Ing. Ivo Herman, CSc.

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Traffic Control, Information and Fare Collection Systems and Technology

(Complex Solution)

For the public transport vehicles and train information systems management we offer the role of system integrator of the following information system parts:

- **on the dispatcher side and others workplace in public transport** – traffic management and position monitoring with SW SPRINTER 2014;
- **on the communication site** – our solution with "hybrid" private radio communication network and technology (also radio exchange) or GSM/GPRS/UMTS (3G) and LTE;
- **on the side of "intelligent vehicles"** – new board computer EPIS 4.0A, EPIS 5FC and MSP 5.0 and driver LCD terminal, internal and external sings, cameras systems, automatic point switching, tachograph, ….);
- **on the depot side** - uploading data into devices in vehicles and their downloading (reading logs, blacklist, whitelist, fare collection data, etc.);
- **on the stationary intelligent internal or external LED and LCD signs** - communication with dispatching centre, vehicles, sightless people, cameras, etc.;
- **on the transport routes and their administration** - automatic point switching, crossroad preferences, point, advertising depend on time and position, etc.);

Contacts and location

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Pic. 1: Production building.

Certificates:
The production quality management system ISO 9001:2010 has been certified since 2008. Currently we are preparing for ISO 27001, ISO 27005 certifications.

Business subject:

- Production, installation and reparation of electronic devices.
- Research and development in technical science.

Company location:

The company is located 50 m behind Brno (Czech Republic) at the adjacent to a four-lane road leading from Brno to Vienna and about 2 km south of the D1 motorway junction. It is easily accessible from all access roads into the city.

Principles of company function:

Following description of management, information and fare collection systems and technologies for vehicles stop is trying to emphasize the general principles of system solutions and these solutions then present the specific products. Since the company is based on solving customer problems, we are able to customize our supplied equipment to your specific requirements.

Based on the experience of more than 20-year-old working in the information systems of public transport, we designed the structure of the new complex fare collection system, including the involvement of intelligent vehicles and this is the first time we succeed to realize in the project "Dynamic dispatching" in Pilsen (CZ) as on this system we follow and at the same time prepared solution.

We have started the realization **of the biggest project in the Czech Republic in the field of information systems in transportation in the last 10 years** for Ostrava Public Transportation. Within solving the project there is realization and installation of **624 On-Board Computers EPIS 4.0B**, equipment of communication system in 6 depots, new dispatcher including the latest version of SW **SPRINTER 2014** and the latest version of radio network **EPIS FD-NET** including at least 25 radio channels on 3 radio base stations supporting roaming. A part of this project is also drivers´ training centre installed with vehicle simulator and dispatcher. Chosen vehicles will be equipped with Counting Passenger System.

Company profile

The Ing. Ivo Herman, CSc. company was founded on 1. 5. 1990 for the purposes of producing and developing specialized electronic products with links to previously realized significant projects. The central program of the company consists of proposing and realizing electronic products from the fields of processing acoustic signals, high-frequency technology, database information and control systems, telecommunication systems; and trading activities. Regarding the above mentioned fields the company offers its customers a complex approach to the problems they want to have solved.

The composition of the company ensures short innovation cycles and state of the art technical solutions. Many development assignments are now solved by 10 development operatives which guarantees short innovation cycles and fast development of applications. The work is executed in accordance with the wishes and requests from our customers the results of which are "fitted" solutions. One of the biggest advantages of the company is its close connection to scientific circles and specialized technical equipment of **The Faculty of Electrical Engineering and Communication Brno University of Technology**.

References

Our products and systems are working in many travel companies in different types.
For example:

- Installation of 624 On-board computers EPIS and 135 Automatic Passenger Counting Systems – 2014/2015
- 58 tram stop LED panels for Travel Company Brno - 2014
- 65 systems using EPIS 4.0A board computers in Jihlava and dispatcher system – 2014
- More than 130 stop panels with cameras and public WiFi for passengers - 2012
- More than 90 systems using EPIS 4.0A board computers in Zlin (CZ), 2011 - 2013.
- Approx. 420 systems using EPIS 4.0 board computers in Pilsen (CZ) – from 2009.
- Approx. 650 systems using EPIS 2.45 UIR units in Ostrava (CZ), 2002 – 2007.
- Approx. 650 systems using EPIS 2.45 NMR units in Brno (CZ), 2002 – 2005.
- Approx. 1000 pieces of MSP units for monitoring bus positions in the South Moravia (CZ).
- Approx. 1000 pieces of BSV units (vehicle systems for automatic point switching) in cooperation with Elektroline, a.s. (Bendigo (AU), Lyon (FR), Atheny (GR), Milano (IT), Pilsen (CZ), etc.).
- Approx. 300 pieces of point switching electronic systems – from 2003.
- Approx. 200 stationary sings (ELP) – since 2006 (preparation more than 100 pcs to the end of 2012).
- Approx. 1200 vehicle receivers for sightless people (EPNEV) for public municipal transport and for Czech railways – since 2002.
- Complex solution for private radio network – from 2002.
- Dispatcher SW systems SPRINTER (Ostrava, Pilsen, Zlin – all in the Czech Republic).

Our activities in the field of "traffic management, information and check-in systems and technologies"

- *SPRINTER 2014 – software integrated a central dispatching control system with a control of stationary signs and depot systems.*
- *Board computer EPIS 4.0A for public transport (new - municipal).*
- *Board computer EPIS 5FC for regular public transport (new - regional).*
- *Interior and exterior vehicles LED and LCD signs (LED low power solution).*
- *Vehicle control unit for position monitoring and voice communication (new MSP 5.0).*
- *Intelligent stationary signs ELP (electronic stop panels).*
- *Radio communication system for middle distances in depot and on the route.*
- *Integrated and intelligent power supply units -- IJN and NRJ.*
- *Multifunction digital announcer - communication center in vehicles.*
- *Non-contact point control system for trolleybus and tram.*
- *Control box for trolleybus point switch.*
- *Receiver of the sightless people commands (regional, municipal and train solution).*
- *Preference of public transportation vehicles at crossroads.*
- *Camera systems in public transport vehicles.*

