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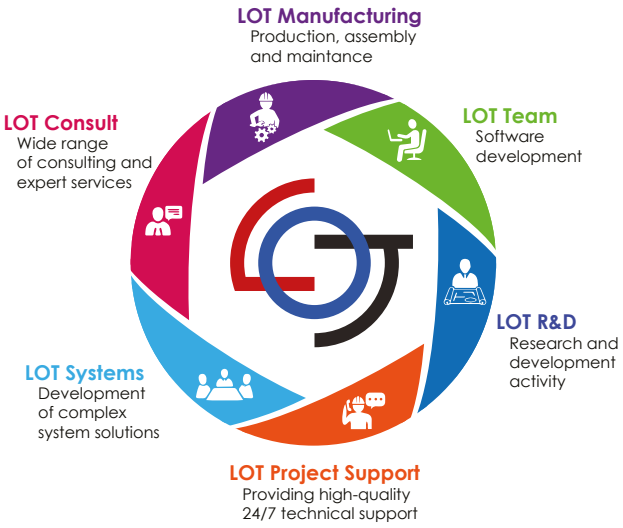
Smart Solutions

for Urban Transport

Content

About LOT Group

LOT Group is a group of companies specializing in development and integration of complex systems. We provide solutions, develop concepts, and manufacture equipment independently and implement them jointly with clients and customers.



- More than 20 years of professional experience.
- Constant growth.
- More than 90% of international sales.
- UITP full member.
- Team of professionals.
- 6 patents, 1 IP rights certificate, 3 authoring patents, more than 30 conformity certificates.
- Presence in 11 countries.

We are an active innovative engineering company. Our team of professionals develop and implement complex system solutions for transport. We carry out research and development activity to offer innovative solutions, produce, assemble and maintain hi-tech equipment for transport solutions. We develop reliable software, provide wide range of consulting and expert services as well as 24/7 technical support.

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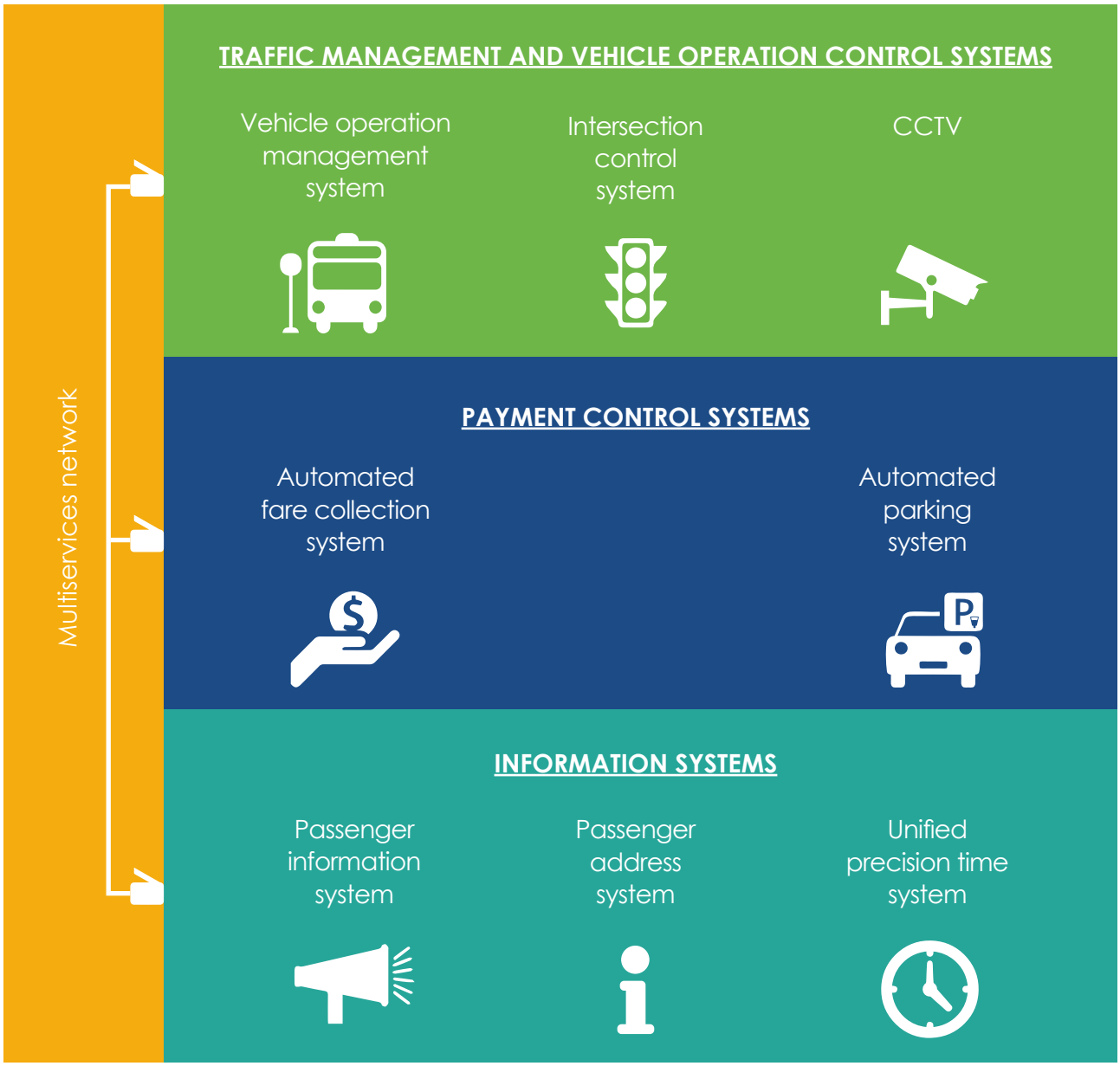
Smart Solutions

