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# Reach for the sky

Satellite-based tolling system in Slovakia

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# REACH FOR THE SKY

Slovakia is the perfect showcase of a well-executed and financially successful GNSS tolling deployment, with much-needed funds flooding into government coffers – while on the technical side it's ready for EETS and much more



➤ The satellite-based OBU, the core of the solution, is used to detect tollable roads and road segments

➔ Situated in the center of Europe, Slovakia has experienced 10 years of strong and profound economic growth. Measuring 450km from the eastern to its western borders and 75 and 150km from north to south, all in all the country covers a total of 49,000km<sup>2</sup>. The central and northern parts bordering the Czech Republic and Poland are particularly mountainous, making any kind of road construction quite expensive. The climate also takes its toll: cold winters sometimes below -30°C and hot summers into the upper 30°Cs make it costly for road operators to maintain the road network. The country is additionally easily transited and the haulage industry has a tendency to leverage lower fuel prices in

neighboring countries and not contribute anything in the way of fuel tax for the construction and maintenance of the Slovak Republic's road network.

These factors led to the government's decision to introduce a road user charging scheme for trucks to overcome some of these challenges. The road network today consists of about 570km of highways. But by charging just this part of the road network, the deviation to first-class roads would have been great, while many of the first-class roads were part of the transiting routes (TEN-Trans European Network) anyway. The decision was therefore taken to also include more than 1,800km of the first-class road network totaling [then] to 2,370km. In order to

follow the fair 'user pays' principle, around 2,300 charge stations were planned to be set up, comprising more than 7,000 traditional lanes on toll plazas. The costs involved with such a solution, however, favored a satellite-based solution as the investment for an infrastructure-based charging system would have been prohibitively high.

## PREREQUISITES FOR A GPS SYSTEM

What are the prerequisites for a GPS-based road user charging system? There are essentially three building blocks which can be identified that are defined and designed according to the customer's specifications and requirements. First, there's the onboard unit (OBU), which is responsible for the detection of tollable roads and road segments, together with an electronic tolling back-office handling the toll transaction data. Second, there's an enforcement solution using fixed, mobile and portable enforcement in order to guarantee the toll income for the toll operator. And finally there's a strong back-office to handle all customer- and administration-related data – for example name and address of the payee, pre-pay and post-pay information, etc.

The satellite-based OBU is the core part of the toll solution, comprising several components. A GPS module is used for localization and a GSM module for secured GPRS data communication from the OBU to the back-office and vice versa (for example for software updates). A microwave module is used for independent enforcement checks as well as for interoperability reasons. A security module protects the OBU from tampering, as well as for data security reasons, while a movement sensor promotes short boot time of the OBU and a host processor that handles all OBU-related data and initiates the data transmission process according to the customer requirements. In addition to the hardware, some software is also needed for charging, the core part of which is a so-called geo model that is a downsized map of the of the charged road network. This geo

model can be changed reliably and secured during the update processes and therefore allows new roads, bridges and tunnels to be incorporated very quickly and simply into the existing solution.

**THE PROJECT AS SUCH**

At the beginning of January 2009, the Slovak government awarded operator SkyToll with the contract to implement and operate the satellite-based charging system for trucks above 3.5 tonnes and buses with a capacity more than nine people. The 13-year contract for the operation also included an optional five-year extension. Siemens was contracted by SkyToll to execute a functional test of concept mirroring the complete tolling solution, and was contracted to deliver the satellite-based solution including the OBUs, software reflecting the dedicated business logic, and the geo model for all toll roads. Siemens also received the maintenance contract for the electronic toll solution for the next 13 years plus the same five-year option.

The overall system design reflects the Slovakian government’s ambition to privilege environmentally friendly vehicles, with a comprehensive charge table set up including environmental class and type of the vehicle, number of axles, vehicle weight and road type. Finally, 42 different vehicle categories were created that have reflected the legal framework of the Slovak toll law.

From Siemens’ point of view, the functional test of concept was the first major milestone for the project and was successfully completed in mid-February 2009. Further projects milestones included completion of system design, the start of OBU production and finishing the system integration – all of which were executed according to the project plan and to SkyToll’s satisfaction. Tolling hit the road on January 1, 2010 and started on the complete road network of more than 2,370km less than a year after implementation. The project was delivered on time, to budget and the desired quality and not a single cent of penalties kicked in.



Ⓜ In the Slovakian truck-tolling system, more than 193,000 active OBUs are currently registered

More importantly, the Slovakian government was benefiting from the collection of a brand-new source of revenue to ensure the upkeep of its road network.

**AFTER 18 MONTHS OF OPERATION**

The success of the toll collection system in Slovakia since the start button was pressed mirrors the economic growth of the region. Up until the end of June 2011, the Slovak government earned €75.7 million from the toll collection system; in June 2011 alone, €13.6 million was added to the Slovak budget. When you compare this to the same period of 2010, that’s an increase of €12.1 million and €400,000 respectively. Overall, toll revenue up to that point in 2011 was around 11% up compared with the same period of 2010. Interestingly, 43% of foreign haulage operators contributed to financial success of the toll collection system. More than 193,000 active OBUs are currently registered in the system with the foreign share being 66%.

The enforcement of the toll collection system and subsequent issuing of fines and charges is a vital part of this multilane free-flow system. During the first half of 2011, 1.1 million vehicles had been checked by mobile enforcement units while fixed enforcement units carried out more than 44.3 million enforcement checks.

Of this number, around 2,700 enforcement cases were detected.

From an operations standpoint, all Siemens OBUs in the field are updated remotely. Indeed, multiple updates have been carried out without constraining toll collection even if a vehicle entered Slovakia after a longer period traveling in Europe.

And is there any success to report from a toll roaming and interoperability standpoint? Indeed there is. The first tests with the integrated CEN 278 DSRC module of the OBU showed that this hotly debated issue is not rocket science. Siemens prepared the Slovak solution in a way that the units are able to collect tolls on other European toll networks, in doing so easing the administrative and toll collection issues of foreign operators and bringing tolling counties in Europe another step closer together. The hybrid solution is ready for deployment as long as the political will of the various operators finds a common agreement. ❌

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