Pic. 2: *The dispatcher center with central monitor*

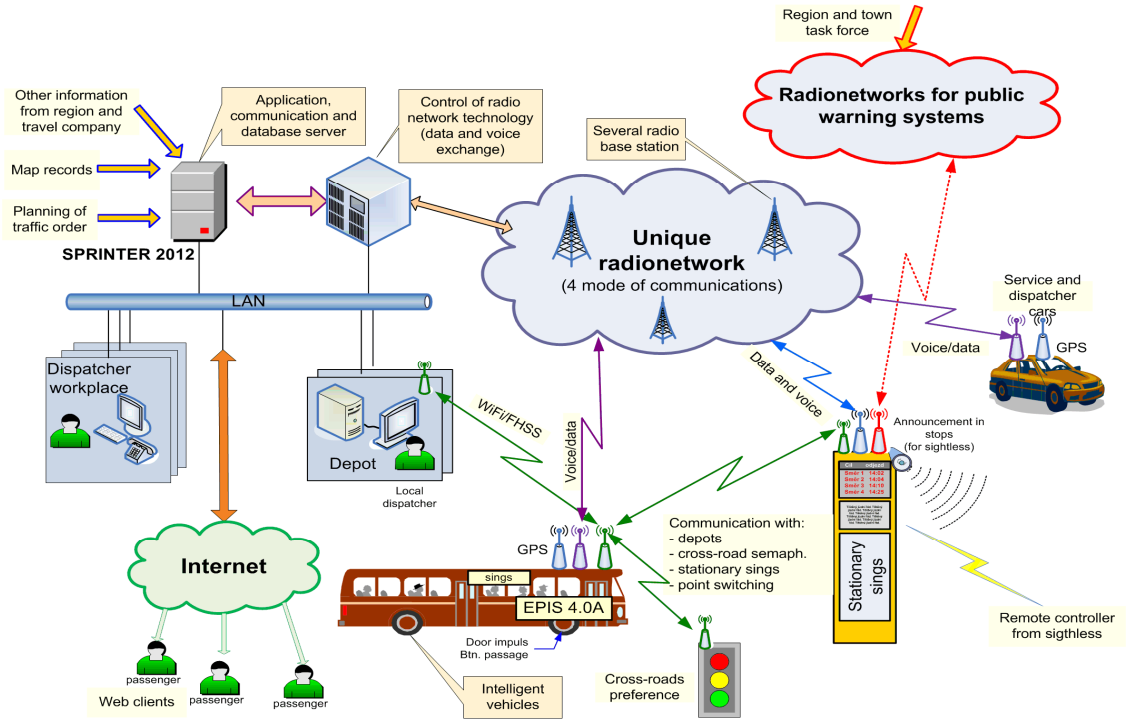
This description of vehicle control, information and check-in systems and technologies for public transportation try to emphasize the general principles of the system solutions. These solutions will be presented on particular products. Since this company is based on solving customers´ requirements, we are able to provide you with the solution that exactly fits you.

Based on the experience of more than 20-year-old working in the information systems of public transport, we have designed the structure of the new complex system, including the involvement of intelligent vehicle and this is the first time we have succeeded to realize it in cooperation with GES electronics in the project "Dynamic dispatching" in Pilsen. Currently prepared solutions, especially On-Board Computer with Checking in Action – EPIS 5FCC, follow the previous systems.

The structure of control, information and fare collection systems

The following picture shows the basic structure of the “control, information and fare collection systems" that we offer as a system integrator. The system consists of:

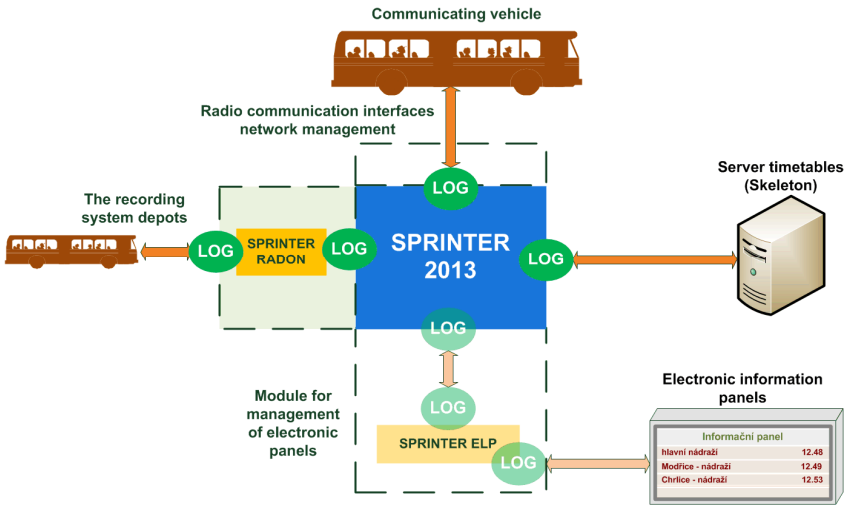
- **Dispatching information system** containing the SW SPRINTER 2014, technology of communication management with dispatcher and vehicles or between depot and vehicles, position monitoring of vehicles and its checks relation to the timetable and processing various statistics.
- **Communication systems** via private "hybrid" radio network based on broadcasting stations or general GSM / GPRS / UMTS (3G) technologies.
- **Intelligent vehicle** "can" remotely communicate with the dispatcher center, depot, stop panel, point switches (tram, trolleybus), crossroad controller and command receiver from blind people. The core of these systems is formed from our new EPIS 4.0A or EPIS 5FC board computer based on the PC platform, containing LCD touchscreen terminal for drivers. Onboard computer activity is mainly based on the knowledge of the position of the GPS coordinates. The system for handling can be added to the printer cards, contactless smart cards, etc.
- **Solving the tracking of transport company vehicles**, where integrated radio communication adapter allows broadcast stations to position monitoring, calculating the distance traveled and entered into the log book.
- **Stationary stop panels** that include standard LED or LCD panel sided or two-sided. The panels can be integrated MP3 player, direct voice message from the dispatcher, camera system, the command receiver for the blind, etc. Our LED panels are normally low-power and high repetition rate. They may include exchanging information from a single system notification and warning the population.
- **Web server** for connections of passengers over the Internet (coming soon).
- **Wireless point switching system** for building a route system (tram, trolley) or **crossroad preferences**.



