

European Experiences in Nationwide Truck Tolling using Satellite-Based Technology

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Bulgaria's Transition to e-Tolling & the European Experience

Multi-Lane Free Flow Tolling in Austria

“LKW Maut” since 2004 – with Microwave Gantries



Multi-Lane Free Flow Tolling in Slovakia

“Myto” since 2010 – with “Virtual” Gantries (GNSS)



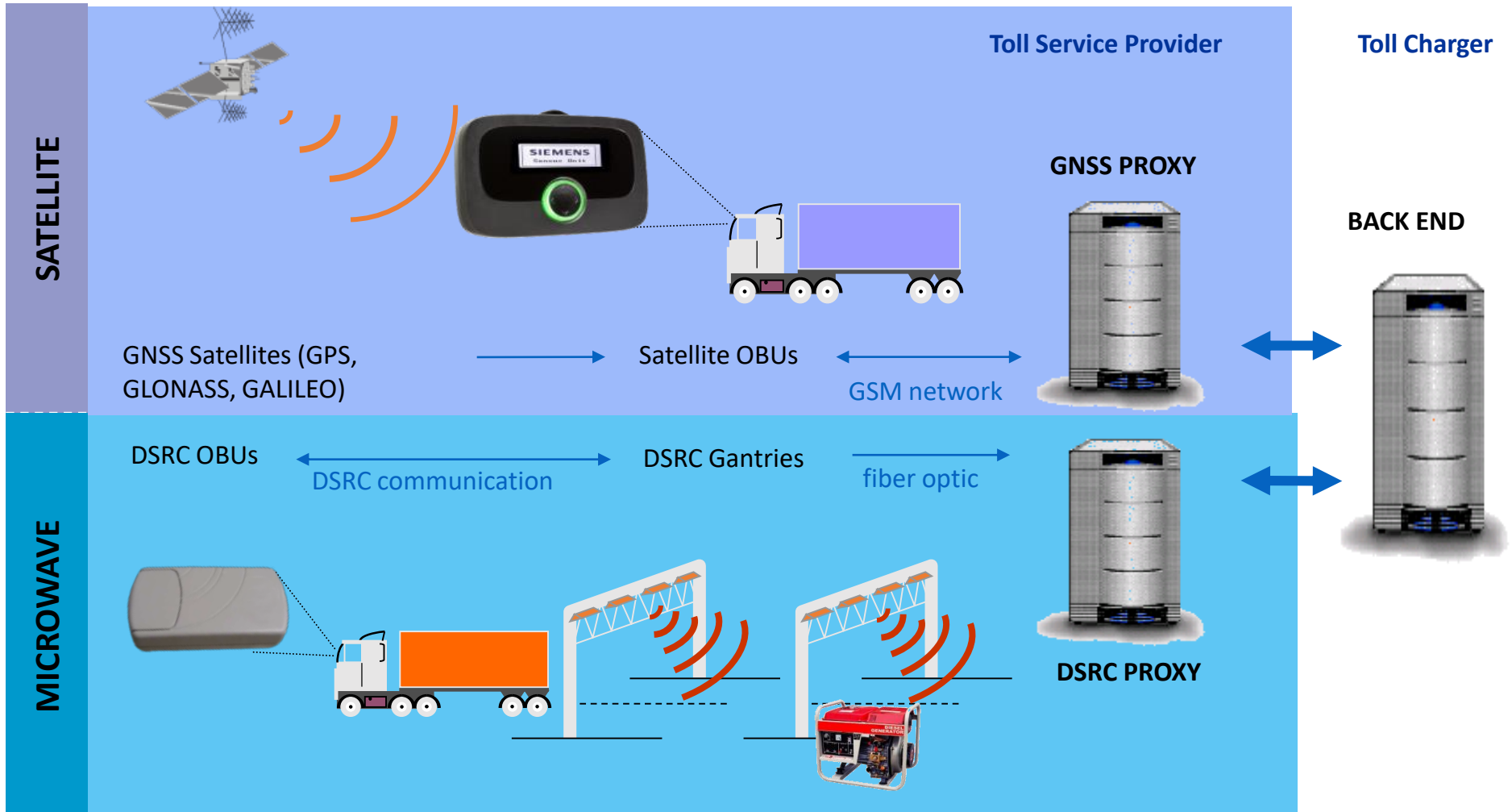
Tolling Multiple Road Categories

Slovakia, Germany, Hungary, .. Czech Republic, Bulgaria



Comparison of the Technologies used in EETS

Front-End can use satellite or microwave technology



Development of GNSS-Tolling in Europe

From Switzerland in 2001 to Bulgaria in 2019

