

Information on the means of conducting integration tests for OBU and ZSL Operators

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Dictionary of terms

Term	Description
Virtual Gantries	A road area delimited by the characteristic points whose geographical coordinates are located in the Central System. Detecting a vehicle drive-through a virtual gantry takes place by checking whether the vehicle trace registered by the OBU and sent to the Central System crosses the virtual gantry area.
OBE	(Eng. On Board Equipment) - a toll system component located in a moving vehicle. For example: mobile devices (equipped with free software provided by KAS), external location systems (ZSL), and on-board units (OBU) using satellite positioning and data transmission technologies.
OBU	(Eng. On Board Unit - a device installed in a vehicle to collect the Electronic Toll.
OBU operator	The OBU service management company.
ZSL operator	The ZSL service management company.
ZSL	- a system independent of the SPOE KAS that provides information on vehicle location. Examples are solutions by EETS providers or solutions by commercial companies for tracking the location and movement of vehicle fleets.
JSON	(Eng. JavaScript Object Notation) - a data exchange format.
JSON Schema	Defines the data structure in JSON.
MCC	(Eng. Mobile Country Code) - a unique wireless network country of operation identification number.
MNC	(Eng. Mobile Network Code) - a wireless network (operator) identification number unique within a given country.
Jamming	GPS signal jamming by electronic devices.
Spoofing	Attacks on an ICT system by impersonating another element of the IT system.
EGNOS	(Eng. European Geostationary Navigation Overlay Service - the European GPS and GLONASS systems and, in the future, the Galileo system.
PEM	(Eng. Privacy Enhanced Mail) - a file format for storing and sending cryptographic keys, certificates, and other data defined in RFC 7468.
Base64	Used to encode a sequence of bytes. Defined in RFC 4648.
TLS	(Eng. Transport Layer Security, a standard Internet cryptographic protocol that ensures data transmission confidentiality and integrity, server (sometimes client) authentication. This is a SSL protocol extension.
SSL	(Eng. Secure Socket Layer) - a standard cryptographic protocol used for secure transmission of documents over computer networks.
CSR	(Eng. Certificate Signing Request - a request to sign a certificate; an encrypted message sent to the issuer in the process of applying for an

	SSL Certificate. During CSR generation, there is also a private key created.
GPS	(Eng. Global Positioning System - an American radio navigation system based on satellites.
GNSS	(Eng. Global Navigation Satellite System - a global navigation system covering the whole Earth. For example: GPS.
SPOE KAS	The Electronic Toll Collection System of the National Revenue Administration

1 Introduction

The SPOE KAS is used for toll collection based on GNSS techniques. There must be OBE (On-Board Equipment) installed in the vehicle. Data from OBE devices are transferred to the SPOE KAS via the OBU Operator or ZSL Operator. It is also possible to transfer location data by means of a mobile application (this document does not contain information on data transfer by means of a mobile application). Fig.1 shows the mobile application that may be used to display the SPOE KAS feedback, e.g. balance status, to the driver.