Pic. 3:Communication structure of complex control, information and fare collection system

SPRINTER 2014

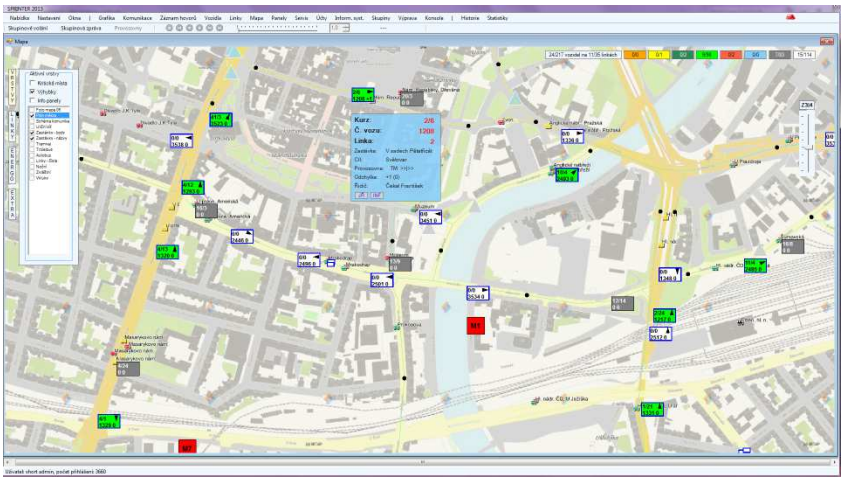
Sprinter Software, since its very first version 2001 to its latest version 2014, serves as a moderator for all required control, information and update functions of public transport company´s dispatching center including controlling and communication of a dispatcher with vehicles or controlling information display signs. The way of communication between dispatching and information display signs or vehicles (i.e. buses, trolleybuses, trams or dispatcher´s car) is independent of a chosen transfer medium. The radio private network enabling voice and data transfer with the aim of single vehicle radio station or GSM/GPRS/UMTS operators´ mobile networks can be used as a way of communication. Nowadays we are working on the version even for integrated transport systems.



Pic. 4: General scheme of composition SW SPRINTER for dispatching DP.

Sprinter Software 2014 – integrated and central control system enables:

- **Control and maintenance of vehicle operation** – control of public transport and technical vehicles (e.g. dispatcher cars, energo, upper construction etc.) and their following, or communication during their operation on track.
- **Control of vehicles´ information system in depots** – it solves update of information data, check-in and technological systems in vehicles.
- **Communication with vehicles (radio net)** – it solves control and maintenance of radio networks using one or more base stations. This function is from the viewpoint of a dispatcher hidden and radio network is transparent.
- **Information display signs** – a module for control and maintenance of information display signs at the stops.
- **Vehicles statistics, traffic history** – generated according to different criteria including animation of previous traffic.



Pic. 5: View vehicles on a map background in the Sprinter 2014

Private "hybrid" radio network for transport companies

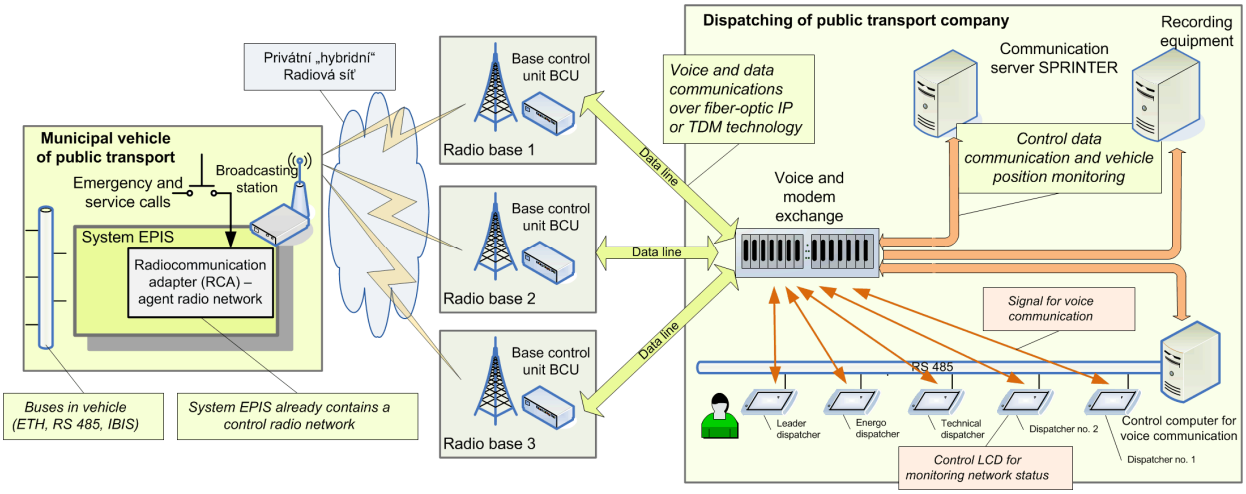
Private radio network for transport companies we have been developing since 2000. The network was gradually built up and developed in several stages. Today, it contains 3 radio bases and it operates 27 radio channels (not frequencies) in different modes and it is connected more as 40 channels (data and voice). Radio network can be controlled by dispatching SW SPRINTER.

Based on this experience, we offer private "hybrid" radio network that communicates various data-transmission speeds, with the voice communication is classic analogue. The network is built on radio stations with fast switching channels.

Advantages of this solution:

- A new radio network **can be built gradually** on the basis of the existing network.
- **One radio in a vehicle is** used for voice and data communication.
- Service fees are only purchased frequencies (**low-cost system**).
- Ability to **communicate with crossroad controllers** on a dedicated frequency (switching transmission power according to the frequency).
- **A solution under control - the supplier is** the creator of the control software and hardware, and therefore radio network can be modified according to user needs.
- **IP technology** to transmit voice and data between the control center and the base (the bases). Can be combined with the technology Voice over IP (VOIP).
- The radio modem and radio communication adapter **is integrated in the on board computer EPIS 4.0x** or can be built into the radio (solves this service vehicles).
- **Various speed for data transfer** depending on the desired function (position monitoring, reading short loop from tachograph, automatically generated messages, etc.)
- The speed necessary to ask for the purpose of position monitoring up to **150 vehicles / 10 seconds** depending on configuration of radio channels.
- **Increased safety** - during outage data server operates autonomously radio network for voice calls in safe mode (the driver will always do so).

  Automatic roaming (switching bases) - based on the measurement of the quality of the received signal is performed automatically select the radio as the base for data as well as voice communications.



Pic. 6: The principle of solving private "hybrid" radio network.

EPIS 4.0A - board computer

Pic. 7: Control unit of the EPIS 4.0A on-board computer

The EPIS 4.0A board computer replaces EPIS 4.0 and is manufactured from January 2012. It has a smaller footprint and much better performance and memory.