Switzerland 2001

Germany 2005

Slovakia 2010

Hungary 2013

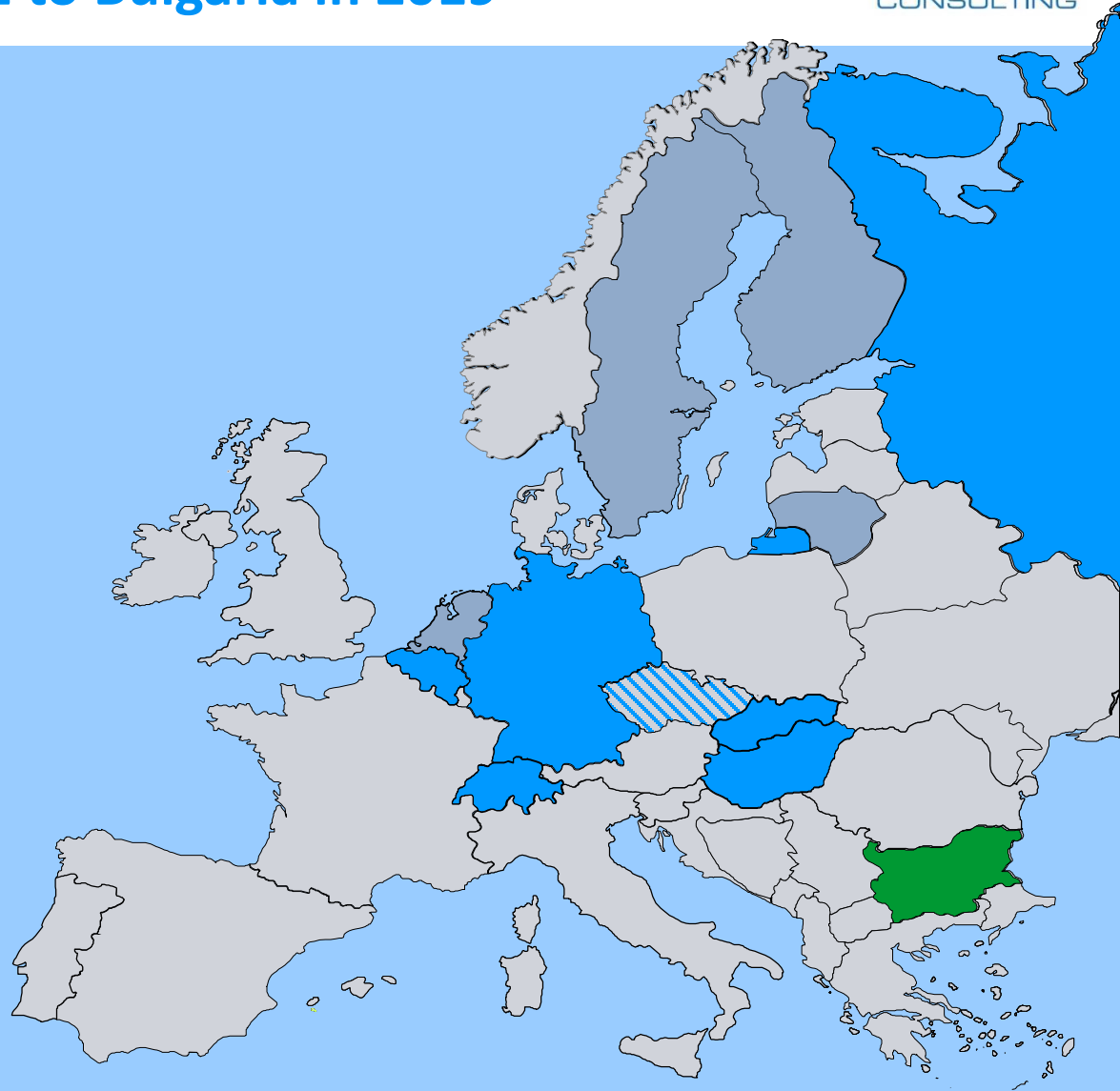
Russia 2015

Belgium 2016

Bulgaria 2019

Czech Republic 2019

Ongoing evaluations



Development of GNSS-Tolling in Europe

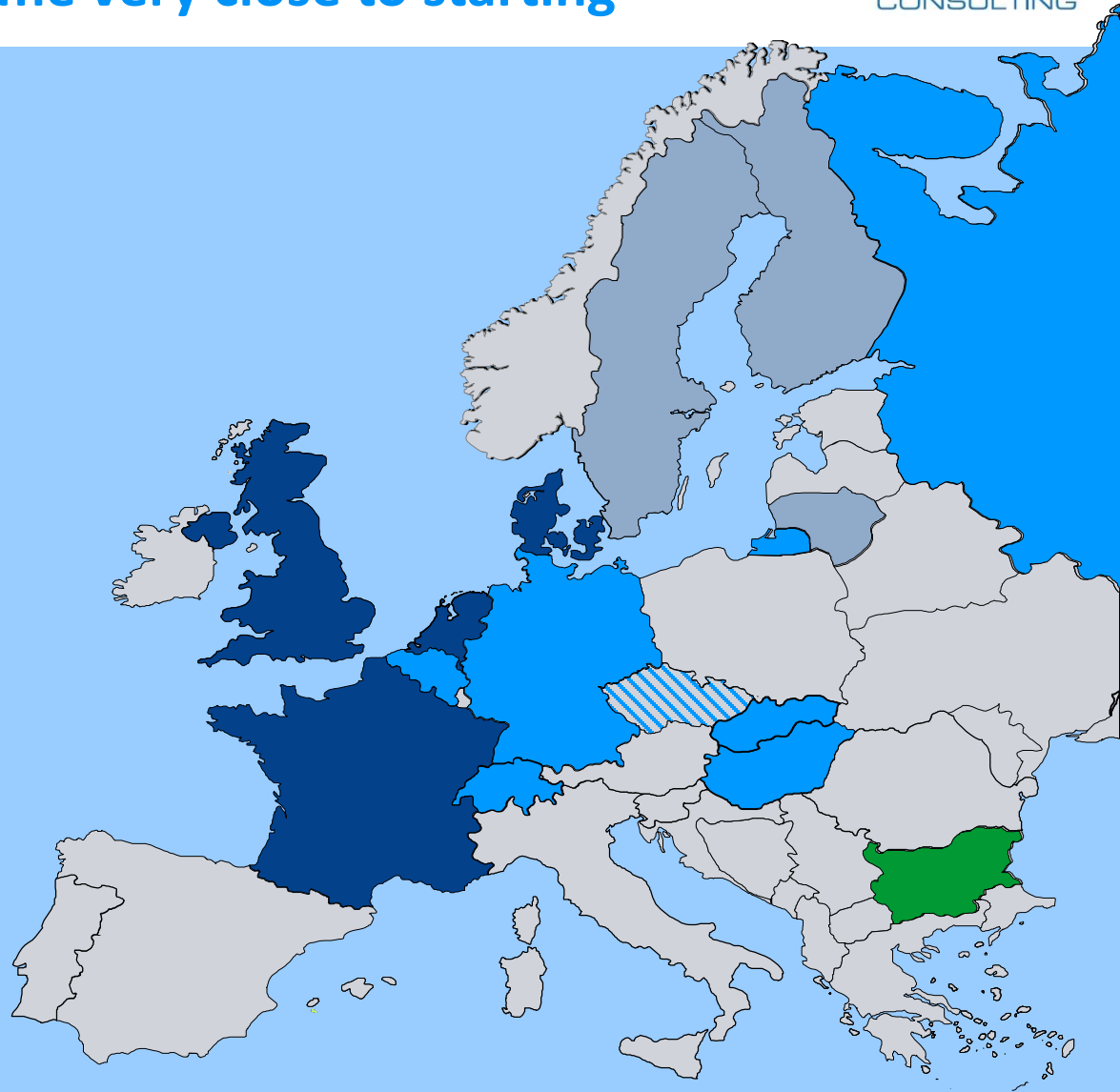
... and some countries came very close to starting

