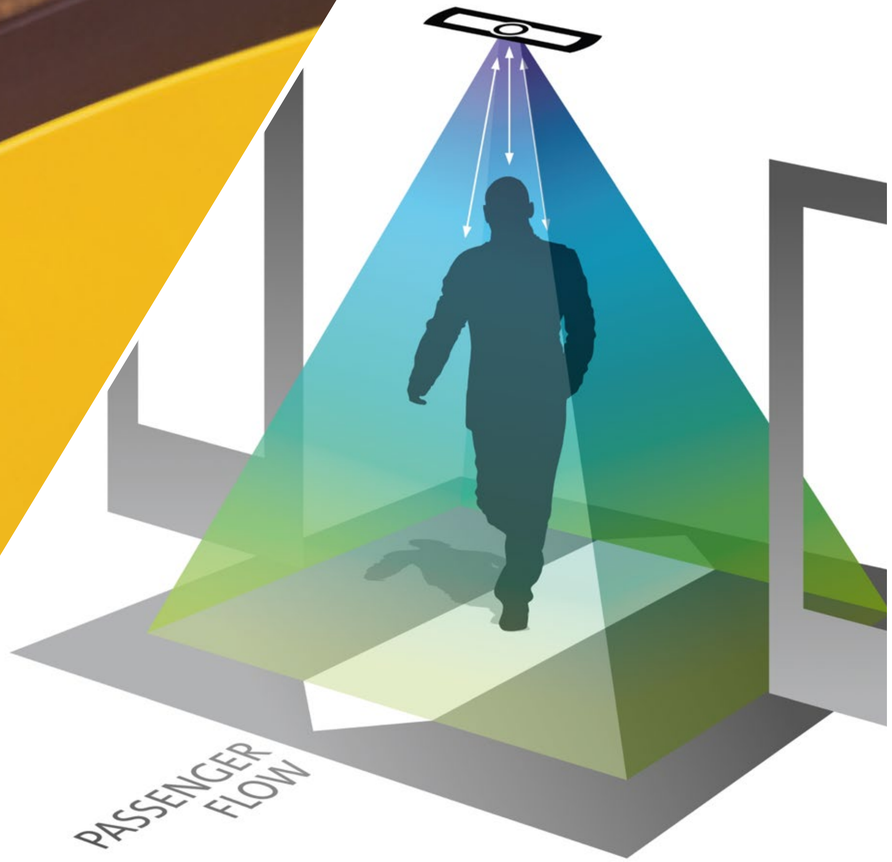
GENESIS MOBO



APCS

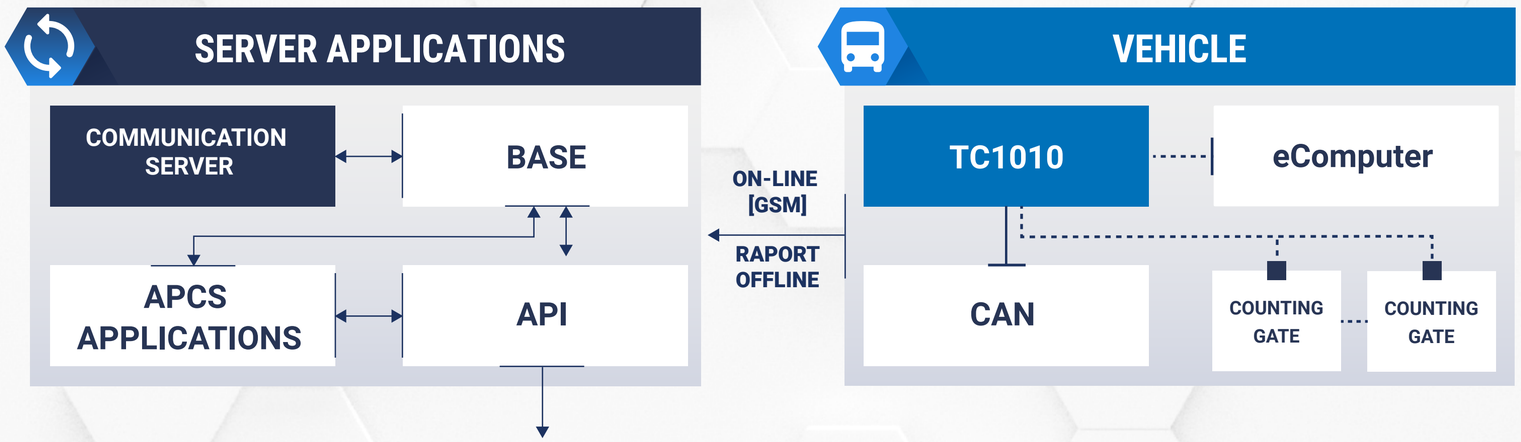
Autonomous Passenger Counting System

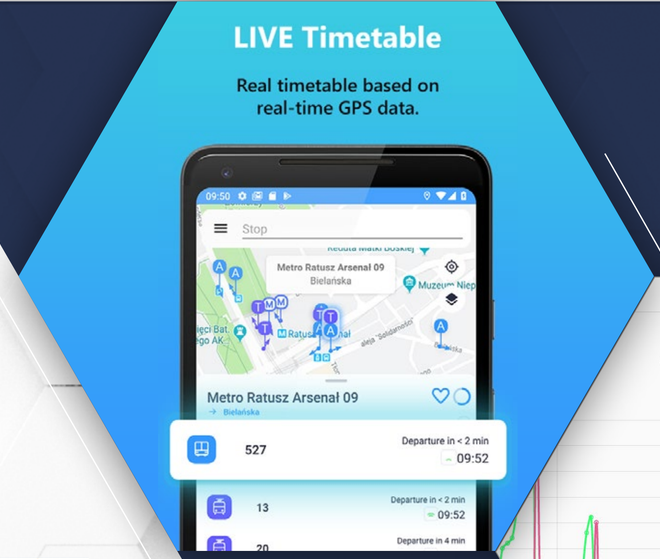

software
Hardware
COUNTING GATES
CAN BUS
AUTOCOMPUTER
CONTROLLER
AND RECORDER TC1010
STANDARD 10″
ALGORITHMS
analytical and corrective
ORGANIZER
GENERATOR
fast generating
and cataloging
of reports
WWW PLATFORM
compatible modules
ADMINISTRATOR
access management
REPORTS
historical data analysis
API
OPEN4PT
OPEN STANDARD
secure data integration
software
MAP
passenger flow
DIAGNOSTICS
AND ALARMS
GENESIS
MOBO
APCS
modular architecture
access via web browser
open standards - open API
all modules compatible with KZM 5

APCS

Infrastructure

Passenger counting system based on a modular architecture, which ensures easy expandability and integration.





```
s.sort(stopsBefore, new SortByWeightOut());
ns.reverse(stopsBefore);

dex = 0;
Stop s : stopsBefore) {

if (canBeSafelySubtracted(stops, (int)Math.ceil(s.outWei
    s.apo += (int)Math.ceil(s.outWeight);
    stops.get(s.list_index).api = s.api;
    updateApcsAtStops(stops, -(int)Math.ceil(s.outWeight), s
    peopleToAdd -= (int)Math.ceil(s.outWeight);

    alreadyUsed.add(s.list_index);
    index++;
    break;
} else {


    if (index != stopsBefore.size()-1) {
        index++;
        continue;
    } else {
        addEnteringPassengers(stops, peopleToAdd, s.l
        index = 0;
        continue;
```

1

KZM 5

WWW platform compatible modules

The system utilizes web technology and is accessible via web browser which implies simultaneous access by many users. The application does not require installation and is independent of the users' endpoints. The application is also supported and updated by the contractor. The system has a modular architecture and allows for each components to be configurable.

