. We designed and built all the toll ring facilities: 19 toll plazas with a total of 63 toll lanes (equipped with induction loops), 38 toll booths and 43 electronic fee collection lanes fitted with monitoring cameras. An especially important aspect of the project was the integration of a manual payment system with a fully electronic toll system based on microwave tags (AutoPass).

The system is highly profitable, cost-efficient and runs 24 hours a day, 7 days a week. Already the revenues achieved in 1990 as the first year of operation – in the equivalent of €90 million – completely covered the necessary investment of only about €30 million. Today the Oslo toll ring earns Norway’s road administration €120 million per year, while the operating costs reach only about 10 percent of that sum.

One third of the not inconsiderable income is used to improve the infrastructure, with a total of 25 road construction projects already realized today.
Austrian Interurban Roads Project 1995 and 2001: An exemplary tolling IT system for all of Austria

The Brenner motorway in Austria connects the Italian and German motorway networks and passes directly over the Alps. In 1993, Siemens won the contract for the installation of a complete turnkey toll system. It had to be easy to operate and ready in a mere 12 months. We succeeded in fulfilling both of these requirements. In two follow-up projects, we also installed the toll systems for the Arlberg and Felbertauern motorways.

One element that makes our solutions so successful is the Siemens toll IT system for back office applications, because it perfectly supports and simplifies all activities required for toll collection. The user-friendly system can be flexibly configured and offers automated functions for all routine processes.

These advantages proved so convincing that our customer ASFINAG commissioned the extension of the system to all other Austrian toll roads in 2001. In the same year, we added new system functions allowing video-based tolling using automated number plate recognition technology. This means that today all vehicles registered in the system can pass the toll plaza on the video monitored lane without stopping at all. By the way, this upgrade was carried out during ongoing operation!

Project for the A8/A1 system in Portugal 2001: Toll collection and traffic management systems combined

In March 2001, Autoestrado Atlantico awarded us the order to supply a complete toll system in combination with measures for traffic monitoring and traffic safety enhancement. Within only 6 months we set up a communications backbone on the basis of optic fiber glass; implemented a microwave-based single lane toll system and installed tunnel control, emergency telephones and CCTV surveillance. The system works to the customer’s full satisfaction, providing the added benefits of optimized traffic flow achieved through a flexible tariff structure, improved traffic safety and reduced consequential damages thanks to the emergency telephone system.

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**Brenner motorway**

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<thead>
<tr>
<th>System topology</th>
<th>half-closed with credits for trip interruption</th>
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<tr>
<td>Collection points</td>
<td>14</td>
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<tr>
<td>Number of collection booths</td>
<td>43</td>
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<tr>
<td>Average number of booths in operation</td>
<td>22</td>
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<tr>
<td>Vehicles processed</td>
<td>annually 14 million daily 38,500</td>
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<tr>
<td>Average time for manual processing</td>
<td>22.08 seconds</td>
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<tr>
<td>Maximum number of vehicles processed per hour at a collection booth</td>
<td>automatically combined 529 combined 322 manually 26</td>
</tr>
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</table>
Camera-based congestion charging: It works – for sure!

The world’s best-known congestion charging scheme is realized in London, United Kingdom, proving that city tolling schemes can achieve all the results hoped for, such as reduced vehicle numbers in a defined zone (London: minus 18 percent), less congestion (London: minus 30 percent), reduced particulate emissions (London: minus 15 percent) – plus a considerable contribution to financing the improvement of transport infrastructure. Siemens was strongly involved in this project, as in the several follow-up projects since then.
London’s Tower Bridge marks the limit of the inner city toll zone.
30 percent less congestion – and many other benefits!

In 2002 “Transport for London” saw that things couldn’t go on like that: Air pollution in London ranked among the highest in Europe’s cities, congestion in Central London cost the British economy about two billion pounds per year, and cars moved at an average speed of about only 14 km per hour. The authorities decided in favor of a camera-based toll solution, the collection of a per-day flat fee – and Siemens as their IT partner.

**Extremely positive effects**
Following the introduction of the congestion charge, the number of vehicles in the toll zone dropped by 60,000 per day (16 percent), and more than every second driver decided to use public transport instead, reducing congestion by 30 percent. Already in the first year of operation, the revenues were so high that they helped pay for the expansion of the city’s transport system.

**Collecting accurate data means charging the exact fee**
For the London Congestion Charge, Siemens provided the entire system architecture for collecting, analyzing and processing all necessary vehicle and payment data. This task is quite complex because many different aspects and vehicle categories have to be taken into account:
- The fee is charged only from Monday to Friday, between 7:00 a.m. and 6:30 p.m.
- Taxis, private rental cars with a London license, motorbikes, bikes and busses are wholly exempt from the charge.
- People living in the toll zone benefit from a 90-percent reduction.
- On request, vehicles running on alternative fuels can also be exempt from the charge.

Collecting accurate data means charging the exact fee

A total of 879 high-accuracy license plate recognition cameras detect the plates of more than 4 million vehicles every day.
The new Low Emission Zone covers nearly the entire Greater London area.