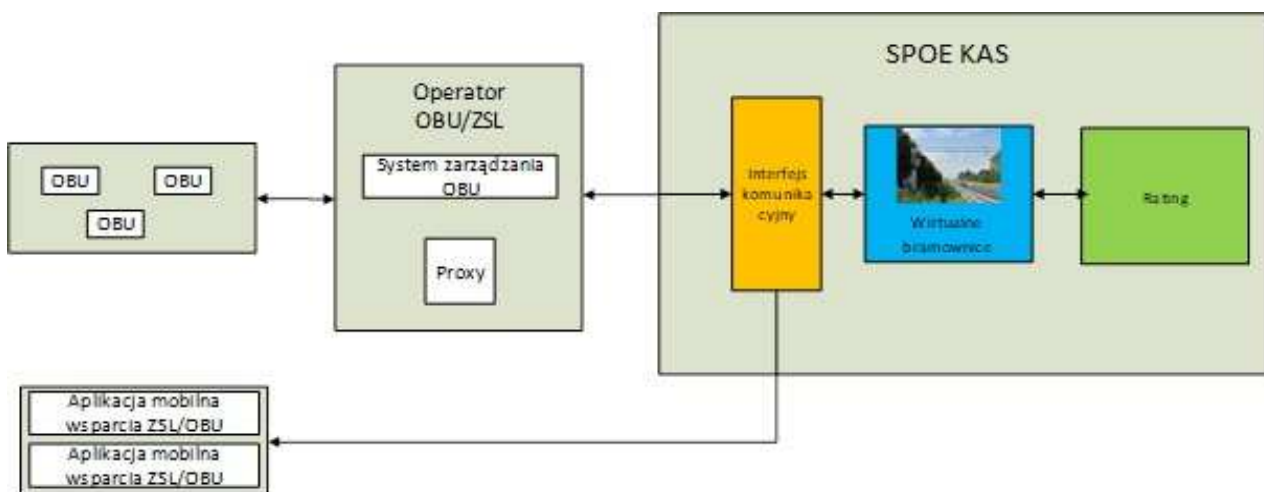


Figure 1 Main system components discussed in this document.

This document describes the procedure of technical verification of location data delivery correctness by the OBU Operator or ZSL Operator.

2 Verification of technical requirements and the means of transferring geolocation data.

Upon registration of the test locating devices in the SPOE KAS, the verification of technical requirements may be commenced. This procedure consists of two stages:

1. Integration: Proxy Server <-> SPOE KAS.
2. E3E drive-through tests.

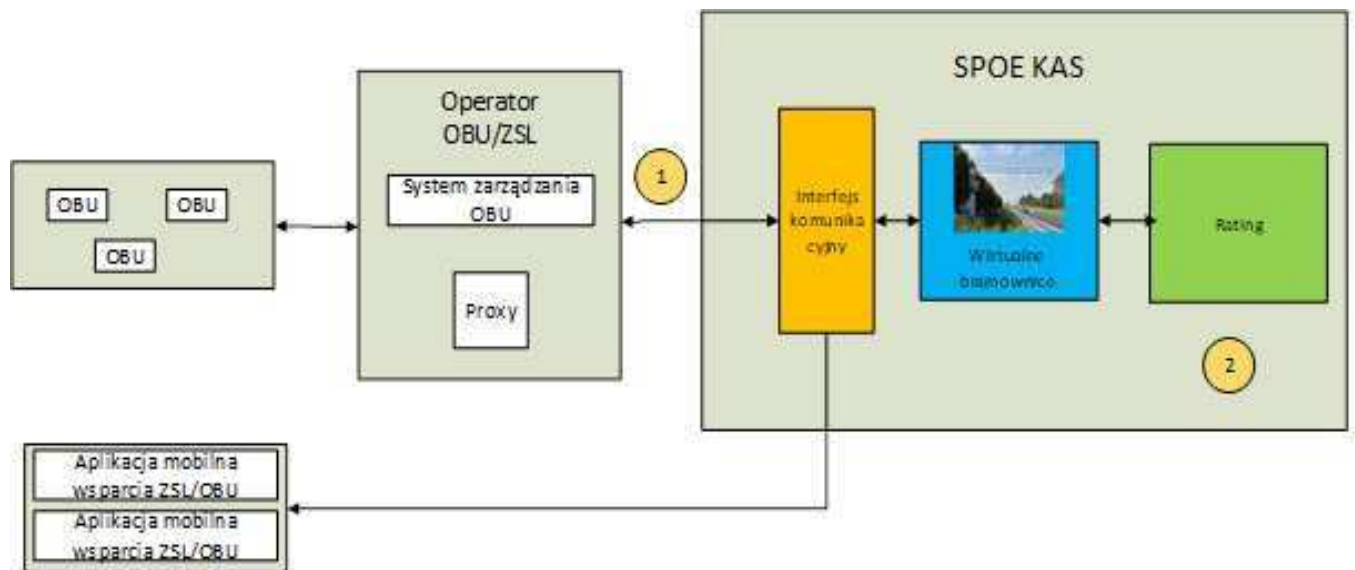


Figure 2 Technical requirements verification points

3 Proxy Server <-> SPOE KAS communication

The purpose of the first verification is to check the correctness of data transmission from the Operator's Proxy Server to SPOE KAS in accordance with the technical specification described in the "Technical requirements for the transfer of geolocation data necessary for the electronic toll collection for OBU and ZSL Operators" document.