- REMOTE ACCESS
- MULTI-USER ACCESS
- SECURITY
- ON-LINE SUPPORTS AND UPDATES

2

WEB platform

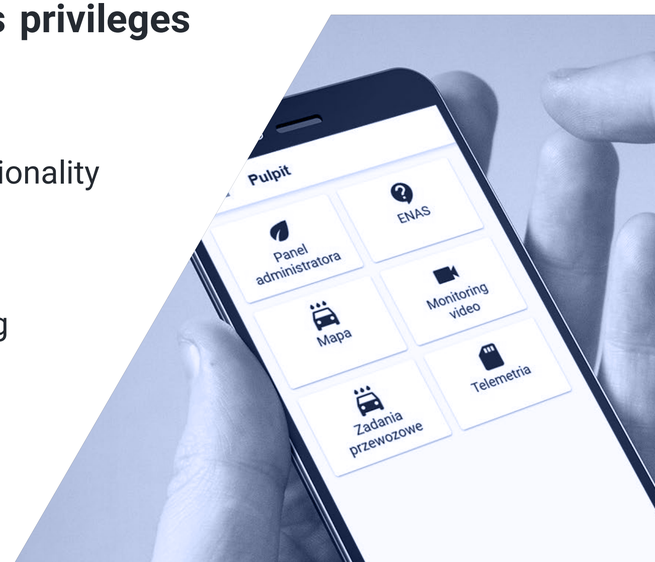
Hi-tech system - Client Server

Administrator
access privileges

The system allows to grant the access privileges to employees and agents.

Restrictions can be applied on access to system functionality and facilities belonging to the company (vehicles).

The access privileges are managed by the contracting authority to whom administrator status is granted. Management of the access privileges does not require contractor intervention.



3

System based on open standards

OPEN4PT

OPENNESS

Practical and safe enterprise development:

- integration with other systems and devices
- possiblity of replacement or development
- cooperation of devices and systems from various manufacturers

COMPREHENSIVE DOCUMENTATION

- data transparency
- systematized dictionaries
- standardized issues
- description of needs and requirements
- possible realizations

STANDARDIZATION

KMQTTD:
communication between devices

KMQTTC:
communication standard between vehicle and server

KMQTTS:
communication standard between server and applications

3

API

GENESIS MOBO

OPEN4PT

The system architecture consists of three areas: vehicle, vehicle - server, server - applications. Each of these three areas is defined by descriptions.
The system description concerns the presentation of sharing or exchanging data.

KMQTTS
open system

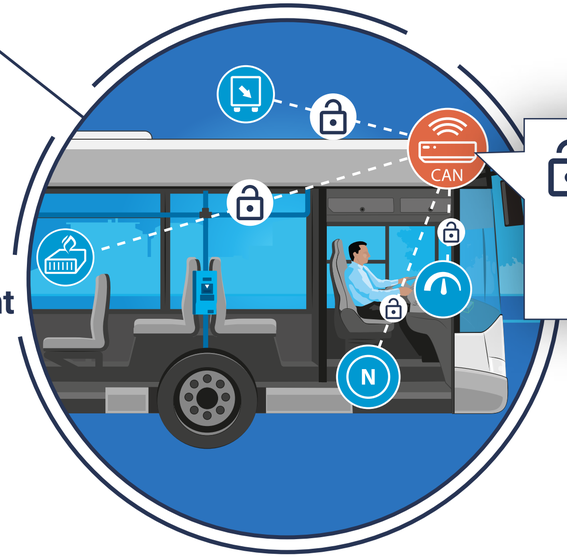
Server

Management

KMQTTS

Time4BUS Driver
application for bus drivers

KMQTTC



Vehicle Equipment

KMQTTD
open access to devices

3

API

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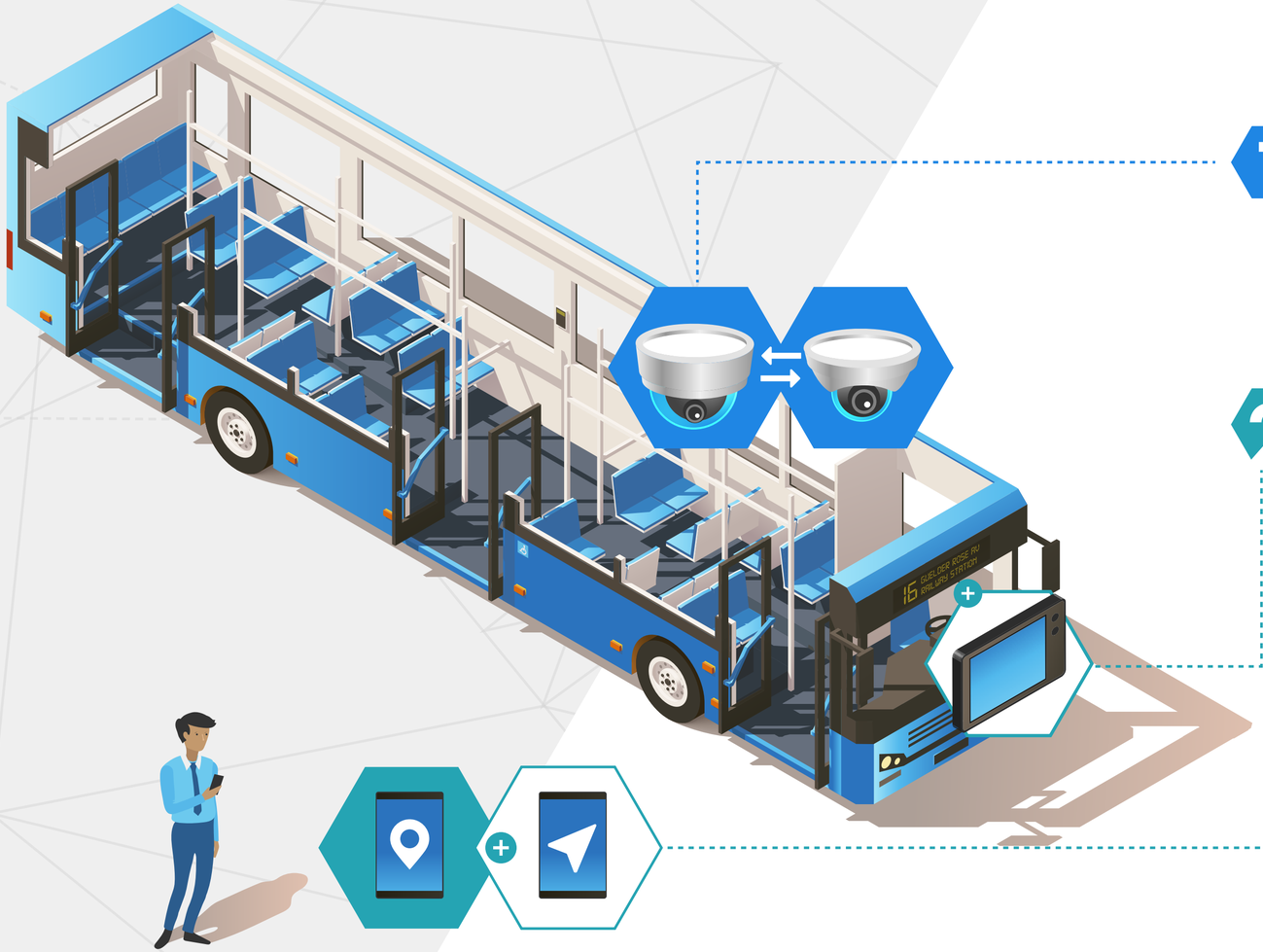
OPEN4PT



1

Replacement of the device e.g. from a different vendor.

There is a possibility to replace any device with a device from a different vendor, leaving the rest of the system unchanged and without losing the required functionality.