United Kingdom

Netherlands

France

Denmark



Expansion of Slovak Tolled Road Network

Initial Network from 2010 to 2013

Approximately 2,500 kilometers, of which 1,800 were first class roads



Expansion of Slovak Tolled Road Network

Extended Network since 2014

From 2,500 kilometers to 17,000 kilometers in just 3 months!



Expansion of German Tolled Road Network From Motorways to Trunk Roads (“Bundesstrassen”)

In 2018, the network expanded from 15,000 kilometers to 52,000 kilometers



GNSS-Based On-Board Units

German OBUs – since 2005

World's first satellite-assisted tolling system, with manual option.

Two options for optional OBUs – they must be installed by professionals.



Dashboard-mounted OBU



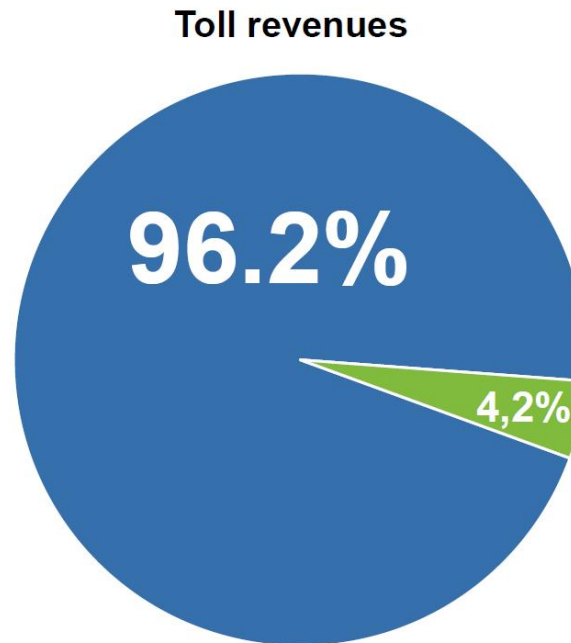
DIN-Slot OBU

- Connection to tachograph (for “dead-reckoning”)
- Infrared interface for enforcement – later changed to microwave

Manual Booking

Booking Terminals in Germany

Much Ado About Nothing? A small fraction of the revenue.



Automatic 96.2%

Manual 3.8%

3,300 terminals, replaced by 1,100 new terminals in 2017

GNSS-Based On-Board Units

Slovak OBUs – since 2010

First mandatory (self-mountable) GNSS-OBU: built-in GSM & DSRC modules.
“Smart client” architecture – OBU beeps when it passes a “virtual gantry.”

Second-Generation OBUs



First windshield-mounted GNSS OBU



Later used in Belgium



Will be used in the Czech Republic

GNSS-Based On-Board Units for EETS

Belgian OBUs – since 2016

The first use of OBUs for the European Electronic Toll Service (EETS)



Default OBU from Satellic



Axxès OBU – in operation on the first day



Telepass OBU (Italy)



AS24 OBU (Total)

Tribox OBU (Eurotoll)



The French GNSS-Tolling System “Ècotaxe”

The very first implementation of EETS





13,000 km of national roads.

