Armenian-English translation

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YEREVAN CITY

TECHNICAL REQUIREMENTS FOR CONTROL SYSTEMS FOR ROLLING STOCK FOR PUBLIC TRANSPORT

CONTENTS

1. Terms and Abbreviations

- Driver Assistant Device: an information panel installed in a vehicle for online instruction of sub-drivers;
- V – vehicle.
- Stop ID – unique stop number in the category.
- GTFS (General Transit Feed Specification): an open standard used to provide passengers with up-to-date information about transport systems;
- GPS (Global Positioning System) – satellite-based independent determination of location on the ground.
- GLONASS Global Navigation Satellite System - satellite self-location on earth.
- GSM (Global System for Mobile Communication) is a global standard for mobile communications.
- Closed data transmission channel DATA.
- Source code - program code of the system.
- Perpetual license - perpetual license.
- Website - website.
- Front office - software development.
- Back office - software base.
- Database - database.
- API (Application Programming Interface) — data programming interface to ensure compatibility;
- QR ticket – a one-time paper ticket.
- MiFare card – a universal refillable ticket carrier.
- Framework – software base.

2. Description of the current situation

The public transport system in Yerevan consists of metro, trolleybus and bus routes.

Current situation

The metro has 10 stations, 7 trolleybus and 68 bus routes.

The ground rolling stock is served by trolleybuses, large, medium and small buses, the total number of which is 766 units, of which as of March 1, 2024 there are:

- MAN bus: 87 units (3 doors: 12.2 m)
- ZhongTong bus: 391 units (2 doors: 8.5 m)
- Higer bus: 147 units (2 doors: 8.2 m)
- GazelleCity minibus: 91 units (1 door: 6.6 m)
- Trolleybus: 50 units (3 doors: 12.2 m)

expected additions until 03.2025

- ZhongTong Bus: 170 units (2 doors: 8.5 m)
- Yutong Trolleybus: 15 units (3 doors: 12.2 m)

There are 3 bus stations and 2 trolleybus stations. There are about 800 public transport stops in the city, 350 of which are equipped with bus stops.

At present, the transport is controlled by dispatchers using mobile phones for instructions and paper tickets for travel and registration.

Ground vehicles are not equipped with factory GPS systems.

All rolling stocks have a CAN port.

Development Program

According to the development plan, the ground transportation route should consist of **50 routes** and **946 rolling stock**, of which:

- 101 - trolleybus,
- 562 - medium-class bus,
- 34 - large-class bus and
- 249 - combined bus.

According to the industry development plan, 1,171 public transportation stops are needed to service the new route network.

According to the same plan, a public transport control center is planned to be located in Yerevan at 16 Leningradyan Street.

3. Project Goal

Public transport management systems use real-time vehicle location and tracking information to enable operators to optimise transport use:

- improve the quality and punctuality of service by tracking vehicles and quickly responding to any delays and incidents;
- improve public transport services by providing passengers with real-time bus arrival data and effectively manage public transport;
- provide passengers with accurate, understandable information in real time, reducing unnecessary waiting time.

4. The immediate goals of the systems

- Full automation of the passenger transportation planning process.
- Control over the operation and maintenance of bus routes,
- Support for precise driving for the driver,
- Providing mutual operational information for the driver and sub-driver,

- Automation of control over Sub-controller activities of public transport,
- Management of the work and shifts of drivers,
- Analysis of vehicle traffic, volume and intensity of passenger flow,
- Provision of information services to passengers.
- Provision of electronic services
- Improved security.

5. Requirements for implementation and operation of the system

- The system must be installed on the server node of the Yerevan Municipality;
- It must be possible to connect the equipment installed on the vehicles to the server node via a closed channel (DATA);
- The licenses of the programs used in the system must be perpetual (perpetual license);
- The codes of the system software (if developed by order of the customer) (source code) must have descriptions or frameworks used in their development;
- The system must have a user manual (in Russian or English is mandatory);

6. Considerations

- When developing the system, the supplier company can use open source mapping and information platforms.
- Possible differences between the proposed solutions and the technical requirements must be agreed upon with the customer.