2

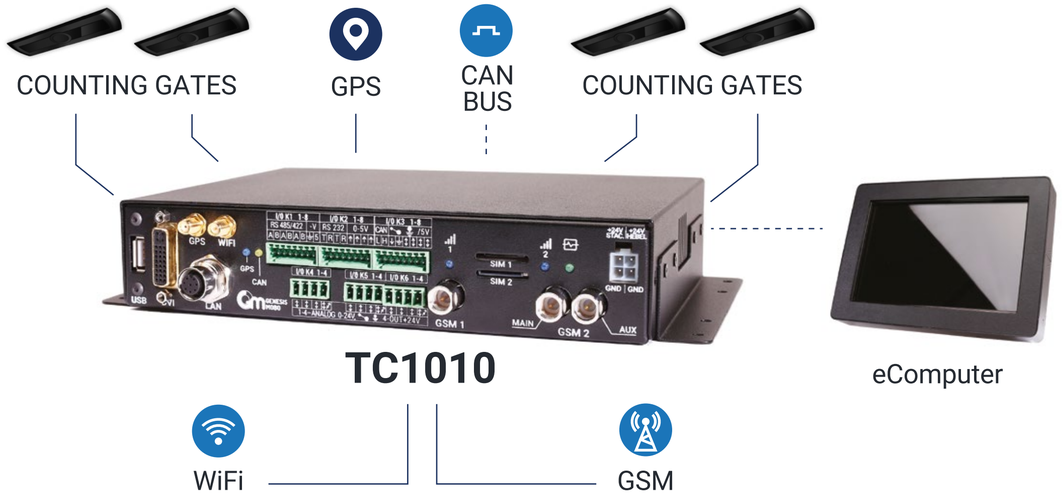
Adding a new device.

New devices can be added later.

Adding new functionalities.

Implementation of new applications for exsisting devices in order to increase functionality.

4



GENESIS MOBO

Hardware
Device TC1010

Multifunctional device with a wide range of uses, equipped with a CAN analyzer, analog inputs, GPS module (additionally, it is possible to equip the device with any audio set). The data collected from the vehicle's signals allow, i.a.:

- managing counting gates,
- data storage,
- recording fuel consumption (generating reports),
- automatic temperature control,
- monitoring of technical parameters (trigger alarms).

Based on the basic data (schedule, assingment to service, GPS position) there is a possibility to run the following modules: deviation system, application for passengers Time4BUS.

Additional functionalities, independent from the acquired data: a dispacher module for registrating and reporting communication events.

GPS

Door signal

Tachometer (CAN)

eComputer

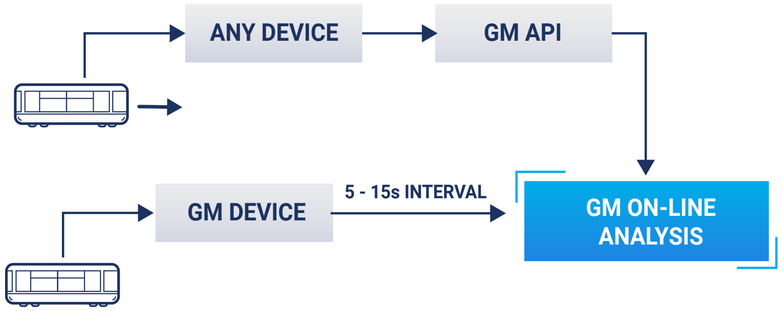
Others

minimum equipment

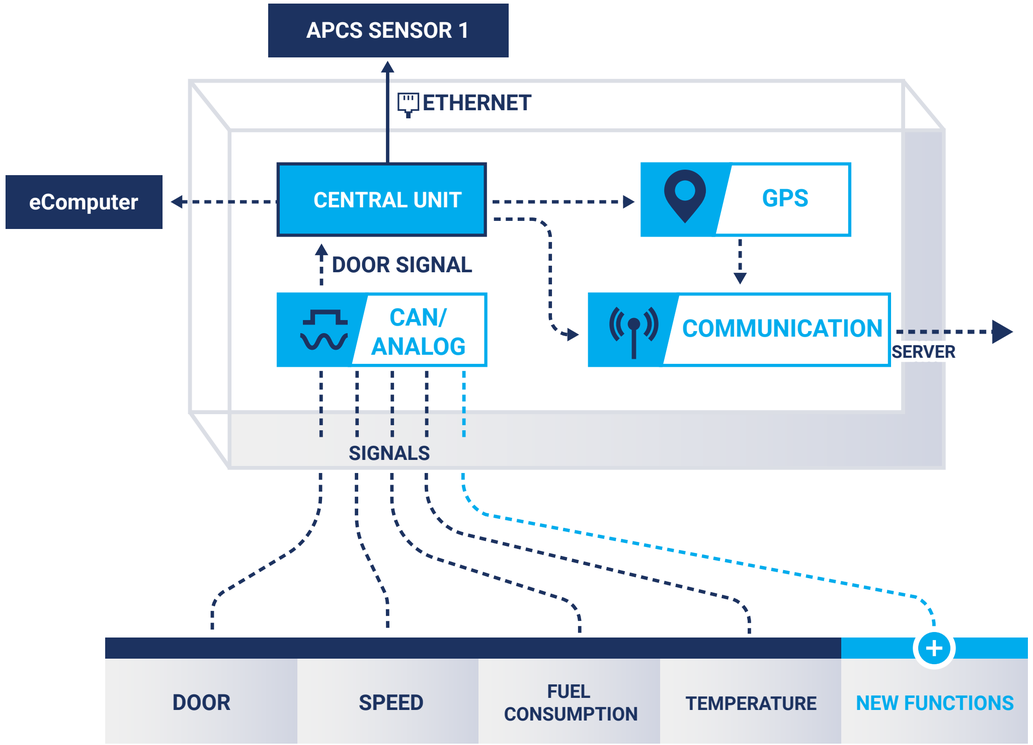
optimal equipment, recommended

extended equipment

4



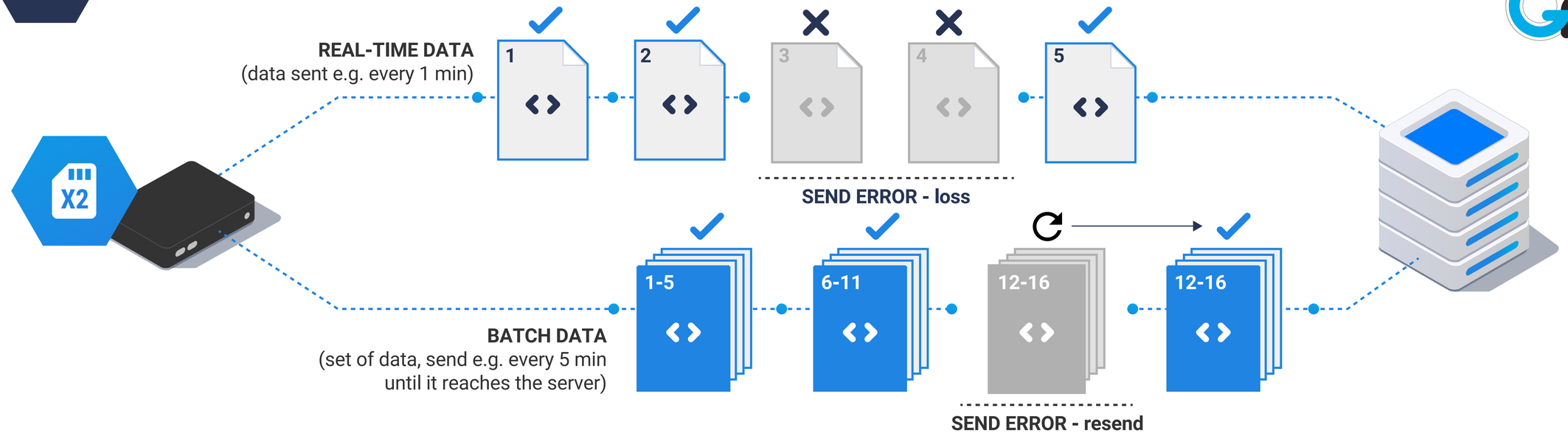
ALL IN ONE DEVICE



Hardware
Device TC1010

- GATES MANAGEMENT
- GPS LOCATION
- REDUNDANT DATA TRANSMISSION (TWO SIM CARDS)
- VEHICLE CONDITION MONITORING (CAN, ANALOG)
- OPTIONAL LI-ION BATTERY