Our smart solutions for urban public transport integrate multiple technologies to improve the flow of traffic and safety.

Smart solutions provide an innovative approach by utilizing state-of-art system technologies and proven field equipment. We offer **complex of systems** with high operational efficiency and adaptability to evolving technologies. Systems' major strengths are excellent safety and open architecture for simple integration with other systems. Our systems are easy to use and easy to extend.

The complex of systems offers proven advantages in terms of **safety and environment** as well as **traffic fluidity** and **time saving.** The systems we offer can be installed independently or in any combination on customer's request.

Smart solution for urban transport includes three types of systems:



Advantages of the systems implementation

centralization of all public transport **control processes** in one single operation control center OCC;

centralized data analysis that come from different public transport control systems, optimization of service delivery to the public transport passengers and as the result increasing the level of passenger services;

increasing of passenger flow by means of providing the passengers with services of higher quality; in its turn it will make possible to decrease the using of personal transport and reduce the air pollution;

possibility to connect different routes to the single operation control system (BRT, bus and trolleybus lines, metro, tram lines) without essential additional costs for creating control centers for each kind of transport;

prompt response for emergencies in public transport traffic (failures, delays, etc.), automatic correction of transport timetable and informing the passengers about these changers;

decreasing the number of emergency situations in control areas by means of traffic management systems implementation;

one single operation control center for providing statistic, financial and analytic information for the whole city public transport.

Benefits of the smart solutions implementation:

- **Improving the mobility:** smart solutions for urban public transport will keep the growing and increasingly mobile population moving around the city and take them to new developments.
- **Optimization of the road space:** smart solutions for urban public transport will reduce traffic in the city by making better use of existing road space.
- **Reduction of traffic jams and congestion:** a new traffic control system will be used to manage traffic across the whole city and to reduce congestion.
- **Comfort for passengers:** the smart solutions for urban public transport system will provide greater access to jobs. The fast, reliable journeys will save time for all commuters.
- **Environmental benefits:** the smart solutions for urban public transport system are good for the environment. The low pollution vehicles will improve local air quality and reduce the emission of greenhouse gases which cause climate change.

Vehicle Operation Management System

Implementation of the system allows to systematize and regulate the procedure of releasing the vehicles to the route, keep precise records of every driver's work and every vehicles operation as well as to provide quick and effective communication between the drivers and traffic control operators.
The main element of the system is GPS traffic control display that is intended to inform the chief traffic control operator about the current situation in the whole control zone of the vehicle dispatching system.

All the main elements of the system are displayed on the central display:

- schematic **illustration of the vehicles** that are on the routes;
- schematic **illustration** of the map with **the stops**;
- schematic **illustration of the routes**;
- symbolic representation of the **operation mode**.

Advantages of the system implementation

Improving the **quality of the service** by means of providing the traffic regularity; lowering the intensity of transport crowding; reducing the intervals on the routes during the rush hours; improving the safety of passenger transportation;

Increasing the information awareness of the population about the public transport operation;

Providing the effective centralized control and **management of transportation** in general;

Increasing the **quality control** of public transport services;

Providing the centralized **monitoring of route passing time and speed.**

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Intersection Control System

Intersection Control System provides automatic traffic lights control at the intersections to provide privileges in traffic for vehicles while crossing the intersections.

Intersection control system is a complicated multilevel system.

The first level consists of executive devices and traffic flow sensors: traffic lights, information panels, microwave radars, surveillance cameras with analytic functions support.

The second level is performed by road controllers. Controllers allow to control traffic lights and information panels, collect information about traffic volume and intersection crowding, analyze and process the received information and according to this data to unload the intersections, to connect with traffic control center via any available communication channel, to record the history of its actions with opportunity to get this information while considering the disputable situations.