Basic system configuration in vehicles EPC 4.0A (it is integrated to one box):

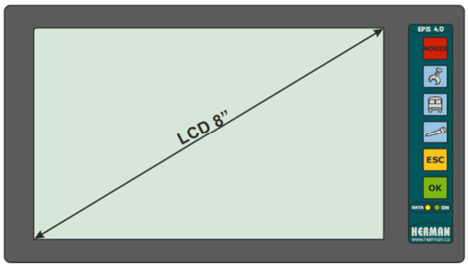
- **Board computer** which is based on low power PC compatible standard with 8GB **COMPACT FLASH** and 1GB **RAM DDR.** Frequency is 1 GHz.
- **Two interfaces** for Ethernet communication 10/100 MHz and 3x USB (PoE and TPoE).
- **SW triple independent digital announcement** (inside, outside and digital announcement based on MPEG3 standard (capacity 32 MB).
- **Digital acoustic exchange** (all audio switching is digital). Acoustic input are microphone, radio station, external line, GSM, sound interface AC97 and triple MP3 decoder.
- **Digital amplifier – class D** - to inside and outside (both sound power to 50W) and to driver 1x5W.
- **Integrated power unit IJN®21** which contains intelligent switch for (optical table, LCD screen, billing system, tachograph, paying system, City screen, WiFi, etc.).
- **Two radio communication interface** – one for WiFi 5,8 GHz and low energy FHSS. Low energy communication is used for communication with depot and stationary signs, point switch, etc.
- **Many interfaces –** IBIS, RS 485, RS 232, Ethernet, CAN, USB.
- **7“ or 8” LCD display with touch screen** (size 480 x 800 pixel, live 50,000 hrs., 550 Cd/m^2). It can be embedded or on stand.
- **Radio communication adapter** for cooperation with radio station. It can work by protocol standard MPT 1327, conventional mode, TNDS (time multiplex for position monitoring) and fast data modem (cca 10 kbit/s).
- **Internal sensitive GPS receiver** for position monitoring and time normal for board computer – SiRF STAR IV – precision 2,5 m.

- **Vehicle IP router** – connected for example to CITY SCREEN (LCD display for passengers), tachograph, etc. Control unit EPIS has integrated firewall for communications thru WiFi. Vehicle has two computer network – internal and for external access.
- **Cameras** for watching to inside or outside space.

EPT 4.08 LCD touch terminal

EPT 4.08 is an 8" color TFT LCD monitor (the IPS technology) for industrial use with touch control using a 5-conductor resistance touch surface. The size of the terminal is 8" and it is suitable for public transportation vehicles because it does not take up too much space (it is easy to find a suitable place for installing this device in the vehicle) and the displayed texts are very easy to read.

EPIS system meets the standards: EN50151, EN50155, ISO11451, ISO7637-2



Pic. 8: EPT 4.08 LCD driver terminal.

Properties of the EPT 4.08 LCD driver terminal

Proportions (w × h × d)	228 × 134 × 50 mm
Certification	EN50151, EN50155, ISO11451, ISO7637-2
Electrical energy consumption	12 W (typical)
LCD display	WVGA – TFT (the IPS technology)
Display size	8"
Active surface size	174 × 104,4 mm
Resolution	800 x 480 pixels
Video interface	LVDS
Number of colors	262 K (6-bit input)
Brightness	600 Cd / m2
Contrast	900:1
Illumination lifespan	70 000 hours (LED)
Working temperature	from -20°C to +70°C

Checking system - EPIS 5 FCC

The EPIS 5FC on-board computers with the checking ability (checking system – commonly called „the machine“) are designed for regional public transportation and include a ticket printer with extended lifespan, a contactless card reader, a backup power supply accumulator, a multiple digital annunciator unit, a GPS unit, GPRS or UMTS (3G) data communication, integrated Wi-Fi, isolated payment black boxes and other components including our new SW „**back office**„. They are produced in a divided version EPIS 5 FCS – a control unit and an LCD terminal or in a compact version EPIS 5 FCC – now the preferred version.

The EPIS 5 FCC meets:

- **the vehicle operation temperature requirements** (-20°C to +70°C) – if the temperature is deeper below zero, the vehicle has to be kept in RESET to allow heating of the inside of the vehicle using “waste” heat,
- **the high performance requirements** – the ARM processors working on a frequency of 1 GHz (at least 10x higher performance than other on-board computers commonly used in the Czech Republic – for example PXA) – when the ARM processors are used, they can also be multi-core,
- **the low energy consumption requirement**, consequently, there is no need for cooling using a ventilator,
- **the high memory capacity requirement** – a micro SD FLASH 8 Gbyte or a 8/32 GB SSD disc and at least 1 GByte RAM DDR (DDR2 or DDR3),
- **the universal application for systems with the possibility of payment to the driver requirement**
- **the requirement of direct radio communication** with dispatching or accounting centers.

Check-in system includes:

- 3” thermo printer with long-life cutter and printing head (200 million prints)
- Contactless chip card reader MIFARE Classic 1K, 4K and MIFARE DESFire EV1 2K, 4K, 8K. It includes a controller for SAM modules (support of MIFARE SAM AV1 and AV2).
- Independent memory for data storage of payment transactions and operations with contactless cards (black box) as default. It enables to read out data in case of failure of the unit.
- 4 fold independent digital detector (inside vehicle, outside vehicle, for a driver and for a passenger)
- Acoustic exchange with the microphone inputs, GSM/GPRS/UMTS modules, audio PC card and 4 fold digital detector. Acoustic exchange is supplemented by amplifier with the mean power of 2x20W (50W peak – inside vehicle, outside vehicle) and 2x10W (for a driver and for passengers).
- Ability to play video spots on the driver´s terminal including ability to synchronize video spots played on vehicle LCD signs (combination of transportation´s information and advertisement).
- Integrated sensitive GPS receiver SirfStar IV for location identification (accuracy 2.5 m).
- GSM/GPRS/UMTS module to communicate with dispatching and automatic software updates. Integrated 2.4 GHz WiFi module as optional usage for data update.
- Backup supply – for a case of main supply of 24V failure (e.g. while starting engine) includes backup battery enabling to keep the system running without OS reset for at least 20 minutes.
- Interface to control tables using RS 458, Ethernet 100 Mbit/s, or interface IBIS including the ability for recording BUSE tables.
- Automated software update – in previously set times or intervals, data unit wakes up and using WiFi or GPRS, it asks dispatching for new versions of software that are possibly uploaded.
- Customer side LCD 4.3” display with brightness and 480 x 272 pts resolution.
- External router for Ethernet interface with IP addressing inside vehicle – connection of check-in system, LCD sign for passengers, tachograph, etc.

Position monitoring unit – MSP 5.0

MSP 5.0 module is basically a **new type** of on-board computer for **not only public transport vehicles**. It can be implemented as a simple and small control unit within Public transportation. It can be used as master or slave unit once connected into vehicle bus. Thanks to inbuilt GSM/UMTS modem it can be also used as a vehicles´ communication central point. In the default version it supplements the previous solution MSP-3D2.