Completely implemented.

800,000 OBUs produced.

Cancelled 2013 after protests.

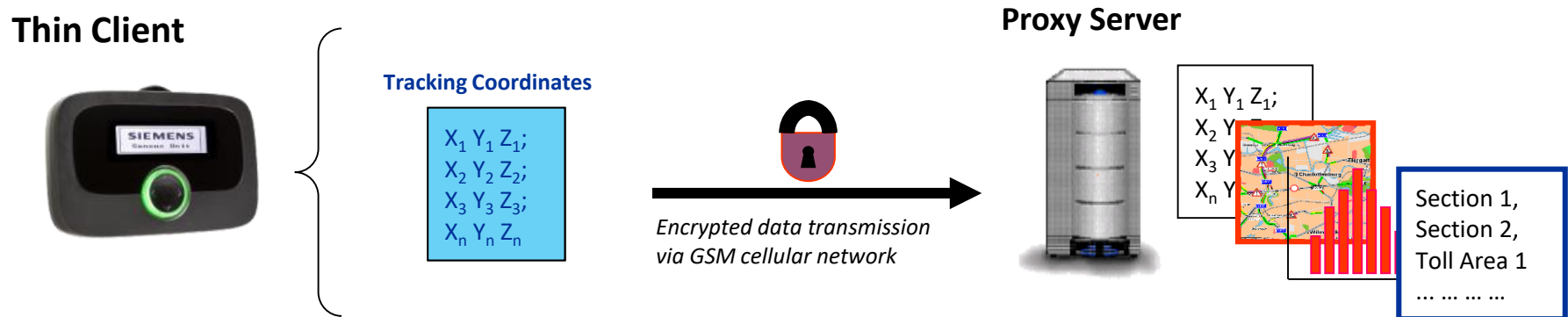
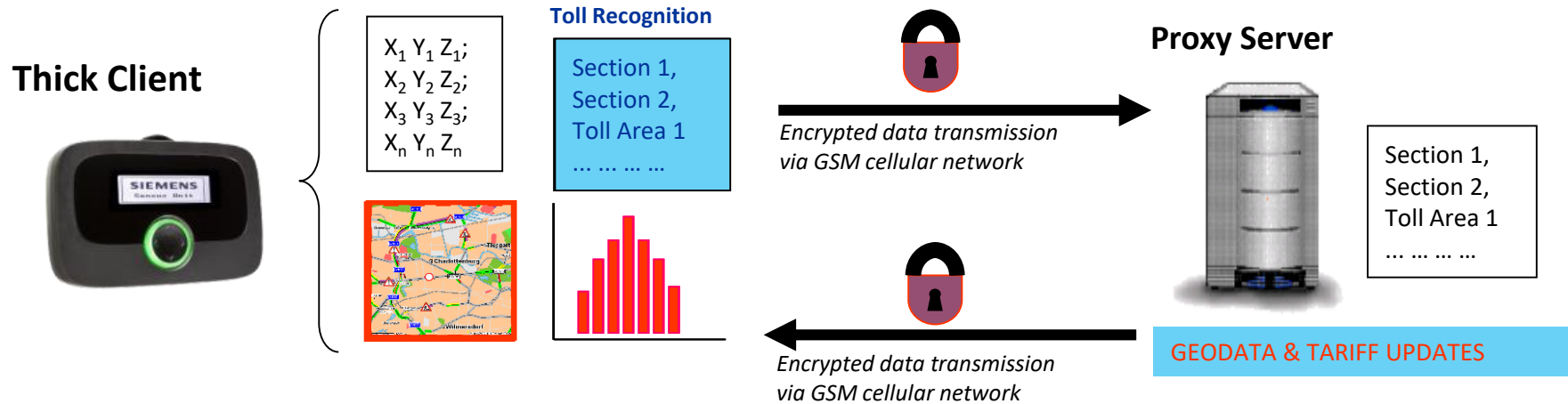