4



Device TC1010

redundant data transmission

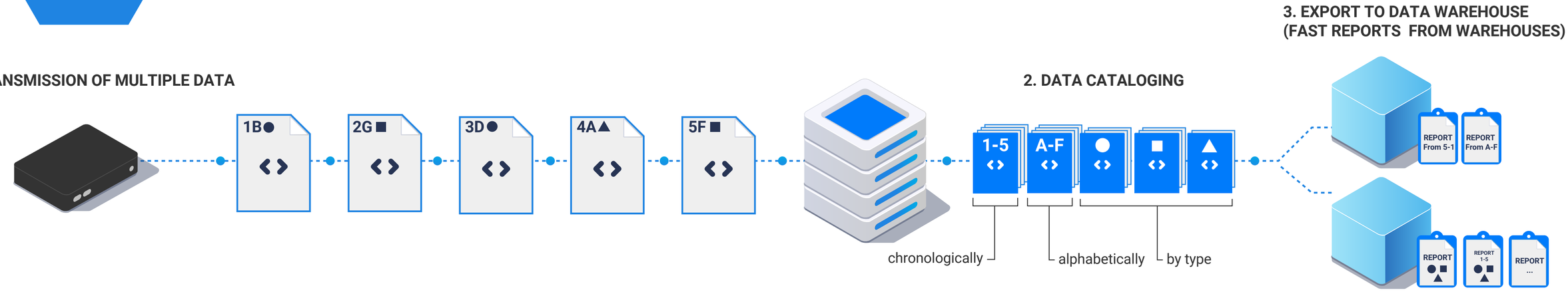
In case of short-term or long-term loss of transmission, data is collected on the device. Transmission is resumed when the connection is restored. For security concerns, our counting gates control devices are equipped with two separate transmission channels, with two separated SIM cards, which guarantees the efficiency of data transmission.

TWO DATA TRANSMISSION CHANNELS:
Our system separates real-time data from data intended as input to the reporting system (BATCH). Retransmission concerns only BATCH data, while real-time data is transmitted on a regular basis – it reflects the current state of the vehicle.

REAL-TIME DATA informs about the current state of the vehicle, which is updated every 1-5 seconds. The transmission is not acknowledged, nor resumed in case of connection loss (because it is not obligatory).

BATCH DATA is the complete vehicle status information carrier. Each transmission of this data must be acknowledged by the server. In case of any failure, the BATCH must be retransmitted.

5



Reports organizer

fast generating and cataloging of reports

Reports generator and data preparations system for the needs of long-term summaries.

Reports generator:
Allows the user to create collations. The first step is to choose a data source: it can be either a source of historical data or any data warehouse. Based on the user's choice, the program loads the definition and presents the user with the report preparation screen that consists of three areas: **field definiton, conditions definition, agreggation definition**. It is possible to add multiple fields, conditions or aggregation definitions. The user can save the created collations for future report generaions.

Intelligent reporting system (data segregation):
In relation to aggregated reports our system has an intelligent reporting systems. The user selects the aggregation method and the range of data of interest. The system cerates a data warehouse to store the data continuously and then processes the historical data according to the warehouse criteria.

The daily data is processed on ongoing basis, one time per day. The warehouse, created in this way and continuously filled with the data, serves as one of the sources for the report generator, considering that the given data was pre-segregated, is already fast.

6

Reports
15 various reports

The reports are intended for passenger counting analysis.
We currently offer 15 different reports, divided into four types:

1. Line and vehicle reports
(report: basic, line, vehicle, route, route segment, trip)

2. Stop reports
(report: all stops at a bus stop, stops due to lines, stops due to vehicles).

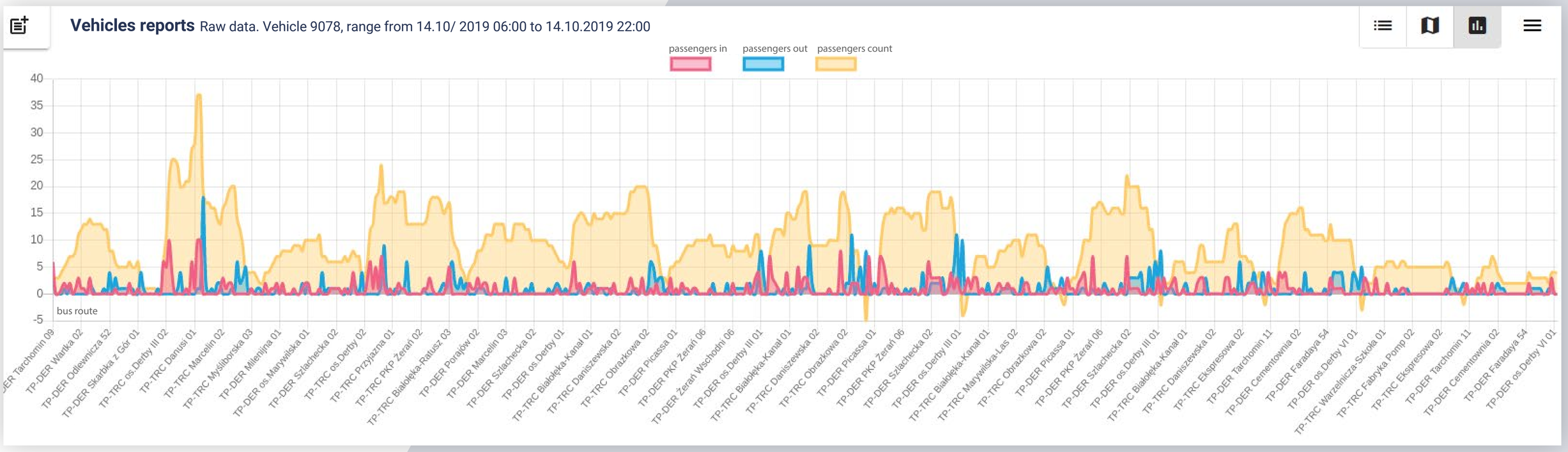
3. General reports
(reports: stops by line, stops by vehicle, stops by bus stops, stops by day)

4. Service reports
(report: entry to exit ratio, zero exchanges by stops)

6

Reports
15 various reports

Vehicles reports:
Are used to test the filling of a specific, selected vehicle, without limitation as to transport tasks or lines on which the vehicle has operated. The user is presented with a full run of the selected vehicle time interval.



7

Data and algorithms

data categories

Currently the application includes four data sources:

- incremental data
- raw data
- semi-raw data
- corrected data

The system stores all vehicle passage signals and then, based on these signals and after comparing them with the data from the schedule, generates incremental data. They report the number of entering and leaving passengers since the start of data collection (activation of electronic systems in the vehicle).