Pic. 9: Unit MSP 5.0

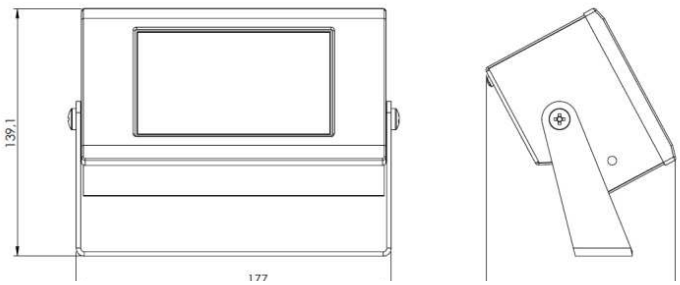
The basic parameters are given by ARM processor with at least 1 GHz frequency (one up to quad core), 1 GB RAM, at least 2 GB fast SD card, or SSD 8 GB or 32 GB. MSP 5.0 includes 5" LCD capacitance touch screen with high brightness display. According to the number of controlled elements, it is possible to equip the computer with high speed 2.4 GHz WiFi module, GSM/GPRS/UMTS modem, insulated RS 485 bus, standard RS 485, CAN, IBIS or USB interface.

MSP general parameters:

- Linux operation system – startup time 40 seconds,
- Typical consumption – 24 V/ 0.3A, approx. 7W (depends on display´s backlight adjustment),
- Peak consumption – 24 V/3A (valid for peak acoustic power of the announcement inside vehicle and outside vehicle),
- Possibility to remotely control the turning on of the unit
- WiFi IEEE 80.2.11b/g (optional – WiFi can be implemented inside vehicle for passengers),
- GSM / GPRS / UMTS (optional type of modem),
- 1 x Ethernet 10/100 Mbps (optional, with PoE),
- 2 x USB (for recording and operation),
- IBIS /CAN 2.0 /RS 485 (optional on extra PCB, all can be installed simultaneously), in case of IBIS bus, the solution can be used as master or slave unit.
- RS 232.
- GPS – SiRF STAR IV – position accuracy up to 2.5m.

Audio paths enabling announcements or interconnection:

- Two independent audio announcements – each of 20 W sine (determined for outside and inside vehicle),
- One independent announcement to driver´s speaker with the power 5 W (implemented into MSP unit),
- Integrated microphone into MSP 5.0 unit (electret condenser microphone). It can be switched either for announcements to passengers or inside/outside vehicle.



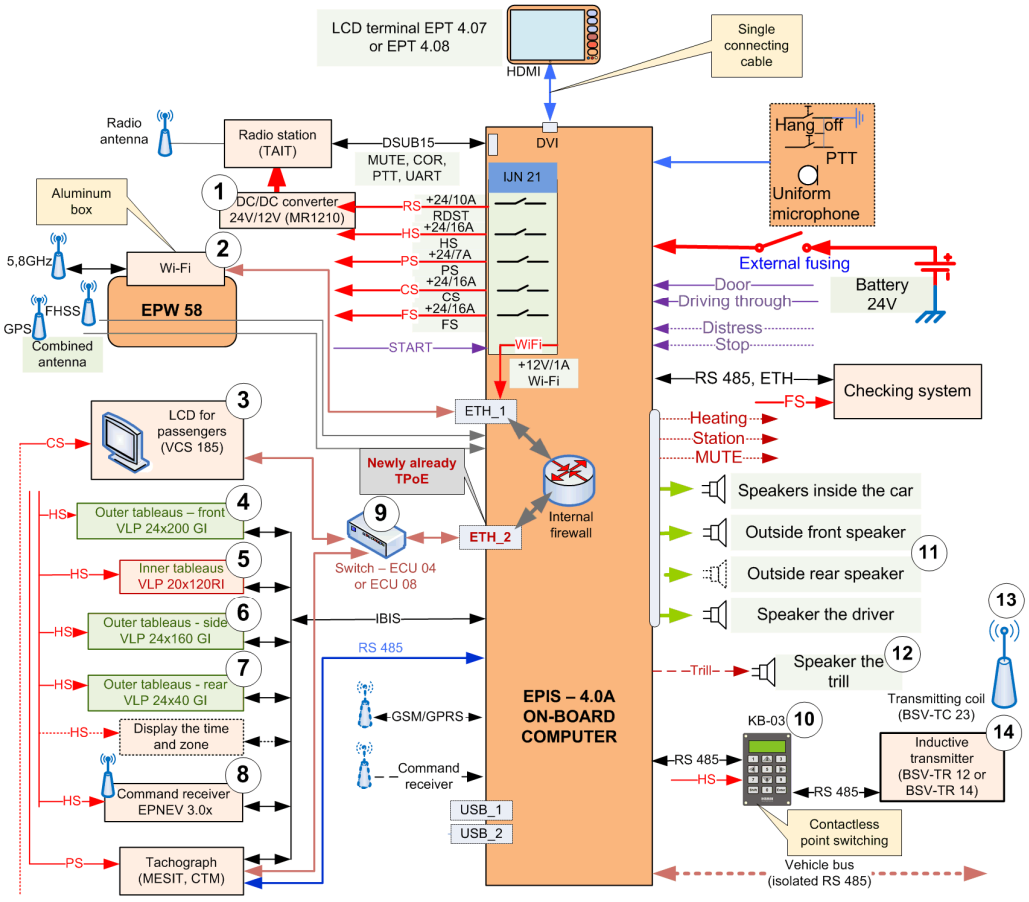
Pic. 10: Outer measurements MSP 5.0

Connection of intelligent vehicles for public transport

This page shows an example of a standard connection of public transport vehicle with EPIS 4.0A system. This version has a power supply (IJN 21) integrated unit into the board computer and the power is divided into separate branches (MS, AS, FS, RS and CS). The system still uses IBIS as a fundamental communication bus and RS-485 bus for new types of communication. City Screen (LCD for passengers) or tachograph are already connected via Ethernet bus. The control unit EPC 4.0A acts as a firewall.

On-board computers of the EPIS – a new perspective on vehicle informatics:

- The original conception of a number of separate devices is replaced by one small efficient built-in computer based on PC computers.
- A divided conception – the control unit, LCD terminal and antenna system are now three separable parts of the system which allows placing only a touchscreen on the dashboard and hiding the rest in the technological parts of the cabin and of the vehicle. Thanks to this, connecting is much simpler and the dashboard much better arranged. The terminal is connected to the computer with just one HDMI cable.
- Instead of slow busbars (IBIS) it is possible to use Ethernet or our new TPoE (targeted switching on of vehicle devices) interface.
- All information about the schedule and the route are shown on the display in a well arranged way. There is also a possibility of showing shots from vehicle cameras.
- **Versatility of use** – single trams, joined or bidirectional trams, trolleybuses, buses, trains.