7. Basic diagram of the system operation

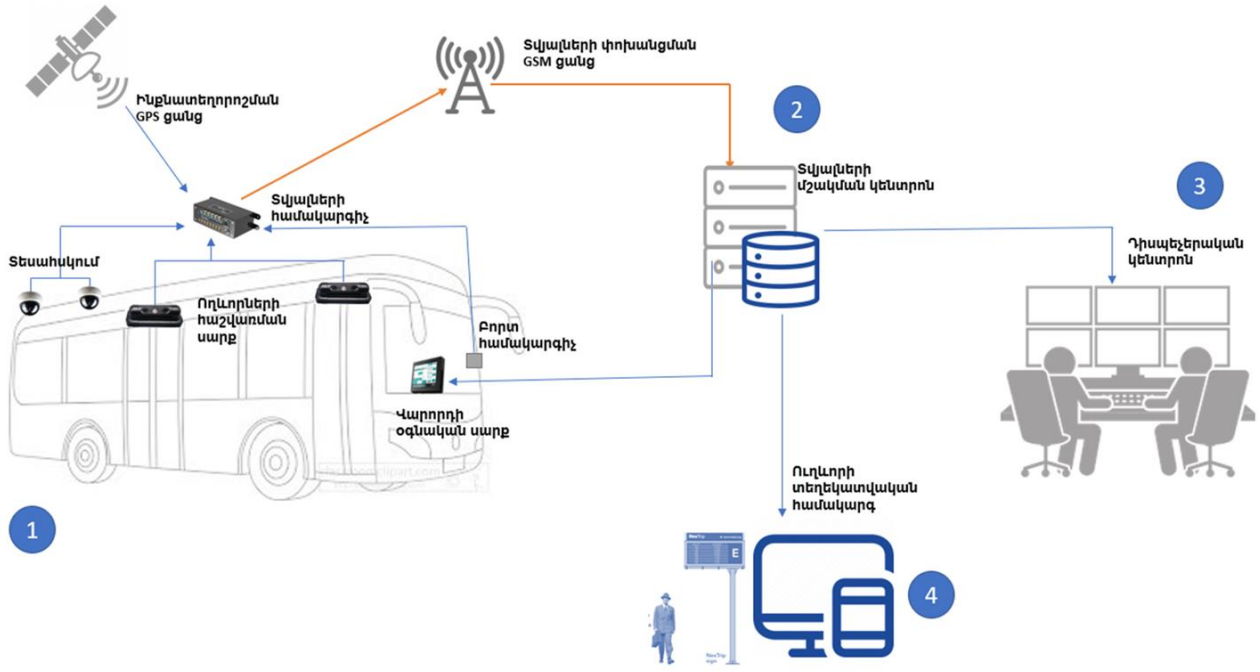
The diagram below schematically shows the systems for managing public transport activities and providing information services to passengers, where:

N1 – on-board and on-board equipment, the data of which is transmitted via a cellular network to the N2 data processing center.

N3 – control systems based on data processing centers, where services are managed.

N4 – an environment for providing information services to passengers about public transport, routes, schedules, etc.

Schematic diagram of the system operation



PUBLIC TRANSPORT TRAFFIC MANAGEMENT SYSTEM

8. System specification

The public transport management system is designed to manage, automate (dispatching) and control services in the route network development program.

Public transport management systems use real-time vehicle location and tracking data, allowing operators to optimize transport operations.

System specification by roles:

- Sub-controller (dispatcher)
- Driver
- Passenger
- System administrator

8.1 Sub-controller

The main role of the sub-driver is to plan, control and manage the work of public transport, while having the appropriate tools. The sub-controller reports to and is accountable to the manager (dispatcher-administrator level I) and immediately reports to him on all events.

8.2 Driver

One of the driver's main duties according to the schedule is reliable and regular passenger transportation. The driver carries out the instructions of sub-controllers. Instructions are given using the <<Driver Assistant>> device installed in the car, which works online with the central system.

8.3 Passenger

Passengers of public transport are consumers of services provided by the transport system operator, who use this service to move from one place to another.

Information about the arrival of transport, information about transfers, delays, special conditions, etc. should be available to the passenger in real time via a mobile application, web platforms, information screens installed at terminals and bus stops, etc.

8.4 System administrator

The administrator sets the main parameters of the system.