The third level of the system is intended for transmitting the data from road controllers to the traffic control center and if necessary, for receiving the control commands by devices of the first level.

The fourth level of the system is performed by the central server node, central traffic control center, automated working places that provide the information to other systems and allows to control the equipment of certain intersections and the whole system in general.

Implementation of the Intersection control system will allow to **solve the following problems:**

improving the **traffic control**;

lowing the level of motor vehicle emission from cars standing in traffic jams;

reduction the travel time and **total reduction of fuel consumption**;

vehicles priority control along the road over the other participants of the traffic;

maximum assistance in keeping the vehicle timetable;

prevention of traffic jams and **reducing the time of traffic jam** elimination at the complicated and crowded intersections;

providing the **information for municipal services** about the highway crowding, providing the possibilities of changing the traffic situation for solving the emergency situations (providing the priority for special purpose vehicles, etc).

CCTV

To control public transport traffic and to provide safety movement on the lines we offer to implement the following **subsystems of the CCTV system**:

- Automatic video-detection subsystem of moving vehicles;
- Automatic video-detection subsystem of vehicles passing on red;
- Sectional speed measuring subsystem.

Automatic video-detection subsystem **of moving vehicles provides** the following functions:

- Vehicle license plate recognition;
- Searching for stolen vehicles;
- Checking traffic of lanes reserved for busses and trams;
- Electronic toll system supervision;
- Modular solution enabling additional functions.

Automatic video-detection subsystem **of vehicles passing on red provides** the following functions:

- Video-detection of a traffic junction light state;
- License plate recognition;
- Photographic documentation and traffic offence archiving;
- Option of reconstructing the traffic accident from the video-recording;
- Connection to traffic junction light is not necessary.

Sectional speed measuring subsystem provides the following functions:

- Recognition of license plates;
- Measuring of an arbitrarily long section;
- High reliability and accuracy;
- Automatic data processing;
- Easy processing of violations.

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Implemented project

Almaty, Kazakhstan

In cooperation with the city authorities of Almaty, dispatching system was implemented to schedule vehicles and control passenger flows of urban transport. A single control center was created and all the necessary equipment was installed to connect to it.

The **operation control center** is equipped with:

- Telematics server that provides interaction with the complex avionics and initial processing of the obtained data;
- Database Server that gathers users and telematic data based on high-performance NoSQL database MongoDB;
- Server of geoinformation processing;
- Video Wall;
- Operation control center is equipped for 20 operators.

Each unit is equipped with public transport:

- GPS / GLONASS tracker;
- Fuel level sensor;
- Passenger flow counter;
- Differential fuel flow meter.

Baku Metro, Azerbaijan

LOT Group has implemented the dispatching and signaling system in Baku Metro. The Operation Control center was created, and required equipment was installed to communicate with the Operation Control Center and with 10 station control centers. SCADA handles 20 – 30 thousand of digital signals.

The **Operation Control Center** is situated on 28th of May station and is equipped with:

- Server QNX;
- Database backup server;
- Data base management system server;
- Automated workplace (AWP) of central dispatcher;
- Communication network equipment;
- Video wall of operator's AWP;
- Displays of trains dispatchers for Metro's red and green lines;
- Video server;
- Graphics processor;
- Video wall of information display system (1 x 12 m);
- Video wall of executive controller's AWP;
- Executive controller AWP.

The **equipment of automation and telemechanics of train** movement to communicate with newly established Operation Control Center includes:

- Monitoring and signaling units (24 sets);
- Server hardware equipment;
- Network switch type Catalyst 3560 24 10/100/1000T;
- AWP of centralization room operator (main and backup), intended to control the devices of route-relay station centralization;
- Automated workplace of electromechanician to control signaling systems parameters;
- Communication devices power supply system.

Automated Fare Collection System

Automated Fare Collection System provides automatic fare collection on the lines, access control to stations, control and analysis of passenger flow as well as controls the tariff policies.

Bar-coded tickets, smart tokens, contactless payment cards of MIFARE® standard and bank cards are used as payment media in the system. Bar-coded tickets and smart tokens are used as means of one-time fare payment. Contactless payment cards of MIFARE® standard and bank cards are used as means of repeated fare payment. MIFARE® cards can also be used as season tickets of different purposes.

The system consists of software and hardware and provides performing the functions. System consists of automated working places, which allow to control system operation and receive required data. Core of the system is a processing center (central server node). Set of server equipment with correspondent software, which provides system's operation, is installed in the processing center.