-  Réseau national taxable
-  Itinéraires nationaux exemptables
(faible trafic PL hors RTE)
-  Réseau soumis à péage autoroutier,
non taxable
-  Départements les plus périphériques



Thick-Client vs. Thin-Client GNSS OBUs

“Intelligence” either in the OBU or in the Back-Office



The Motivation for EETS

One Vehicle, One OBU, One Contract

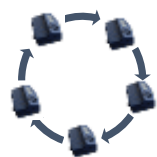
A typical truck in Central and Eastern Europe: 7 different OBUs



The EETS Revolution

The New Value Chain Evolving with EETS

Each element of the value chain can be outsourced to specialists.



Toll Detection
OBU Operation



Map & Modelling
Service



Charge Record
Generation



Billing, Invoicing



Toll Charger
Interface



Customer Service
Contract Mgmt.



Value Added
Services

Courtesy of T-Systems

- **OBU supply and operation (which can include toll road detection)**
- **Geodata: map and modelling service (already offered in Belgium)**
- **Generation of toll charge records**
- **Billing and invoicing**
- **Management of interfaces between Toll Service Provider to Toll Chargers**
- **Customer Service and Contract Management (including call centers)**
- **Value-added services (such as fleet management)**

Alternatives to Tolling On Board Units?

Smartphones or tracking devices are not good options

There are good reasons for tolling OBUs being installed in each vehicle

- OBUs are specially designed for tolling (e.g. “automotive“)
- Hardware is thoroughly tested to guarantee service levels
- OBUs are relatively inexpensive (< €100)
- Secure storage and transmission of tolling data
- Much higher position accuracy (mounted on windshield)
- No risk of other “apps” interfering with tolling application
- No risk of a virus attacking the hardware
- No excuses, such as “my battery power ran out”
- Enforcement is far more demanding (no DSRC interface)
- Simple and straight-forward user interface (think about call center issues!)
- Not interoperable, not EETS compliant



Galileo: Europe's own Satellite Position System

26 Satellites already launched into orbit

17 Satellites now fully operational, initial services launched in 2015



Galileo is Ideal for Satellite-Based Tolling Systems

The only GNSS operated by a civilian organization

GALILEO IS READY, SO TAKE ADVANTAGE OF IT!