7

Data and algorithms

processing

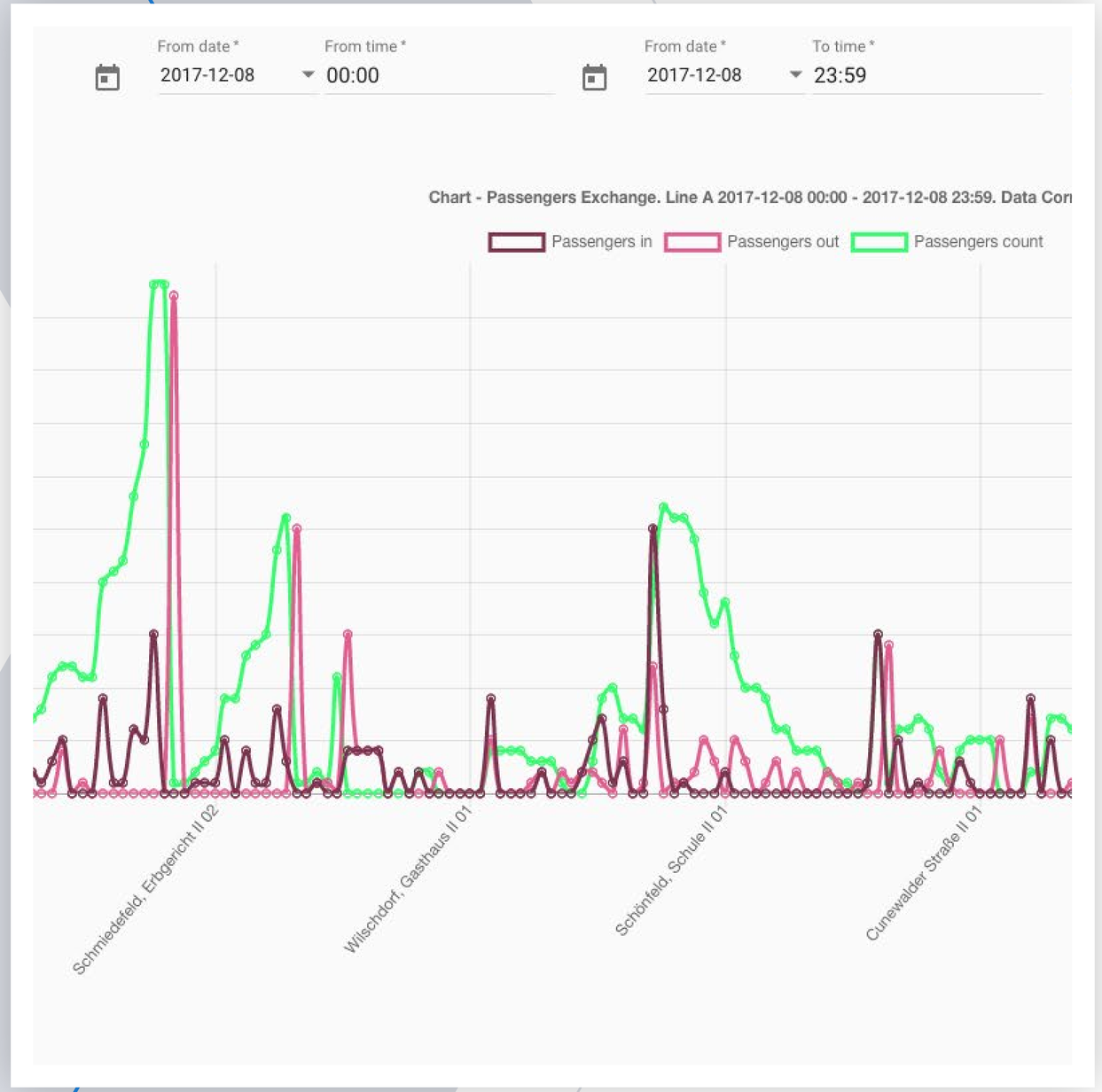
INCREMENTAL DATA —accumulating counters→ RAW DATA →

correction at the marginals → SEMI-RAW DATA —correcting algorithm→ **CORRECTED DATA**

Raw data: as a result of processing incremental data, raw data is calculated, which inform about passenger exchanges at specific stops. A correction of exchanges at the marginal stops is performed on the raw data and the result is semi-raw data.

Semi-raw data: is processed by algorithms which, as a result of analysis of the vehicle's passage, complements the missing outputs or inputs, resulted in corrected data.

It is very important that the entire processing process can be repeated at any time and starting from the first step, which in the case of errors in one of the data sources and its subsequent correction enables the recovery of reliable data that otherwise could not be used. Experience shows that the error arises from under-counting, not over-counting. This means, in a vehicle one of the gates undercounts either leaving passengers or entering passengers. Therefore, the algorithm should complete the insuffiency of entering or leaving passengers resulting from filling, and not reject the sample on the basis of %.



7

Data and algorithms

corrective algorithm

Practice shows that a popular form of correction is adding missing passengers to stops with the highest number of entries and exits. The algorithm can also be configured in such a way that passengers are added proportionally, between stops with the highest number of passenger exchanges, as there is the highest probability that there will be no assingment in these places. It is also possible to have a configuration that uses previuos trips of this vehicle or that line, ideally made under as similar circumstances as possible, to add passengers. In summary: there are many possibilities and it is up to the Orderer to choose the method that is most suitable for them.

Our algorithms are used by Public Tranport Authority in Warsaw and their operations were verified also with the video surveillance cameras recordings. We have received feedback that when the counting gates work correctly the results are very close to the semi-raw data and the better measurement is obtained in the proportion of 50% - i.e. once the measurement from the corrected data is better and once from the semi-raw data. If one of the counting gates fails and its measurements are inaccurate, the corrected data much more reesembles reality.

The important aspect is the presentation of both semi-raw data and corrected data, in order to verify the performance of the algorithm in any way, as well as to understand its performance.

Semi-raw data

ROUTE	IN	OUT	LEFT
Marginal stop Stop 1	5	0	5
Stop 2	8	1	12
Stop3	2	2	12
Stop 4	10	2	10
Stop 5	0	8	2
Stop 6	0	3	-1
Stop 7	3	0	2

Corrected data

ROUTE	IN	OUT	LEFT
Marginal stop Stop1	5	0	5
			12
			2
Stop 4	10	**3**	**11**
Stop 5	0	8	2
Stop 6	0	3	**0**
Stop 7	3	0	2

The algorithm adds a value after a large exchange of passengers, corrects errors in the data.