4 Drive-through test

The purpose of the case is to check the correctness of the detection of the events of driving through Virtual Gantries on the basis of the position location sent by the OBU/ZSL device.

The checking is carried out on the basis of two mapped routes made by vehicles with active devices:

- Route 1 Warsaw - Legnica - Warsaw,
- Route 2 Warsaw - Modlin - Warsaw.

A working, running OBU / ZSL device is a precondition for carrying out the tests in each vehicle. The device should be permanently connected to the power supply during testing. The device should receive GPS signals before the proper test (after the OBU and ZSL are started).

Route 1

Route 1 from Warsaw to Legnica via: A2, A1, S8 and A4 according to the map (Figure 3) (Detailed routes can be found in the file: SPOE_1_1.gpx oraz SPOE_1_1.kml), and towards Warsaw via A4, S8, A1, S8 according to the map (Figure 4) (Detailed routes can be found in the file: SPOE_1_2.gpx oraz SPOE_1_2.kml).

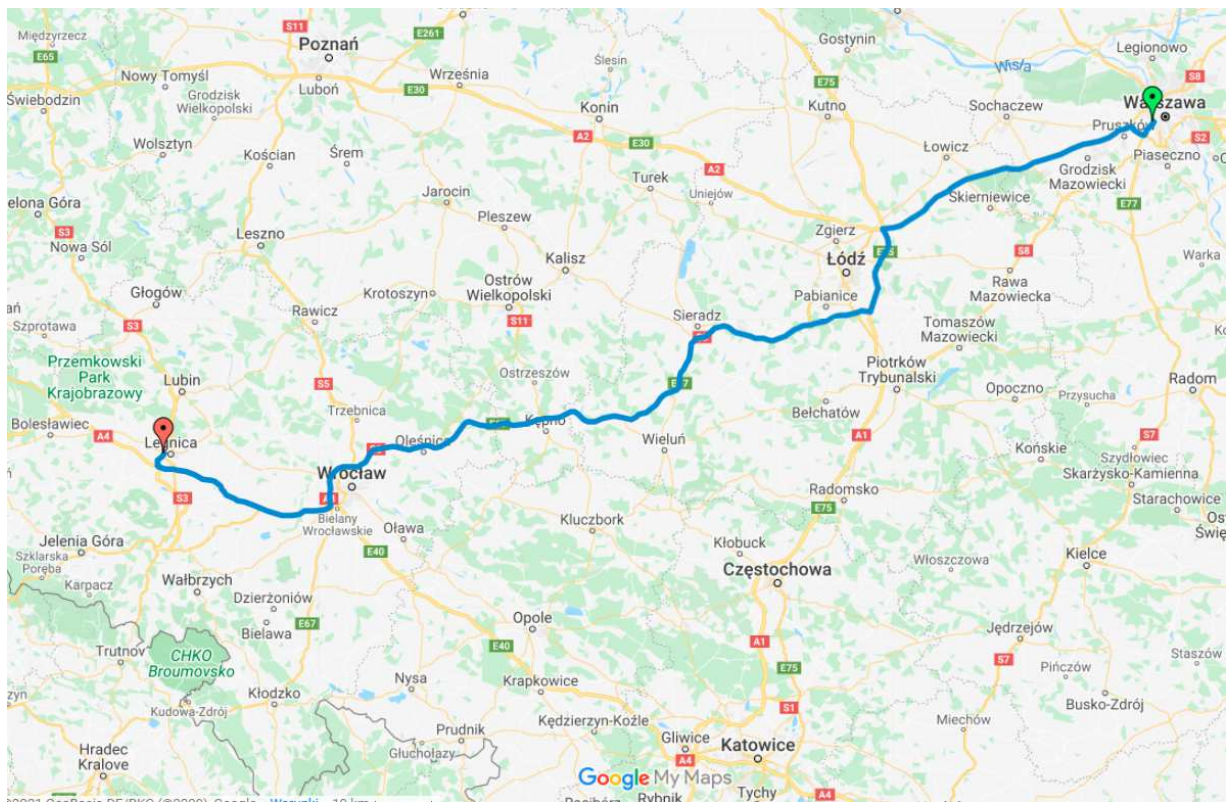


Figure 3 Warsaw-Legnica route

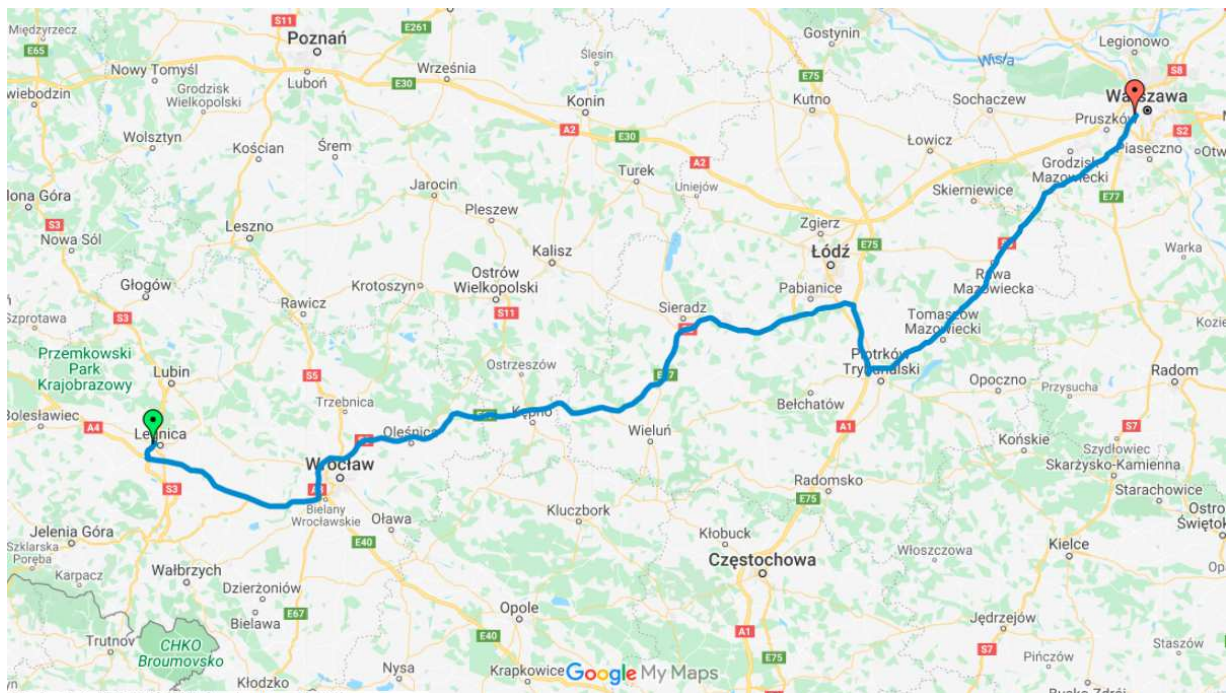


Figure 4 Legnica-Warsaw route

As part of the above drives, the vehicle should additionally perform the following activities to be checked:

1. Exiting the route to a MOP (devices running throughout the stop lasting 30 minutes) MOP Chojny Północ.
2. Exiting from the route to a MOP (complete deactivation of the OBU device for the duration of the stop 30 minutes after stopping, activating immediately before starting the drive) (MOP Chojny Południe + ad hoc)

3. Driving along a section parallel to the toll road (no events of crossing a virtual gantry should be detected) - from the Wolbórz S8 junction - to the Studzianki Kolonia S8 junction, back to S8 at the Wolbórz junction, according to the map in Figure 5.