9. Equipment installed in the rolling stock

9.1 Equipment installed on Zhongong buses

- Hikvision DS-MP7608H/GLF: 8-channel analog video recorder with 4G network capability.
- DS-2XM6825G0/C-IV(S)(M)(/ND) (C) passenger registration system

9.2 Equipment installed in MAN buses

- HydraIP MR4840 – 8-channel hybrid video recorder that records images from digital and analog cameras;
- IRMA matrix passenger registration system;

9.3 Description of vehicle equipment with at least the following characteristics:

Name	Description
Data collection and transmission unit	Dual GPRS / 3G / 4G LTE GPS / GLONASS, minimum receiving channels - 12 Built in Wi-Fi Min. 6x ethernet port 100Mbps
Driver assistance device	Each vehicle must be equipped with a panel designed to display the location of the vehicle, the route trajectory and the trajectory of movement, store this information and transmit it to the central information system via the cellular network. It must also be possible to display vehicles on the route, the distance between vehicles moving in the same direction, time, etc.
Technical characteristics of the driver assistant device	Processor - min Quad-Core, ARM architecture. 64-Bit, min frequency 1,0 GHz Flash memory min. 4GB RAM min. 1GB Memory min. 16GB Communication min. modem 3G and 4G LTE, WI-FI

	Audio output min. 1 x 2W internal Audio output min. Built-in microphone, external input Operating temperature -20/+60°C Storage temperature -20/+60°C Relative humidity 5 – 90%, incondensable Display Multi Touch color LCD TFT, min. 10", min. 1024x768, min. 600 CD/M2 Position module min. GPS/GLONASS module SAM slots min. 4 slots Interface CAN bus for connection to vehicle (if available), interface RS485 and ethernet for info panels management (in case that this option is available in vehicle) All necessary equipment (holders, mounts, antennas, power cables, etc.)

10. General provisions on the Sub-controller center

Work planning platform.

This feature supports the creation, placement and design of bus stops, as well as routes and schedules. When using data from open sources and other platforms, it is necessary to use GTFS files.

Route plan creation platform.

This platform provides the ability to create and publish driver plans and responsibilities.

Real-time fleet management platform.

This platform provides all the necessary information about transport and routes on the map and in real time for route management and in-car communication via messaging and calls.

Platform for providing reports and statistics.

All of the above platforms must have an up-to-date and accessible interface. The system must display information about the subroutine application and its functionality in a clear graphical form, in particular, event records, including sent SMS messages. The system must be able to work on multiple monitors for each user.

11. Description of the Sub-controller block

11.1 Real-time traffic management system.

This system should provide all the necessary information about the actual rolling stock in real time and on the map. The location of the vehicles should be visible on the map. The system should provide information about the unique vehicle number, registration number, vehicle type, manufacturer, model, drivers, route and trajectory of movement, standing or moving. The status of the vehicle will be determined depending on the actual situation, on time, late or early.

This system should provide advanced filtering of data by route, vehicle, driver and other statuses/data. Should be able to communicate with the driver and control center via messaging or voice.

11.2 User account management and access control (back office) of web subsystems

The system must be able to manage (add, delete, archive) user accounts and privileges of each user by position and role. Distribution of roles of system operators must allow distribution of operator rights by transport operators, by routes or groups of selected Vehicles.

The system must allow access to web subsystems with pre-created users. Users must have the appropriate roles and access to tools in the system. The ability to profile in the subroutine block, saving the settings of different users. The system must save user settings when logging out and logging in.

11.3 Monitoring and Management

The system must have functionality that, based on the specified subauthorizations, will allow the control unit to track and record the actions of users and dispatchers.

11.4 Filters

The system should allow filtering by:

- by period
- by transport operators
- by routes
- according to Vehicles
- by drivers
- by completed routes
- by schedule violations
- by mileage
- by chance
- according to others

It should be possible to apply the above filters simultaneously.

The results of the above filters should be possible:

- display on the map (if possible),
- display as graphs,

- export to the required formats.

11.5 Adding, deleting and archiving vehicles from the system.

The system must be able to accommodate the required number of vehicles, provided that it is sufficiently saturated with equipment. Also, if necessary, the system must have the ability to delete or archive vehicles depending on the need.

11.6 Displaying information about the location and status of the vehicle

The system displays on the map information about the location and status of the selected vehicle based on the last sent GPS coordinates of the self-location, as well as information about the last entered stop, exit from the stop, planned schedule and deviations from the schedule.

The frequency of GPS position data exchange between the vehicle and the system is adjustable according to the operator's requirements.

11.7 Compliance with the schedule

The system must display the compliance or non-compliance with the schedule for the selected mode of transport. A vehicle deviating from the route or schedule must be displayed in the system. When selecting a route, all stops in both directions of the route must be displayed.