Pic. 11: Installation of the EPIS 4.0A on-board computer

New concept of intelligent vehicle power supply management- TPoE®

In 2001, Ing. Ivo Herman, CSc. company was the **first in the Czech Republic to introduce new integrated intelligent power supply unit – IJN**. This new concept was used for the first time in DPMB Inc. and later in the DPO Inc. This principle was proven to be so successful that it has been taken in various forms in the solution of information systems from other companies. **Over 10 years have gone by of developing information systems and vehicles change a lot.**

Therefore, we are introducing a new concept defined by our company and called

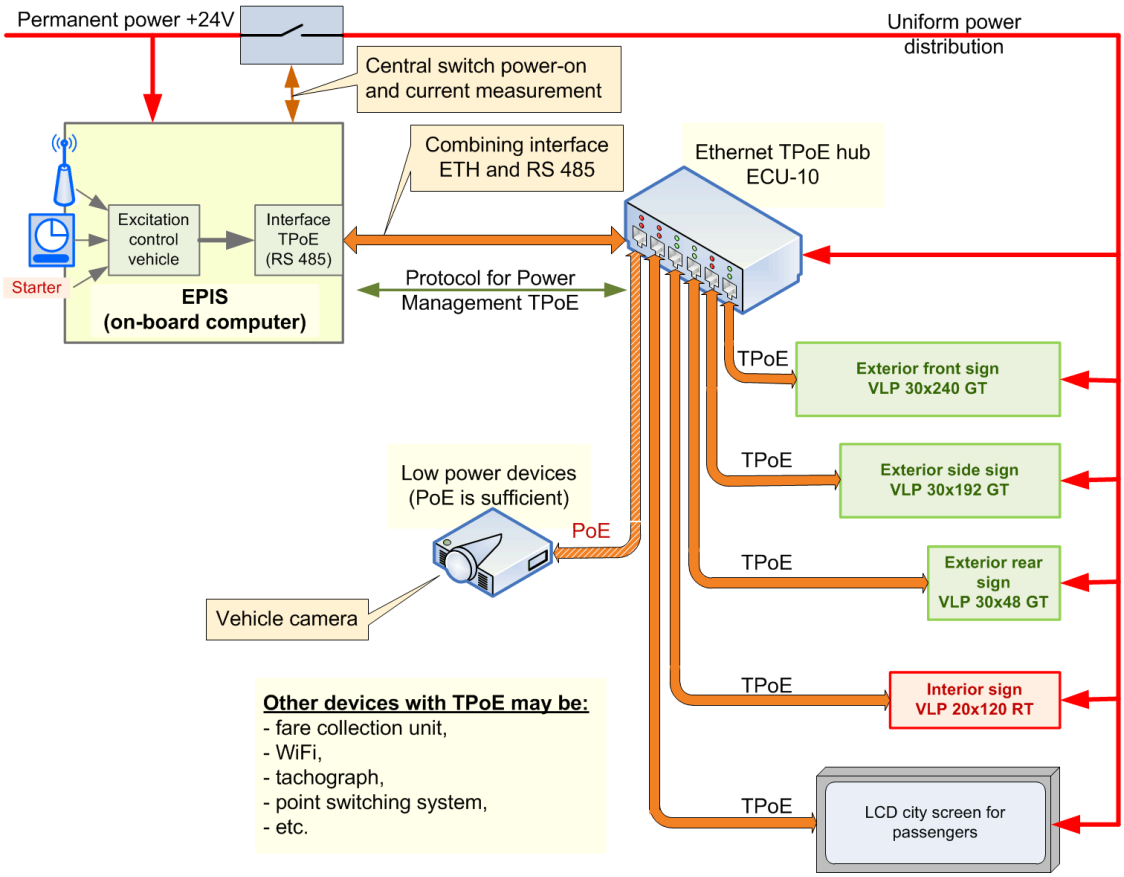
Targeted Power over Ethernet (TPoE®)

Why innovation of vehicle power system solution

- New communication technology based primarily on the Ethernet bus in the vehicle.
- Pressure on solution cost and easy installation in vehicles.
- High source currents for information, control and fare collection systems – for example, double-sided tram with LCD monitors consumes up to 30 A continuous and 40 A peak current.

Why use targeted power management:

Our basic concept of TPoE offers many possible ways of arranging information and fare collection system. Everything is based on only one branch of controlling the power supply that is common for signs, displays, fare collection system, audio circuits, etc. This concept uses modified RJ 45 interface, UTP cable or STP and significantly reduces the cost of power solutions.



Pic. 12: Principle of a targeted power management - TPoE

Display information vehicle systems

The outer information LED panels – vehicle direction indicators are produced in three versions – front, side, rear - in various sizes and with outstanding side readability made possible by using flat LED diodes. They are based on high-illumination LED diodes (max. is up to 3 000 mCd/point with flat diodes or up to 10 000 mCd/point with lens diodes) and on **a low-input power technology with extended lifespan**.

For panels it is possible to create texts using own fonts and icons (school bus, barrier-free transportation, detour etc.) Minimal text size of 50 mm is readable from 25 m, maximal text size 168 mm is readable from more than 60 m.

Basic character properties of outer information LED panels VLP:

- **Display using dynamic fonts** – automated change of font size according to text length
- **Fonts with various symbol height size** – from 50 mm to 200 mm (big variability)
- **Different font size** – simple, narrow, bold, italic, double-sized, triple-sized etc.
- **Excellent visibility** – high luminous flat LED diodes with excellent side readability
- Optional movements of text rotation directions and display cycles according to the state of vehicle
- **Control interface choice** - IBIS (I), RS 485 (R), Ethernet (E), own TPoE (T)
- Brightness control according to surrounding light intensity
- Wide range of supply voltage from +12 V to 32 V
- Low consumption and prolonged life time given by voltage controlled LED panel
- Simple installation into vehicles (similar to current ways).
- The panels are able to display **CP-1250 alphabet of Windows System** (no need to perform translation into other codes while sending commands from dispatching).