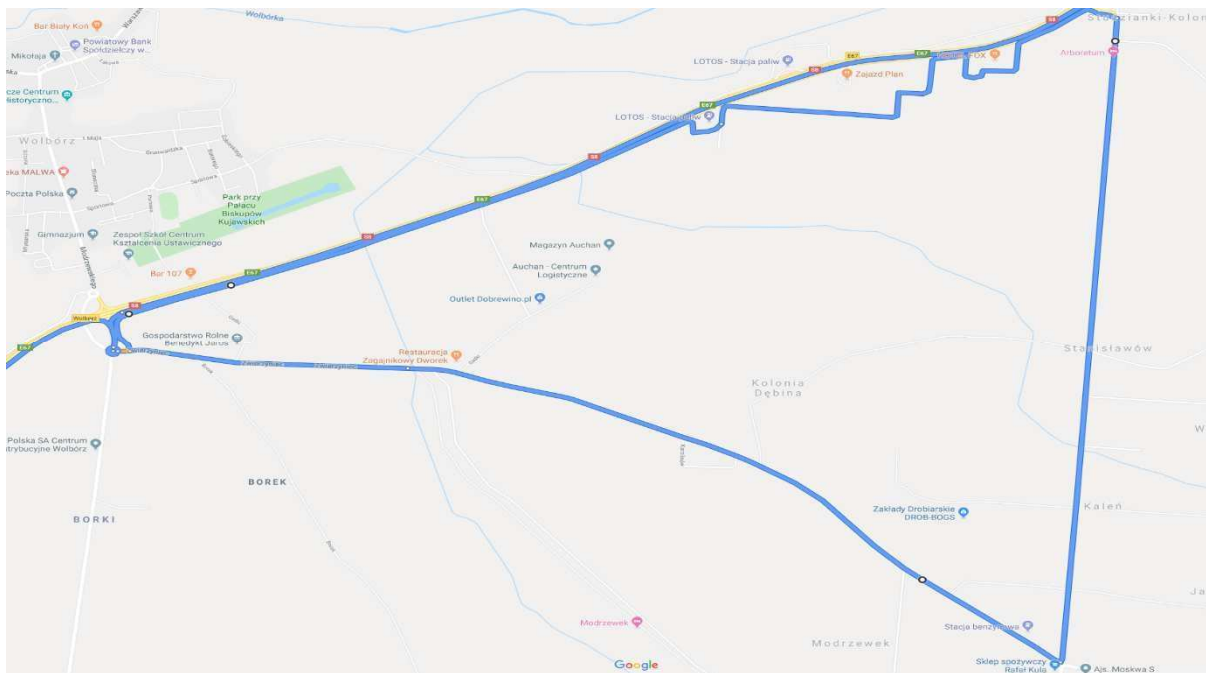


Figure 5 Toll-free section, side road test along S8
(Detailed routes can be found in the file: SPOE_1_3.gpx oraz SPOE_1_3.kml)

Route 2

Route 2 from Warsaw to Modlin and back to Warsaw via the following roads: DK7, S7 (Figure 6), as follows:

- DK7 - border of the city of Warsaw - Czosnów (intersection with district road no. 2405W),
- S7 - Czosnów (intersection with district road no. 2405W) - Modlin junction,
- S7 - Modlin junction - Czosnów (intersection with district road no. 2405W),
- DK7 - Czosnów (intersection with district road no. 2405W) - border of the city of Warsaw,
- Drive along side sections, parallel to the toll section (there should not be any drive through the virtual gantry) in accordance with the map in Figure 7:
 - Drive through a side road on the south side of DK7, Gdańska street, Cząstków Mazowiecki, Modlińska street, Dziekanów Leśny, Kolejowa street (side street to DK7) from Dziekanów Leśny to Łomianki,
 - Drive through a side road on the north side of DK7, Firmowa street, Cząstków Mazowiecki, Modlińska street, Dziekanów Leśny, Kolejowa street (a side street to DK7) from Dziekanów Leśny to Łomianki;
- Return to Warsaw via DK7.