11.8 Map system

The mapping platform can use open source mapping systems (Google maps, Yandex maps, etc.) that contain system management using GTFS data.

11.9 Reporting vehicles with communication problems

The system reports a vehicle with a communication problem by displaying (vehicle number, ID, driver identity, other necessary data) on the map in a visible (clear) notification form in the system and on the map.

11.10 System language

The system must be fully presented in the Armenian (preferably also Russian and English) version, including <<error messages>>.

11.11 Storage and display of vehicle movement history

The system must be able to display the history of the selected vehicle for the selected working day or specified period.

11.12 Collective display of vehicle location

The system shall display information (including through dynamic graphs) about vehicles on all or selected routes and their position in relation to deviations from the schedule (late arrivals, early arrivals). The system shall monitor the movement of the vehicle according to the schedule and

regularly notify the dispatcher and driver in case of deviations from the route (late arrivals, early arrivals).

11.13 Mass display of the current route status

The system must display information (including through dynamic graphics) about the current location of vehicles on the selected route on the map (based on the last sent geographic coordinates).

The system must be able to display at least two selected routes in parallel in the subroutine application.

11.14 Notification of the Deputy Commissioner in case of emergency

The system shall notify the sub-driver by visual and audible means of an abnormal situation in the vehicle.

The system shall be capable of providing two-way voice communication in emergency situations, which is considered a high-priority type of communication, without establishing a call with the sub-controller and with the ability to automatically play a voice message to the dispatcher, while displaying the location of the vehicle on the map.

12. Description of communication types

12.1 Indicator of the presence of communication between the system and vehicles

The system shall display the current state of communication between vehicles and the system (online/offline).

12.2 Ability to send messages to pre-created groups.

The system should be able to send online messages from sub-controllers to selected vehicles or grouped vehicles.

12.3 Vehicle Message Appearance Time

The system shall display all messages sent to vehicles or vehicle groups in accordance with the selected period.

12.4 Providing two-way voice communication

The system must be able to provide two-way audio communication between the driver and the sub-controller. The driver must be able to send a request to the sub-controller to exit voice communication and vice versa. The sub-controller must also be able to simultaneously establish voice communication with drivers of previously created groups in the system.

13. Vehicle Monitoring

13.1 Displaying Vehicle Classification Information

The system should display information about the classification of the selected vehicle, namely: registration number, type, fleet affiliation, route number, other routes served by the corresponding vehicle, etc.

13.2 Displaying the transport schedule

The system must display the planned schedule of the selected vehicle.

14. Presentation of routes in the subsystem

14.1 Display of emergency data

The system must display emergency situations on the map for the selected period, routes and vehicles.

14.2 Display of vehicles operating on the route

The system shall display the actual vehicles operating on the selected route.

15. Route performance management

15.1 Providing referrals

This functionality is designed to digitalize the process of granting the right to leave (Referral) to the driver.

That is, before leaving the route, the ticket must be issued to the driver by the sub-controller through the system.

The Referral will be the activation of the right to make the planned trip using the <<Driver Assistant>> equipment installed in the vehicle with the assigned registration number for the specified driver. Sub-controllers, when logging into the system, must be able to create a request, which must contain at least the following information:

- Date (including time)
- Route number
- Vehicle registration number.
- Driver details: first name, last name, phone number.
- Number of routes on a given day.
- Direction
- Expected start of the route: **08:00**.
- Expected end of the route: **09:00**.
- Stops during the route

The ticket itself will contain a time plan for the given route, indicating the starting point, stops and the end point.

The system should automatically notify about the time of the vehicle's departure on the route in advance, before the route (condition: **3, 5, 10 minutes**), and immediately before the start.

After entering the vehicle, the driver must pass identification via the <<Driver Assistant>> device and activate the ticket provided by the dispatcher, after which he will be able to announce the start of the trip.

The Driver Assistant device, based on the data from the activated ticket, must remind the driver of the trip schedule by stops via the appropriate interface.

The system, based on the extraction of GPS data about the vehicle's location, must calculate a forecast of the travel schedule, including traffic jams, and, having compared them with the planned travel schedule specified in the ticket, present the driver with a driving <<style>> for speed adjustment.

In this same environment, the system must present the driver with the positions of the vehicles participating in the given route, in front of and behind his car, in order to maintain the intervals of the routes as accurately as possible.