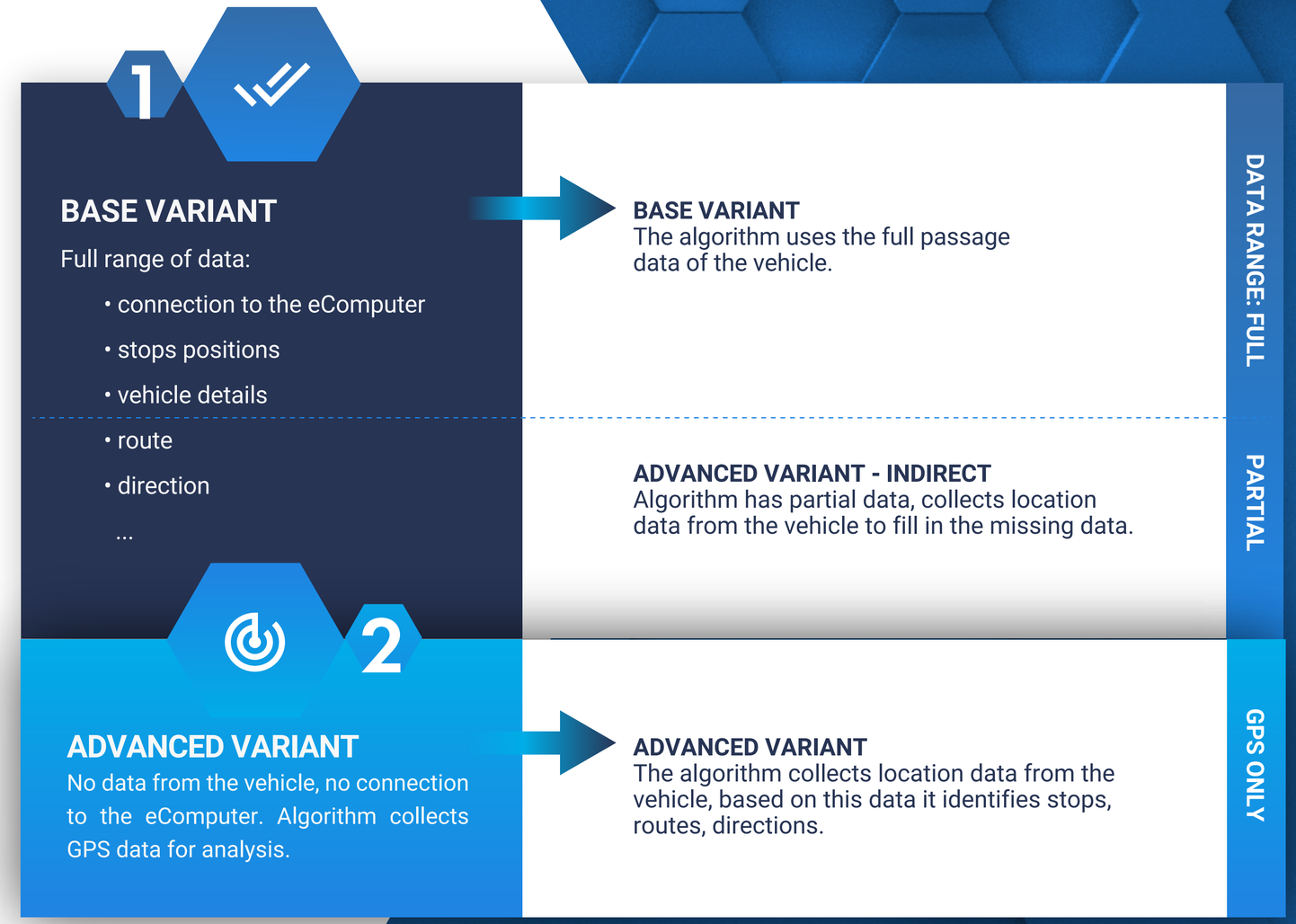
Analytical algorithms

full autonomy

Data processing is fully automatic and does not require any additional actions by system users.

Data is processed in 3 phases:
1. Correction of stops positions,
2. Determination of stop names and codes,
3. Determination of routes, trips and lines.

The data produced by the algorithms, including routes, trips and lines, can be corrected using the Schedule tool.

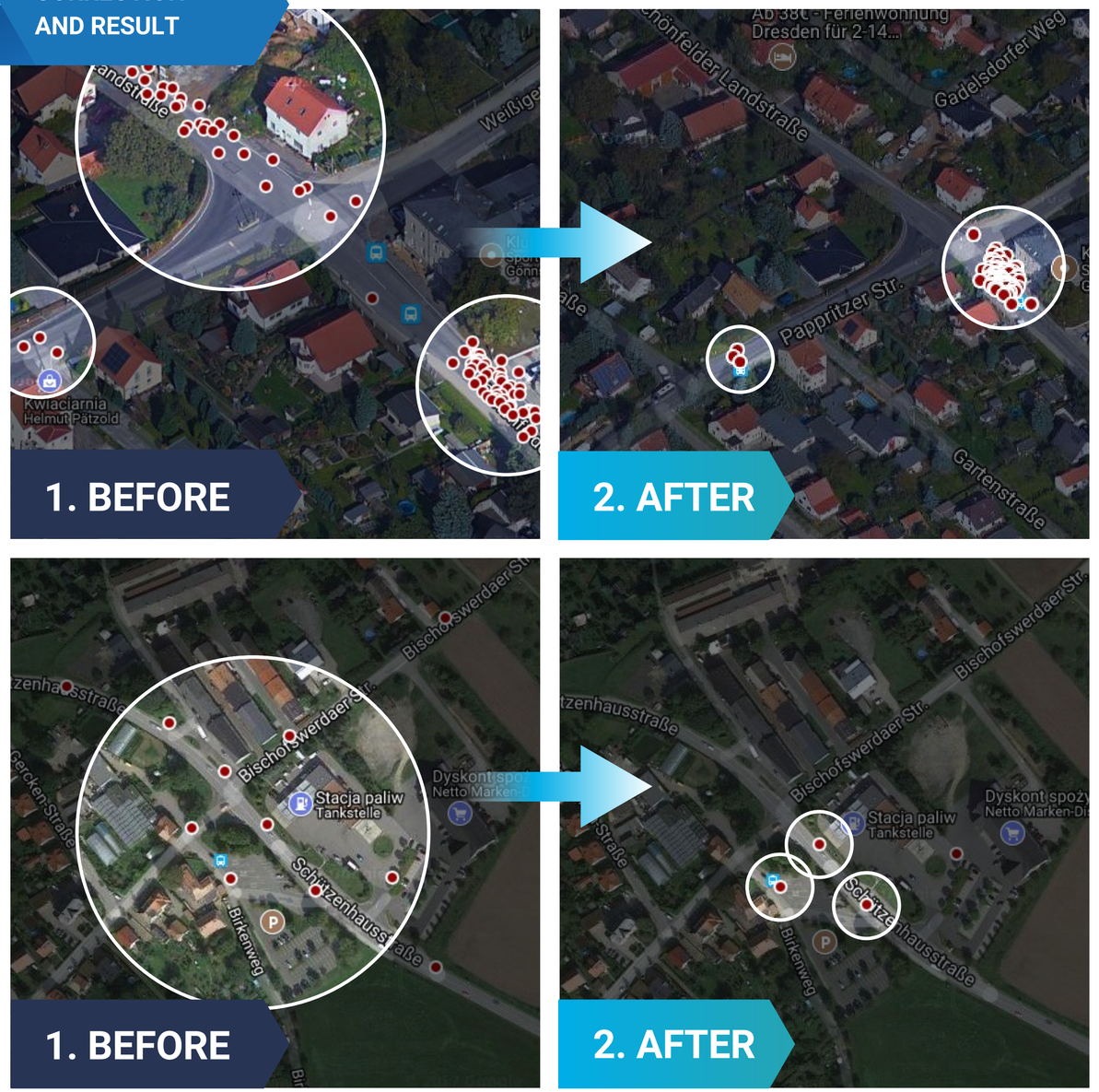


Analytical algorithms

1. CORRECTION OF STOP POSITIONS

The first aim of the algorithm is to determine the position of stops based on GPS readings. It checks in which places the vehicle stopped and what is the correlation of this data as a function of time.