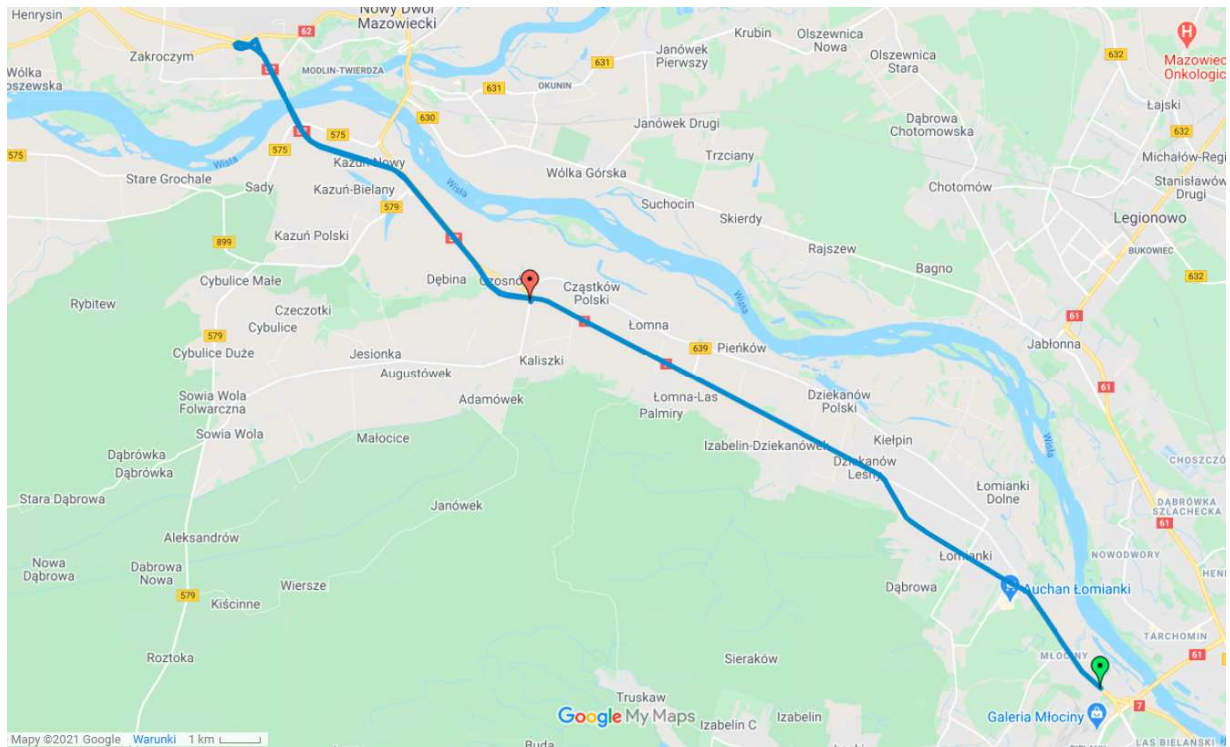


Figure 6 Route to Modlin and back.
(Detailed routes can be found in the file: SPOE_2_1.gpx oraz SPOE_2_1.kml)