Outer information LED panels (tableaus)

We were the first in the Czech Republic to integrate the technology of displaying texts with the help of dynamic fonts in our outer vehicle LED panels. The LED panel itself chooses the biggest possible font to ensure readability of the text from the longest possible distance. It is possible to send texts – stop names according to the definition from the CIS (Central information system) – directly into the panel and the panel itself adjusts the text and optimizes the size of the text as well as the number of lines (see the attached demonstration video of slowed-down calculations – in reality this happens in a few microseconds). Thus it is not necessary to prepare special databases and to maintain these databases. **Defining the ways they are displayed is enough!**

Version produced vehicle panels:

- **VLP 19** – outer LED panels with **10mm** distance of LED diodes, which is intended for low cost solution (similar to existing third party solutions) – version **ECONOMIC** with deformed Czech symbols.
- **VLP 24** - – outer LED panels with **8mm** distance of LED diodes and full **support of Czech language** – version CZECH TEXT. They are especially suitable for **system of automatic text formatting using dynamic fonts**.
- **VLP 30** – outer LED panels with **6.2mm** (6 mm also possible) distance of LED diodes that are intended for displaying of 3 rows of Czech text – version **HIGH DEFINITION TEXT**.

Pic. 13: The outer information LED panels - VLP 24x160

Inner LED panels (displays) – VLP 10 or VLP 20

Pic. 14: Inner LED panels VLP 20x120

Inner LED panels (single-line or double-line) supply the passengers with topical information regarding the number of the line (3 characters), the present and the next stop, the terminus (a minimum of 20 character in a distinctive font), the names of important stops on the route and transfer connections, the time and the tariff zone and others (for example a planned ¨lockout).

New display possibilities are brought mainly by double-line pannels, they include for example information regarding the state of the follow-up lines and their delays, present happenings on the stop, etc…

Parameters of the VLP:	
Outer measurements (W × H × D)	Single-slided: 788 x 94 x 55 mm or double-slide: 650 × 153 × 71 mm
LED matrix	10 (20) rows x 120 columns
Maximum power consumption	35W / 50W (single-sided/double-sided)
Average consumption	10W / 12W (single-sided/double-sided)
Design	single-sided or double-sided

Inner vehicle LCD panels - VCS

Inner vehicle display panels (CityScreen) for passengers based on industrial LCD displays are designed for public transportation vehicles (both municipal public transportation and regional public transportation) to serve as an information system for passengers.

A widescreen LCD display is, used as a display panel. This display can have resolution with a minimum side ratio of 5:4 (resolution 1280 x 1024), however different side ratios are also possible: 16:9 (resolution e.g… 1366 × 768, 1680 × 1050, 1920 × 1080), 16:10 (resolution 1440 x 900) and higher side ratios (resolution e.g. 1920 x 502 points)

Pic. 16: Inner single-faced LCD panel VCS 185.


Pic. 15: Inner double-faced LCD panel for passengers – VCS-185b

Parameters of the VCS:	VCS 185	VCS 185B
Diagonal of the screen of the LCD display	1 x 18,5“	2 × 18,5“
Native screen resolution	1366 × 768 px	1366 × 768 px
Response time	5 ms	5 ms
Maximum brightness	400 cd/m^2	400 cd/m^2
Number of displayable colors	16,7M	16,7M
HW picture decoding:	MPEG 2, MPEG 4, H.263	MPEG 2, MPEG 4, H.263
Interface	Ethernet 100Mbit (RJ-45)	Ethernet 100Mbit (RJ-45)
Operation temperature	from 0°C to +60°C	from 0°C to +60°C
Outer measurements (W × H × D)	490 × 285 × 63,5 mm	490 × 285 × 120,5 mm

Information stop LED panels

Electronic station display panels (hereafter ELP) and systems are meant for informing (using images or voice) the passengers at the stops about arrivals, delays, departures of public transportation vehicles and about extraordinary transportation situations or other circumstances in the surrounding region.

Pic. 17: Information stop LED panels – ELP 302

Basic properties of information LED panels:

Pic. 18: Passenger Information System - in node Česká – Brno, CZ.

- High performance **ELP CCU** (control communication unit) control unit module containing an industrial PC, an Ethernet interface (or **TPoE**), an interface for radio modules GSM/GPRS/UMTS/TAIT/ISM-FHSS, circuits charging backup accumulators.
- MP3 player with an acoustic switchboard (15W) with the possibility of sending dispatching announcements directly to stop speakers.
- High performance **ELP MCU** module controlling the LED matrix (30.0 Hz).
- Integrated **EPNEV 1.13** command receiver for the vision impaired which posses the ability to read a displayed text including browsing.
- Illumination regulation controlled by sensors on both sides of the panel (valid for double faced panels).
- Receiving of accurate time and automatic synchronization
- Cameras for sending pictures or videos of the number of passengers on stops and their behavior.
- **LED diode spacing 4-10 mm**. Their color depends on the customer.
- Improvements of communication abilities in the form of a stop LCD display, a simple keyboard and a voice interface to allow passengers to communicate directly with dispatchers.
- The last line can be reserved for the public announcement and warning system JSVV.
- Independent windows can be used to display texts or graphics.
- **Low input power solution** (diodes do not overheat). This is made possible by a special construction of the **MELP** voltage pre-converters with 90% efficiency and by the voltage control of these panels. This method saves up to 40% of energy in comparison with the rival solution.
- Their lifespan is significantly prolonged by their controlled ventilation depending on their inner temperature.
- Remote servicing – of the PC program, sounds of acoustic announcements, schedules, FW of all control units and processors, remote control of the state of the units, temperature and voltage reading etc.
- Thanks to the modular technology, these panels can be easily modified to suit the customer demands.

ELP implementation in LCD:

- simple LCD panels (including one LCD)
- double LCD panel (including two LCD)
- LCD panels complemented with external time display (hour and includes system)
- external LCD panels with or without the touchpad (Information Stall on Stop - I-point)

Pic. 19: Double departure LCD panel (2×21") with a clock – the ELP A821EH type.

Information Stall on Stop I-Point

I-point is multimedia display information unit equipped with 12" LCD display controlled via capacitance touchscreen with increased resistance against mechanical damage. – antivandal – **IP 53** cover (it includes 6 mm wide safety glass). I-point is devoted for outside installation as information point for public enabling to search connection in public transportation, Internet access and the possibility to communicate with dispatching. It also includes integrated speaker and microphone to enable communication with the main dispatching.