Advantages of the AFC system implementation:

- increase in fare collection revenue;
- analysis of the passengers flow records to manage the traffic route efficiency;
- possibility of flexible policy implementation (according to the distance, zone, etc.);
- implementation of different loyalty systems;
- preventing the fraud both from passengers as well as from transport company's staff;
- reducing the costs for collecting the fare;
- developing of the extended report system for on-line monitoring of the financial flows;
- increasing of public transport appeal for passengers;
- improving of environment due to the reducing of private transport usage.

AFC system is intended to perform the following functions:

- to release **contactless cards** of different functional capabilities and purposes;
- to release **payment smart-tokens** for one-time fare payment;
- to **validate payment media** according to the established rules;
- to **collect statistic information** about vending and payment media usage;
- to **accept** and **transmit controlling** signals to the station equipment;
- to **control working efficiency** of station and server equipment.

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Automated parking system

Automated parking system LOT PARKING is an effective and suitable solution.

LOT Parking is intended to provide **qualitative and maximally automatized control** of the cars arrival and departure as well as automated fare collection for the parking services.

Automated parking system LOT PARKING consists of the entry stand, exit stand, payment terminal, system server, administrator's automated work place, cashier's automated work place and special software.

Entry and exit stands have two modifications and allow to use contactless cards or bar-coded tickets as payment media. Entry and exit barriers can be included in the delivery set on the customer's request.

To pay for parking services a customer can use payment terminal or pay at cashier's window. The customer gives the card/bar-coded ticket received at the entry. The system defines the arrival time and counts the cost of parking services according to the current tariffs. The customer has to pay for the services at the payment terminal or at the cashier's window. The system registers the information about the payment and the customer has an opportunity to leave the parking.

LOT PARKING system provides flexible **tariff system**. Depending on the customer's requirements the system allows to choose the necessary tariff. The cost of parking services depends on the time of car staying on the parking lot. Free time interval, when a customer can use the parking free of charge, can be added to the system on the customer's request.

Automated parking system LOT PARKING can be installed on the objects where parking services should be paid:

- on the territory of special parking complexes;
- on the parking areas near business centers;
- on the parking areas near sport and entertainment complexes;
- on the parking areas near railway stations and airports;
- on the parking areas near hotels;
- on the parking areas near exhibition complexes and shopping centers.

LOT PARKING is solving the following problems:

Automation of **car arrival/departure** to the parking lot;

Automation of **fare collection system** based on bar-coded tickets and contactless cards;

Suitable **control and analysis of financial activity** of the parking complex;

Reducing the number of misfeasance of the staff and dishonesty of customers;

Monitoring of the events in the LOT Parking system in the real time mode;

Comfortable conditions of using parking services for customers.

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Implemented project

Automated Fare Collection and Passenger Record-Keeping System for the Urban Electric Train of Kiev, Ukraine

LOT Group was engaged to develop and implement an Automated Fare Collection, passenger record-keeping and access control system at 14 stations of Kiev's Urban Electric Train.

In accordance with the customer's requirements, LOT Group developed an automated system that was seamlessly integrated into the city's existing fare collection system. This allowed using the system's electronic tickets and cards for some of the other modes of Kiev's public transport, for example, the Kiev Light Rail.

The system allows using a **range of payment media**, including:

- Bar-coded paper tickets;
- MIFARE® contactless cards;
- Smart tokens (with the printing of a receipt);
- Pre-printed thermal paper tickets with the recognition system.

The **Implementation Effort** Included the Following:

- Software development in accordance with the customer's requirements.
- Delivery and installation of 28 cashier workstations and several more workstations for the platform officer, administrator, for financial reporting.
- Installation of a data network that comprised 14 stations and a central server module and equipping of the platform officer's room.
- Manufacture and installation of 86 custom-designed turnstiles, 24 gates for disabled passengers and 6 token reactivation machines.
- Equipping of the platform officer's room.

The Project's Features:

- Minimum possible time-to-market.
- Two types of turnstiles: tripods and gates for disabled passengers.
- Temperature range from –40° to +60°C.
- The system operated smoothly during two abnormally severe winters, when the temperature in Kiev went down to –36°C.

Automated Fare Collection System for the Ground Public Transport of Kiev, Ukraine

LOT Group was approached to implement an AFC system for the bus lines of Kiev's municipal transport operator Kievpastrans. The project was planned as the first stage of the city's public transport's transition to a centralized fare payment system that would use a single means of payment.

Currently, there are more than 200 buses operated by Kievpasstrans and equipped with electronic ticket validators.

The delivered AFC system was designed to automate the control and record-keeping of regular passengers and welfare recipients in Kiev's public transport. It was allowed automating and expanding the customer's existing capabilities for the monitoring, recording and analysis of payment data.

The Project's Features:

- A recognition mechanism to verify whether the ticket is valid or not;
- Protection against re-composting;
- Pre-printed thermal tickets;
- The system effectively operates at extremely low temperatures.