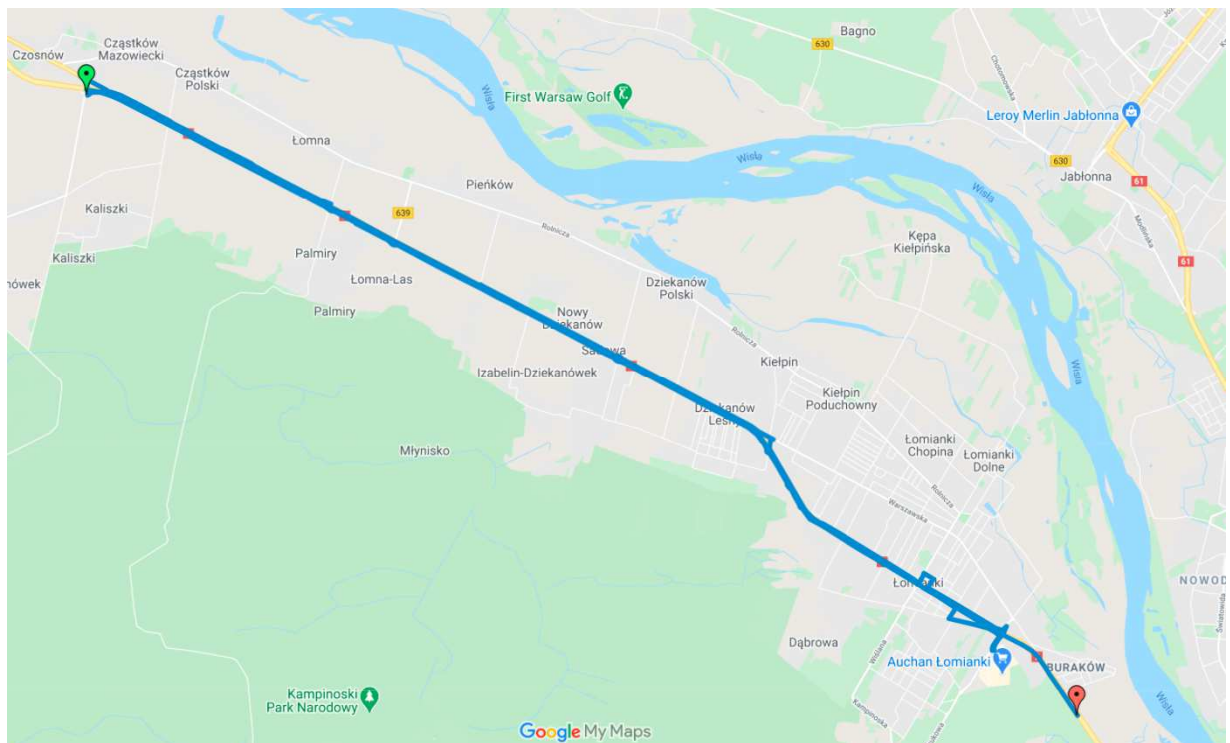


Figure 7 Route to Modlin - drive through parallel roads
(Detailed routes can be found in the file: SPOE_2_2.gpx oraz SPOE_2_2.kml)

5 Procedures related to the implementation of drive-through tests

For test purposes, the ZSL Operator / OBU Operator will have to notify the test start date. The drive-through test is performed following the principles given below:

- **one vehicle** equipped with **maximum** (recommendation not requirement) **2 different test types** of OBU / ZSL **devices**; **each device type** must be **represented by 3 devices**, giving the **maximum of 6 devices** per a vehicle; during the test, the vehicle **runs each** of the **two designated routes twice in both directions or**,
- **two vehicles** equipped with **maximum** (recommendation not requirement) **2 different test types** of OBU / ZSL **devices**; **each device type** must be **represented by 3 devices**, giving the **maximum of 6 devices** per a vehicle; during the test, **each vehicle drives through** one of designated **routes twice in both directions**,
- **a total of 4 drives in both directions** are to be made, **two drives on each route**,
- the drives should take place at intervals of not more than 2 working days,
- the Warsaw - Legnica - Warsaw route can be broken into two days, e.g. Warsaw - Legnica on one day and Legnica - Warsaw on the second day,
- it is recommended to start the route at one of the end points (Warsaw / Modlin / Legnica), however, it is possible to start it at any point on the route and end the **drive at the same point where it began**,
- the drive will be monitored by SPOE KAS,
- the result will be positive after detecting, **for each tested device**, all events from the gantries located on the designated routes in SPOE KAS,
- the result will be negative if data collection at intervals other than 5 seconds and sending at intervals other than 1 minute (60 seconds) are detected.

The SPOE KAS operator in special cases (e.g. long-term road exclusion from traffic on a long section due to renovation) allows the possibility of changing the route (before the change, consent of the SPOE KAS operator must be obtained).