The integration of many different communication channels is an important factor for the smooth operation of the system. Users can register in advance per telephone, Internet, SMS or mail; payment options include direct debit, telephone, Internet, SMS or postal order.

Continuing success with the Western Extension Zone (WEZ) ...

When the Western Extension Zone was added, Siemens was involved again as systems integrator. At the 127 detection points, a total of 879 high-accuracy license plate recognition cameras were installed for capturing more than 4 million plates per day and sending the information to the central data processing system. This enormous amount of data required the installation of highly innovative system architecture.

In contrast to the first application, this solution is fully integrated so that the cameras need no external computer hardware anymore.

... and the Low Emission Zone (LEZ)

February 4, 2008, marked the start of the LEZ, with IT technology from Siemens. The LEZ covers all roads and a number of motorways in the entire Greater London area. The LEZ charge is applicable 24 hours, 7 days a week. The goal is the long-term improvement of air quality in Greater London. To achieve this, all high-pollution vehicles such as diesel-fueled trucks, busses, coaches, vans and lorries that do not meet the Euro-III particulate emissions standard are charged with a per-day fee of 100 to 200 pounds. This fee has to be paid before entering the zone. Compliance is monitored by stationary and mobile cameras that recognize the license plates and transfer the data to the Siemens system.

Since the introduction of the Congestion Charge, the streets in the toll zone have to accommodate 18 percent fewer vehicles.
In Sydney, our satellite-based toll system was put to an intensive test – with success: The recognition rate reached 99.14 percent.
Satellite-based toll systems: The future is already here ...

In 2005, in the Seattle region in the US state of Washington, we implemented the first satellite-supported toll system. Today we can say that this application was the start of the future of tolling! The satellite-based Siemens toll system can be used on small roads as well as major motorways, and even in the deep street canyons of modern megacities; it offers 99.86 percent accuracy, as repeatedly proven, and does without any special roadside infrastructure. All commercial, trial and demonstration applications portrayed on the following pages are based on the Siemens “Nucleus Generic ETC” platform.
It works. It is highly accurate. And it offers benefits that convinced the traffic authorities of several countries.

Seattle, USA, 2005: “Will it work in an area-wide application?”

In a large-scale trial project with more than 400 vehicles, over 5,500 road kilometers and 6,000 toll sections, we installed the first area-wide toll system along the Puget Sound. The Siemens On-Board Unit (OBU) used in the trial had already passed the test in Austria and is used today for the truck toll scheme in Germany and other applications. Just as the OBU, the Siemens-developed central management system passed the test with flying colors, especially because of its high degree of flexibility in adapting tariff structures or expanding the tolled zones. The project results were more than promising, we can say, because they demonstrated the maturity of the series-produced Siemens technology and the high accuracy that can be achieved with GPS-supported systems.

By the way, the world’s largest and most complex GPS-based tolling system, too, uses Siemens OBUs: For the truck toll system in Germany, the data for 86 percent of all transactions are collected by the Siemens OBUs.

Australia and United Kingdom, 2005/2006: “Will it work reliably and safely?”

From November 2005 until the end of February 2006, Siemens carried out a field test in Australia, with the technical control center for the GNSS-based toll solution being located in Vienna, Austria. In Melbourne, Sydney and on a road in the north of Sydney, our satellite-based toll solution was tested intensively in so-called matrix tests. This was the first practice test for our new hybrid solutions, for instance, combining GPS and microwave technologies. The results of the field tests by far exceeded expectations!

The first area-wide satellite-based toll application ever: 2005 in Seattle, USA

Our new hybrid OBUs support both GPS and microwave toll collection technologies
The trials proved that our satellite-based toll application
• works smoothly and reliably
• offers 99.74-percent detection accuracy
• is easy to integrate into existing microwave installations
• allows easy step-by-step migration of existing toll solutions thanks to its hybrid technology
• supports totally flexible tariff schemes based on time of day, road type and vehicle classes
• makes it possible to add or exclude roads from the toll coverage, quasi over night.

The tests also demonstrated that our solution can do more than help collect toll fees. It can also be used for the accurate detection of special vehicle classes, subject to restrictions on the load they carry (such as hazardous goods vehicles).

In parallel to this trial project, Siemens was one of only three companies selected for system performance demonstrations for Charging Data Services and Central Services in the United Kingdom, with Siemens satellite technology receiving the highest marks. Our GPS-based distance calculations were significantly better than odometer calculations.

**Slovakia, January 1, 2010: Start of the most advanced toll system in the world**

Within only 11 months we implemented a satellite-based toll system in Slovakia. In addition to the tight schedule, further challenges had to be met: Beside 500 kilometers of motorways, the system was to cover a total of 1,900 kilometers of first-class roads. In addition, the system was to offer options for modifying the toll coverage at any time during ongoing operation – realized successfully through over-the-air updates. Cross-border toll collection is also an important aspect and easy to realize with our solution. A trip from Bratislava (Slovakia) to Prague (Czech Republic) was covered in its entirety – using one and the same OBU! After all, Siemens can rely on more than ten years of experience in developing GNSS OBUs, with the third generation already on the road.
The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.