CORRECTION AND RESULT



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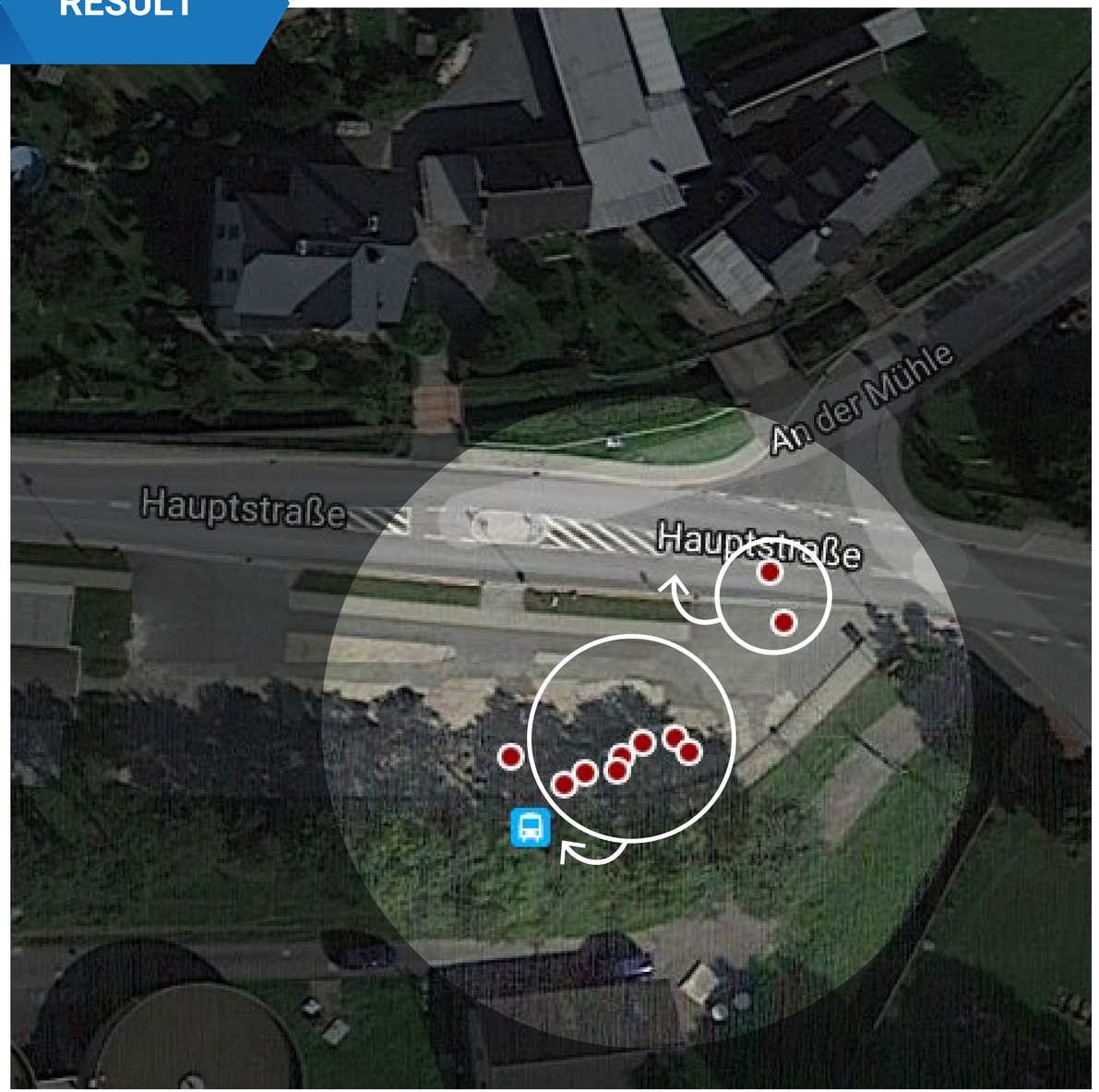
Analytical algorithms

2. DETERMINING BUS STOP NAMES AND CODES

The next aim is to determine the name of the stop and thus give it an unique identifier.

The GPS positions determined in the earlier phase are automatically translated into names. If the program does not detect a stop in the vicinity of the reading, the stop is named with the street name.

RESULT



7

Analytical algorithms

3. DETERMINING ROUTES, TRIPS AND LINES
Finally, based on the data collected in the previous phases, the algorithm determines routes, trips and lines:

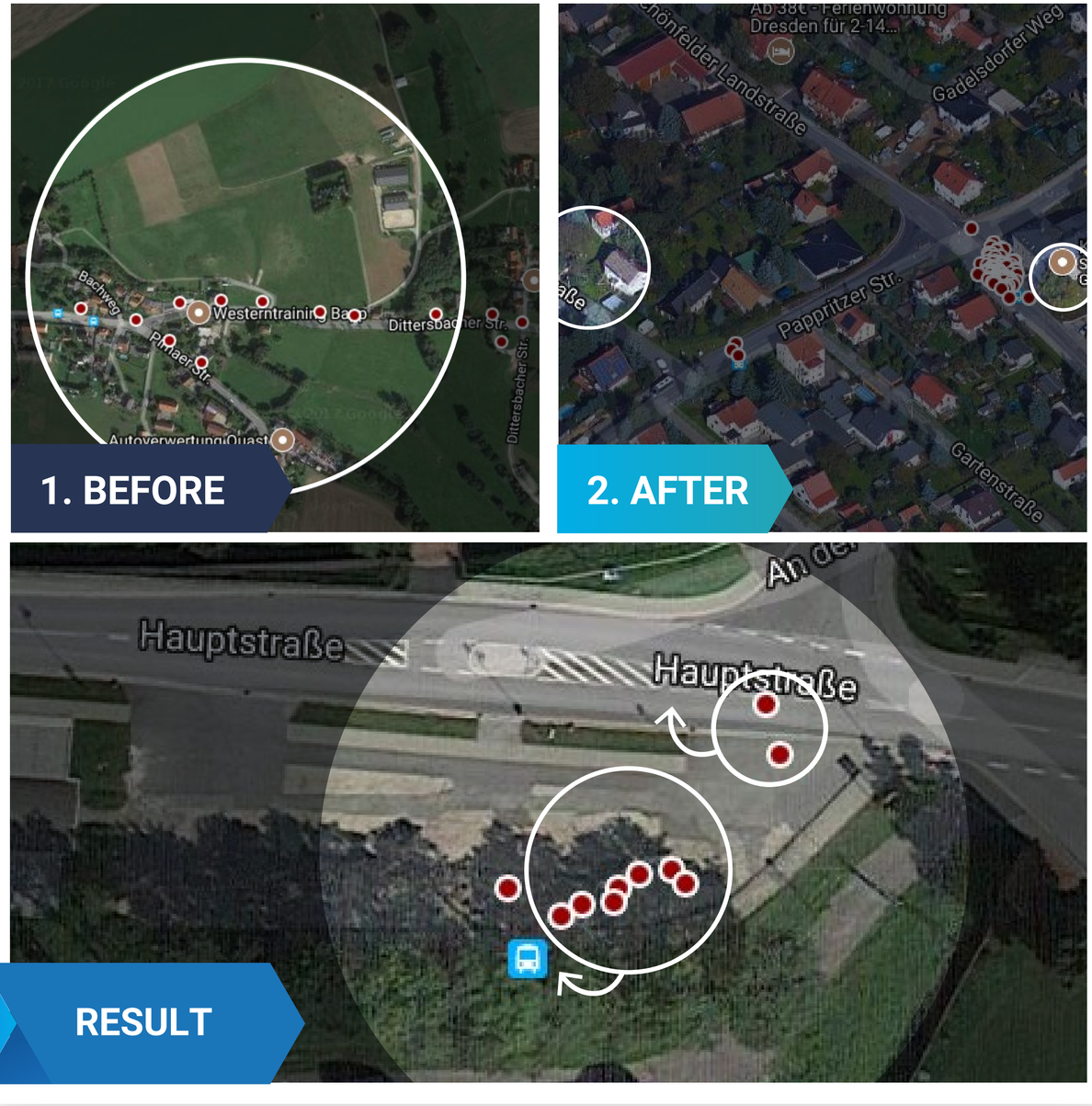
- the first and marginal stops of a trip are identified by the waiting time at the stop,
- routes are recognized by combining start and end stops
- trips are identified by adding start and end times to the routes,
- lines are recognized by grouping the same routes.

ELIMINATING INCORRECT READINGS
Eliminated from the final data are:

- stops without passenger exchanges,
- repeated stops in a short time interval.

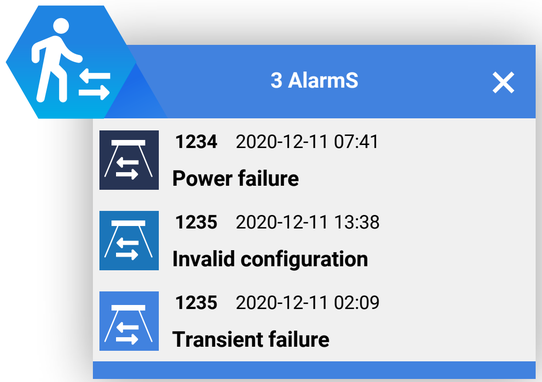
DATA PROCESSING
Data can be processed repeatedly, and the user can change the parameters to get better results.
Some of the parameters are:

- stop grouping range,
- minimal marginal time.