LOT Group's AFC system was designed to and has succeeded in achieving the following results:

- A 15% increase in the customer's fare collect.
- Prevention of unauthorized passage.
- Compensation for the conveyance of welfare recipients in strict accordance with their actual number.
- Reduction in the budget subsidies for the public transport's maintenance.
- Optimization of the public transport's schedules, in accordance with the actual passenger flows.
- Decrease in the load on the public transit system due to the optimized use of the available vehicles.

Automated Fare Collection Project for the Ground Transport of Tashkent, Uzbekistan

The high levels of fare evasion in Tashkent's public transport caused Uzbekistan's Ministry of Transport to consider creating a completely closed payment system to be based on contactless payment media.

LOT Group was approached to develop a project for the AFC system to be delivered. The system is supposed to enable control over payment of the fare and access to the vehicle, while also being able to generate reports on the passenger flow.

LOT Group developed the software for the system and custom-designed and manufactured the required access control hardware (tripod turnstiles) and validation equipment. A single processing center was created to aggregate and process all incoming operational data, including the data related to cards' purchase and reloading of card accounts, purchase of single-trip payment media, made transactions, state of the system's hardware and so on.

Paper tickets with unique details printed on them can be used for fare payment control on board a vehicle. The payment details printed on the ticket include the information about the time and the place of the payment transaction.

The Project's Features:

- Robust vandal-proof equipment, made of 2.5 mm stainless steel.
- The turnstiles are installed on all doors of a vehicle. A vehicle can be entered through the front door and alighted from through any of the other doors.

The project, implemented by LOT Group, has amply shown that the amount of fare collected by the customer can be increased dramatically.

Automated Parking System at Pivdenny Railway Station, Kharkiv, Ukraine

LOT Group successfully installed Automated parking system at Pivdenny railway station in Kharkiv, Ukraine.

This parking system serves about 200 parking places. Reliable software and hardware proved its reliability both in terms of cold winters and hot summers.

System includes:

- entry rack;
- fare unit combined with exit rack;
- 2 barriers;
- system server;
- auxiliary equipment.

Automated Fare Collection Project for the Ground Public Transport of Dakar, Senegal

Senegal's capital Dakar has a population of more than 4 million inhabitants. Buses are the city's only type of public transport. A State-owned Dakar-based company and one of the country's main transport operators approached LOT Group to implement Automated Fare Collection project. The project was aimed to test the system in Senegal's harsh climatic conditions (high temperatures, dust, high vibration, caused by the poor quality of the roads and high humidity).

To implement the project, LOT Group installed system equipment of its own on the customer's buses. Each bus was equipped with set of two validators and an on-board computer, connected to the central database.

In addition, we also supplied card-vending and token-reactivation machines and POS-terminals.

Fare control is performed by a controller using a portable terminal. MIFARE® contactless cards and MIFARE® smart tokens are used as the payment media.

The Project's Features:

- Validators are equipped with a touchscreen TFT display that allows selecting a travel area.
- The equipment is used in extremely harsh climatic conditions (+50 C, high humidity, dust and high vibration).

The project has enabled the customer to gauge the effectiveness of an AFC system's possible implementation in Senegal.

Automated Fare Collection System for Yerevan Metro, Armenia

LOT Group implemented Automated Fare collection system in Yerevan Metro, Armenia.

The comprehensive AFC system is capable of processing up to 100000 transactions per day. The system's implementation included manufacturing and installing custom-designed tripod turnstiles.

MIFARE® contactless cards and optical coded tokens are used as the system's payment media. The system is currently installed at 10 stations, serving 80000-120000 passengers per day.

The Project's Features:

- Building the whole of the required data network.
- Specialized swing gates are installed for passengers with disabilities.

Implementing the project helps the customer to achieve the following results:

- Near-total elimination of unauthorized passage.
- Improved safety at the stations.
- Efficient control over the traffic flow.
- An optimized train schedule.
- A significant increase in the Metro's revenue and profitability.

Passenger Information System

PIS is an effective tool which provides passengers with necessary information connected with bus timetable, train arrival and departure time, current time and date, different help information.

Main tasks solved by the proposed PIS are:

- visual informing of the passengers about the bus routes at the station;
- visual informing of the passengers about the time intervals of bus arrivals and departures at the stations;
- visual informing of the passengers about the bus timetable at the station;
- providing the information about the current date and time;
- providing the passengers with the help information of different kinds (for example, information about the fare, routes, etc.);
- displaying the information of emergency operations services (for example, displaying the information of the firefighting system);
- providing the related systems such as Public Address System, SCADA, ATS, AFC and emergency operation services with the PIS resources.