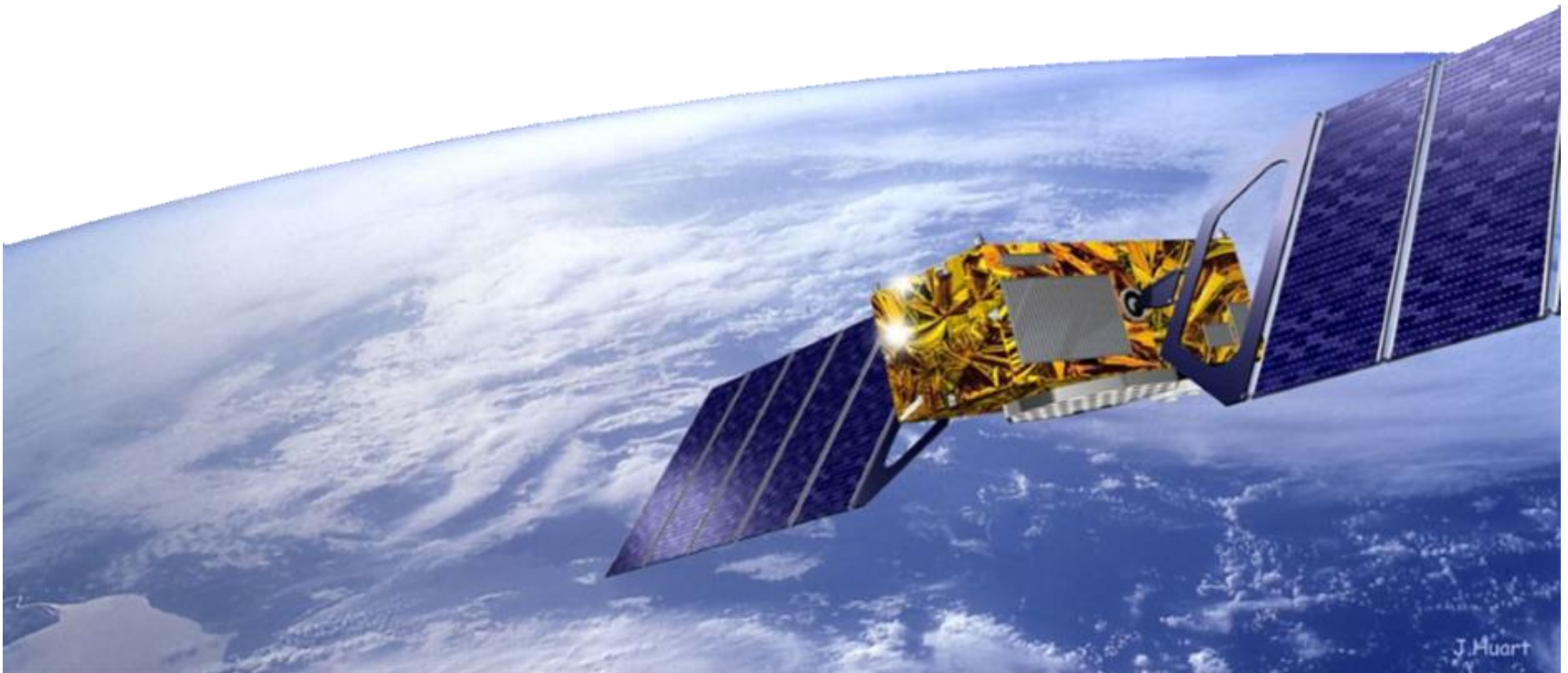


- No risk of losing positioning service in the case of military intervention
- Higher position accuracy with multi-constellation (with GPS & GLONASS)
- Signal authentication implemented to eliminate the risk of spoofing
- Already in the market: 400 million smartphones now Galileo-enabled
- 19 brands of chipsets use Galileo, representing 95 percent of the market
- Most EETS providers already deploy Galileo-enabled OBUs
- European legislation is likely to make Galileo mandatory for tolling

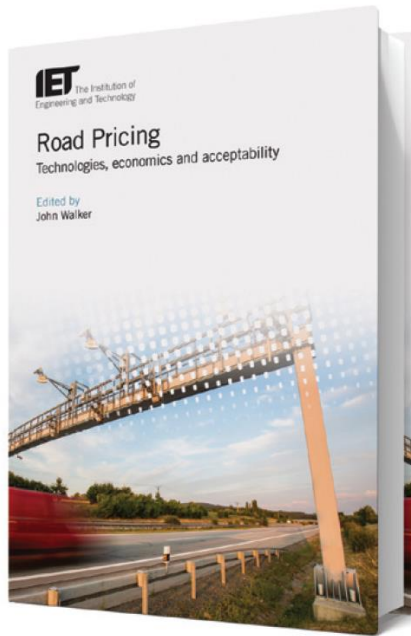
About GNSS Consulting



We consult organizations in identifying and implementing accurate positioning solutions using Global Navigation Satellite Systems.



The new book on Road Pricing published in 2018



“Road pricing is increasingly being used in both developed and developing countries: in the former to combat congestion and pollution, to compensate for falling revenues from fuel duty, to improve the efficiency of the existing transport infrastructure, and to curb carbon emissions; in the latter, also to fund new transport projects. This book looks at examples around the world, the technologies implemented, how the pricing regimes have worked out and how successful the systems have been.”

Editor: Dr. John Walker

ISBN: 978-1-78561-205-3

<https://www.theiet.org/resources/books/transport/rdpri.cfm>

Road Pricing: Technologies, economics and acceptability (Institution of Engineering and Technology), London, pp. 403-443, includes the chapter: “**GNSS-based tolling: standards and implementations**,” by Norbert Schindler and Erich Erker.



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