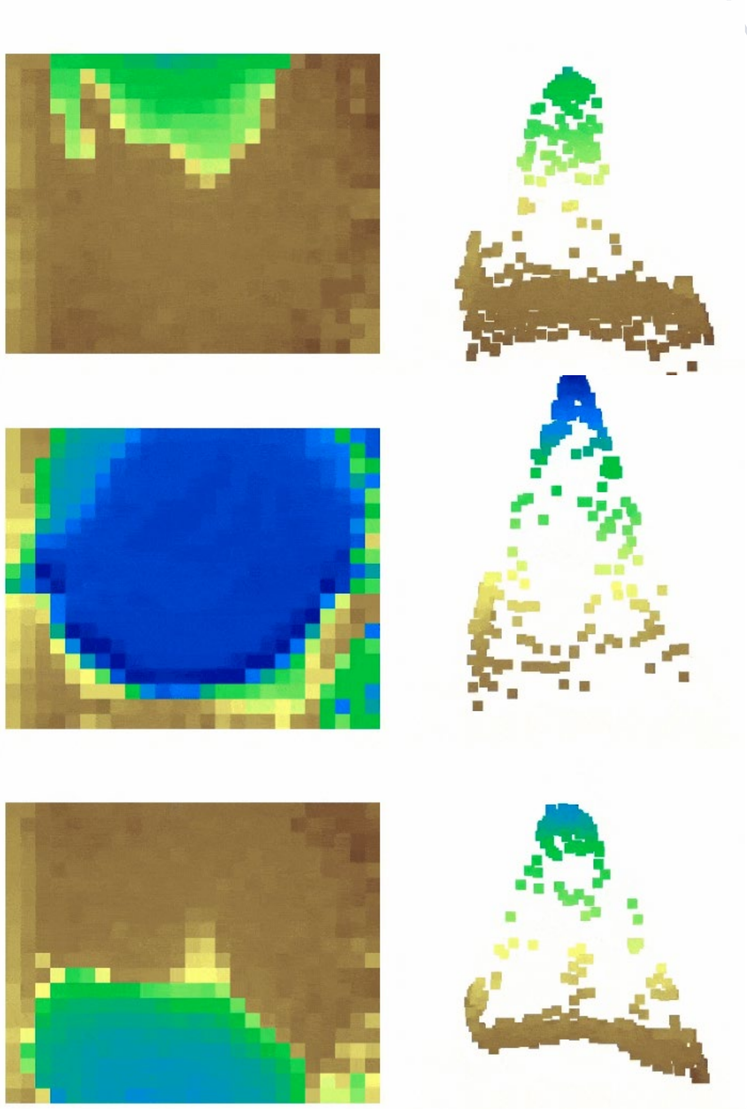


8

Diagnostics and alarms



The system delivered by us is equipped with the functions of diagnostics and monitoring of counting gates. The system informs about irregularities reported by counting gates, lost connection with them and reports the status of the gate control device. Additionally, the system is connected with a sophisticated alarm module that informs on the on-going basis about the occurring abnormalities.

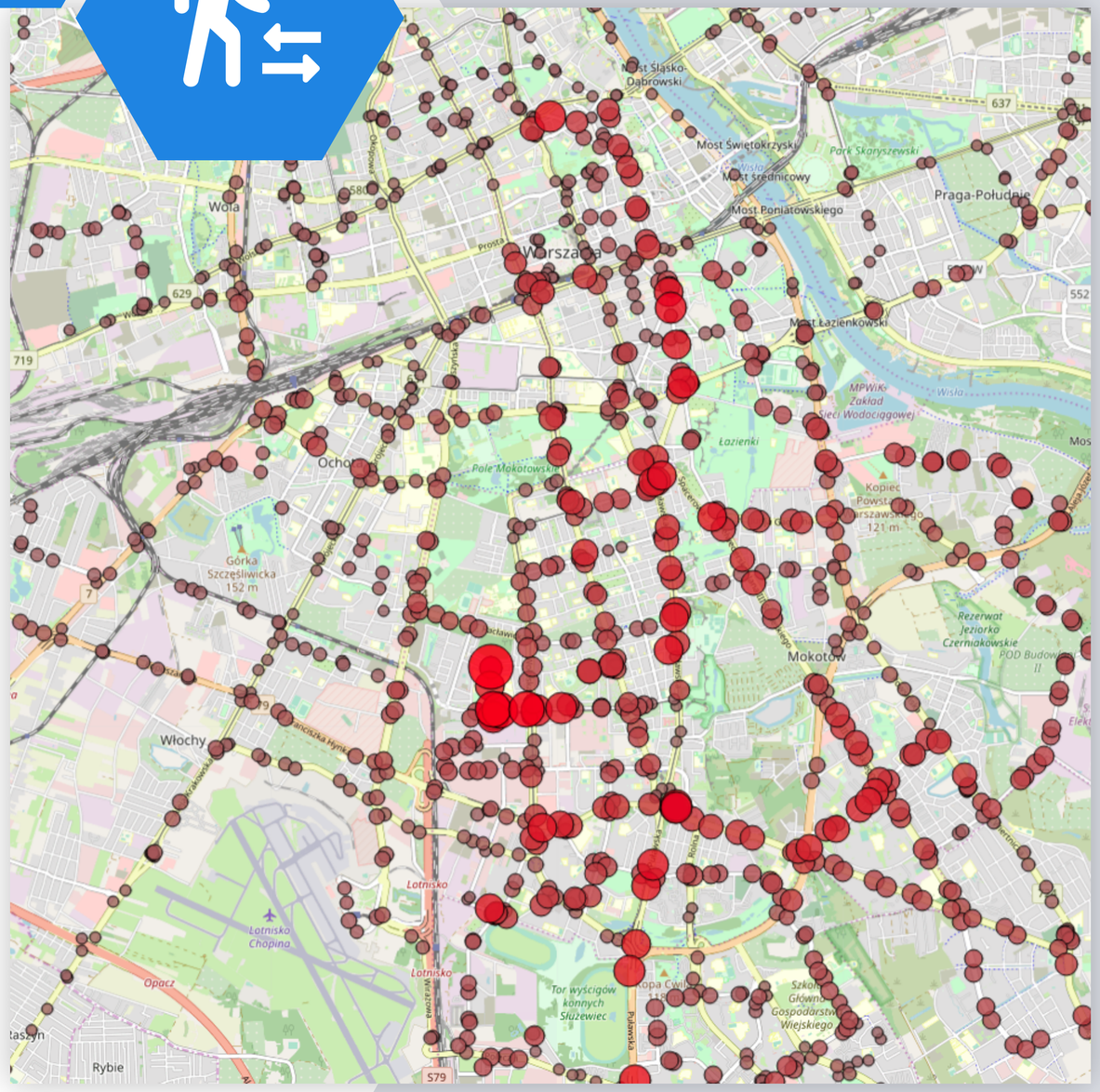


Diagnostics and alarms

image preview

The system allows remote viewing of the counting gate image (if the gate has this option). This function is used for diagnostics. In the case of detecting that one of the gates incorrectly counts the entries or exits, it is possible to call the remote viewing of the image from the counting gate, together with the counters of readings of passenger exchanges. This allows the observation of the gate image and measurements in real time and allows to analyze the actual problem with a given counting gate.

9



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Map

passenger traffic

The map gives the possibility to check the correctness of located stops and hubs.

- CONNECTION TOPOLOGY
- LOAD OF THE STOPS
- LOAD OF THE HUBS

9

Map

passenger traffic

The map gives the opportunity to analyze the correctness of schedules in terms of lines, areas, trips.

- **OPTIMIZATION**
- **LOADS OF THE LINE**
- **PASSENGERS FLOW GEOMETRY**

GENESIS MOBO

Thank you for your attention.

We invite you to cooperation!