The advantages of PIS implementation are:

increasing of the passenger flow by means of informing the passengers about the timetable and intervals of train movement in the on-line mode, in its turn, it allows to improve the efficiency of the passenger service;

prompt response for the emergency situations in train movement (failures, accidents, etc.), automatic correction of the traffic timetable and informing the passengers about these changes;

creation of the PIS joint **monitoring center**, that allows to control centrally the display information on the passenger information displays (PID – Passenger Information Display) and perform its operation monitoring in on-line mode.


LEFT
TURN
SIGNAL
TRANSIT
SIGNAL

Public Address System

Public address system is intended to provide passengers with address voice announcement on the stops and in concourses.

Voice informing of the passengers is an additional component of the passenger information system (PIS) that allows to **implement the following functions**:

- informing about the time of the bus departure/arrival with an indication of the route;
- voice informing the passengers about the changes in bus timetable (delayed, cancelled, etc.);
- providing the service information (information about using the AFC system devices, information about safety requirements, etc.);
- compulsory transmission of voice messages to the duty officers of the PAS system to any station;
- compulsory transmission of voice messages to the duty officers at the station;
- alarm reporting (fire, terrorist threat, etc.);
- providing tourist and advertisement information (with reference to the station);
- possibility of background music broadcast.

PAS system receives the information from other systems (Global Positioning System, Passenger Information System) to be performed in synchronized way to the passengers. PAS system has interfaces for interaction with other systems for example, firefighting system.

Unified Precision Time System

Unified precision time system is intended for precise time synchronization with all systems that require time synchronization and time displaying for the staff and passengers.
The system synchronizes the central time server (Central Master Clock|) time with Coordinated Universal Time and then all slave clocks are synchronized with the central time server of the system.

Unified precision time **system consists of**:

- one central time server (Central Master Clock) situated in OCC;
- Slave Master Clocks situated on the all stations;
- Digital/Analogue Slave Clocks, situated on the stations, in the OCC, depots, service-and-office building, etc.

Implementation of the Unified precision time system will allow to synchronize operation of all systems, provide simultaneous performing of the control commands for different systems from OCC as well as to carry out logging of all systems operation in universal time.

Implemented project

Kharkiv Metro, Ukraine

As a part of Passenger Information System LOT Group's also implemented unified precision timing system in the Kharkiv Metro.

The system has been integrated into the existing software environment and synchronized with all the subway systems. The system serves displays at the stations and provides unified precise time for a dispatching subsystem.

LOT Group designed, manufactured and installed the following equipment at **29 stations of the Kharkiv Metro**:

- 58 usual clocks (showing time);
- 58 interval clocks (showing time passed after previous train departure);
- 87 clocks for dispatcher needs;
- A central clock server with GPS devices (satellite time correction);
- 34 switching units;
- An optical communication network.

Baku Metro, Azerbaijan

Among a wide range of different automated system implemented by LOT Group in Baku Metro there was a unified precision timing system.

This system ensures the accuracy of all information and security systems of the subway as well as coordinates the work of displays at the stations and provides unified precise time for a traffic control subsystem.

LOT Group designed, manufactured and installed the following equipment at **23 stations of the Baku Metro**:

- 46 usual clocks (showing time);
- 46 interval clocks (showing time passed after previous train departure);
- 70 clocks for dispatcher needs;
- A central clock server with GPS devices (satellite time correction);
- 26 switching units;
- An optical communication network.

In addition, the system allows controlling electro-mechanical clock using second and minute's pulses.


NSTADT
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Multiservices Network

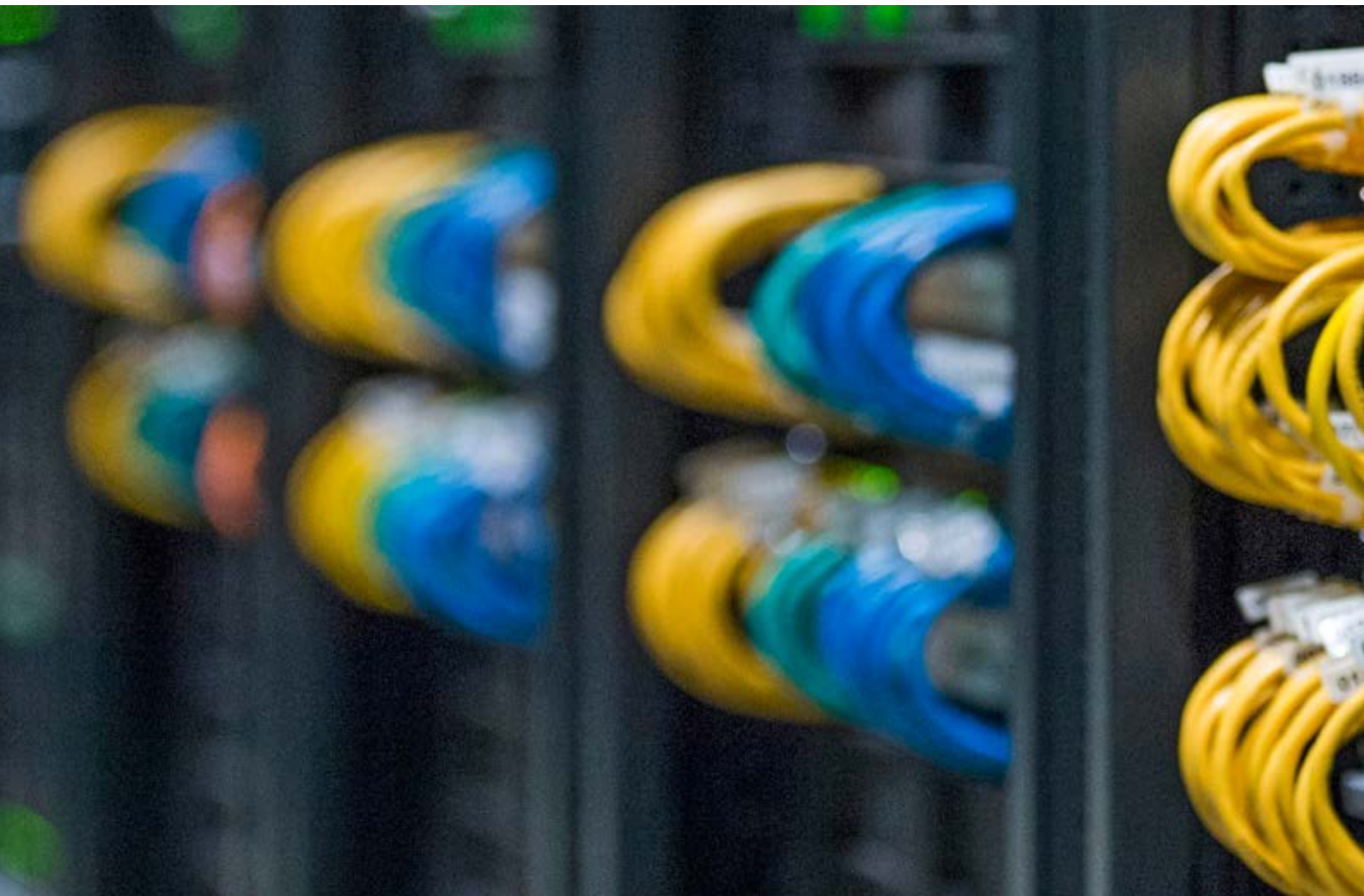
MSN is a Multiservice Redundant Gigabit Ethernet Network which is intended for providing **well-organized telecommunication infrastructure** that covers all strategic objects such as OCC, stations, depots, service-and-office buildings and any other places connected with public transport. MSN also provides reliable communication channels between the strategically important places and the rolling stock or mobile operating staff.

MSN provides reliable data transmission between all the nodes and systems.

The network topology for Multiservice Redundant Gigabit Ethernet Network to link Main Sites nodes will be a «**dual ring topology**»:

- Each of the nodes of the network will be connected to two other nodes in the network, with two connections to each of these nodes, and with the first and last node being connected to each other with two connections, forming a double ring.
- Dual ring network topology allows to transmit all necessary data volumes in case of fiber optic line break or one of the system nodes failures. All the MSN equipment has the required level of backing-up not to lose the transmitted data.

MSN monitoring and control is carried out from OCC, where automated working place of the network duty administrator is equipped.



Advantages of MSN implementation are:

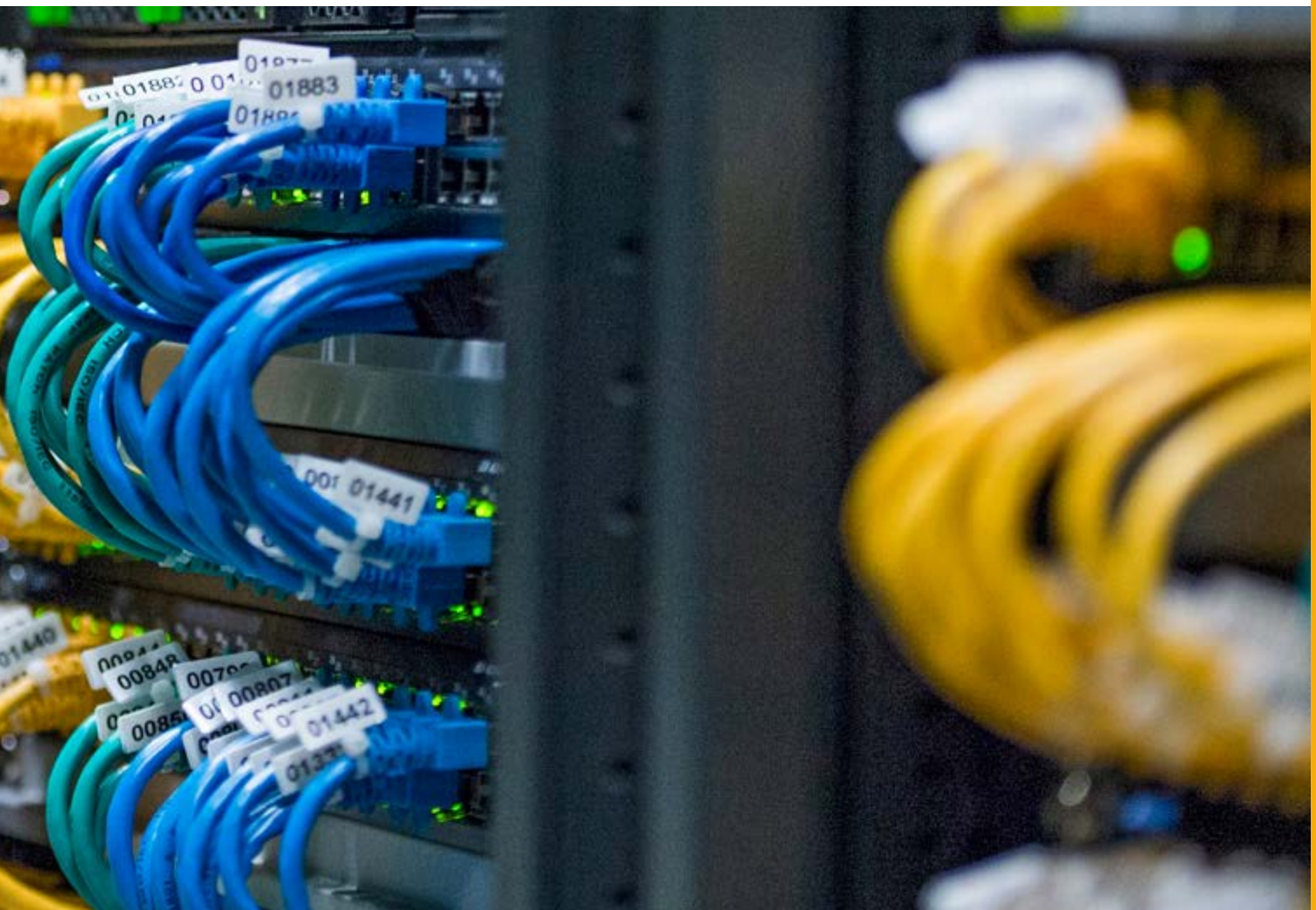
reliable **base for data transmission** between the systems;

single MSN **operation monitoring center** located in OCC;

single logging center of the MSN events;

providing other systems with MSN resources (Signaling, SCADA, Building Management System, etc.);

connection of the **new network segments** to the MSN network on the new public transport lines without essential costs for creation of the network control center for each public transport line.



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Implemented project

Kharkiv Metro, Ukraine

LOT Group implemented Structured Cabling System WLAN and LAN system to serve the information traffic of the Kharkiv metro.

The system has been integrated into the existing software environment and synchronized with all the metro systems.

The equipment installed for **29 stations of the Kharkiv Metro:**

- 8 000 m cable network for power supply and 8 100 m of FTP cable network;
- 45 sets of wall cabinets for server hardware (15U 745h600h600);
- 46 sets of WS-C2960-24TC-L Cisco Catalyst 2960 24 10/100 + 2T/SFP LAN Base Image;
- 5 sets of for WS-C2960S-24TS-L Catalyst 2960S 24 GigE 4 x SFP LAN Base.

Baku Metro, Azerbaijan

LOT Group had implemented Structured Cabling System WLAN and LAN system to serve the information traffic of the Baku subway.

The system has been integrated into the existing software environment and synchronized with all the subway systems.

The equipment installed for **23 stations of the Baku Metro:**

- Installation and launching of the central node;
- Installation and launching of 194 units of remote removal;
- 17 sets of wall cabinets for server hardware;
- 32 000 m cable network.

Yerevan Metro, Armenia

LOT Group implemented Structured Cabling System WLAN and LAN system to provide information traffic in Yerevan Metro. The system was integrated into the existing software environment and synchronized with all metro systems.

Optic backbone was built on 1 Gbit/s technology. A single fiber connection was used. Loop was organized using STP technology (Spanning Tree Protocol).

10 stations of the Yerevan Metro were equipped with:

- central server node;
- 31 units of the remote removal equipment;
- 11 sets of wall cabinets for server hardware;
- 31 000 m of cable network.

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