Pic. 20: I-Point

Dispatching System for Electronic Information Panels – SPRINTER ELP

Nowadays we are able to offer you 2 types of SPRINTER dispatcher systems that can control intelligent panels. We speak about control system integrated into:

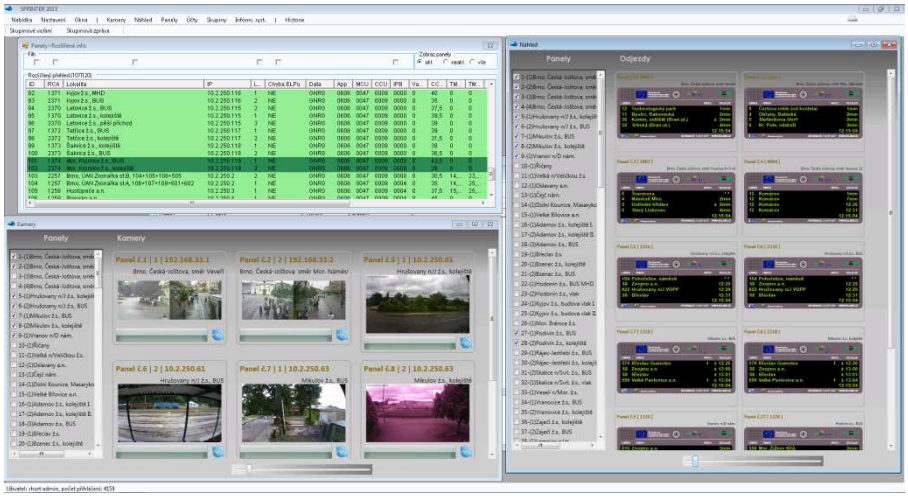
- SPRINTER 2014 system that is mainly determined for Public Transport dispatching,
- SPRINTER ELP system itself devoted for control and maintenance of Information stop LED panels for passengers

Both these systems use the same software platform and hence include most identical windows. This system is devoted for demanding stop display systems which include controlling PC, web communication interface and also enables on-line/off-line operation while displaying timetables.

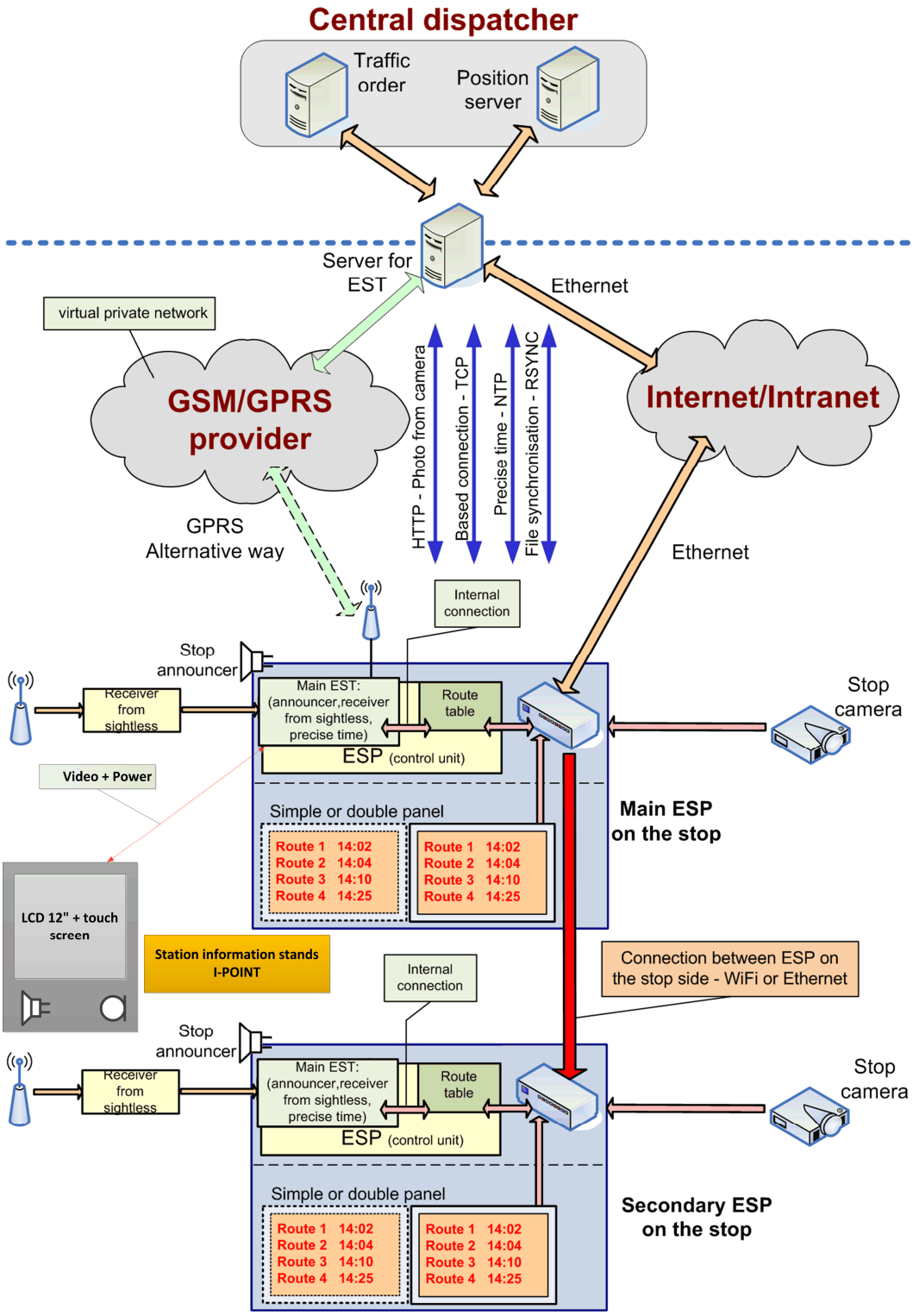
SPRINTER system can signal immediate state of the panels according to currently displayed information. This immediate system is saved into database and previous data can be whenever replayed with various speed using "replay regime".

Options of displaying individual windows:

1. **Preview** – it is determined to display information on panels in a clear way that is currently displayed information
2. **Web map** – it enables to display the localization of the panels in the map
3. **Cameras** – they enable to display pictures from cameras in a clear way and to choose one of the pictures for the following work
4. **Graphics** – it enables selected panels to display lines that pass this particular place (suitable for public transportation)
5. **Panels** – clear display of technical state of the panels
6. **User management** – this window is devoted to set up the rights of the users



Pic. 21: Dispatching System for Electronic Information Panels – SPRINTER ELP



Pic. 22: Block diagram for communication between dispatcher system and electronic stop table (ESP).

Note: *When LCD displays for external environment are used, the same block diagram can remain. The LCD panels must be used in transmissive or reflective mode, where the panels have the ability to absorb light rays. But the fact remains, that the LED panels can have up to 50 times higher luminosity that LCD displays.*

Command receivers for people with impaired vision EPNEV 3.1x

These products include – voice and sound systems that can be accessed using a command controller for people with impaired vision and are able to inform people with impaired vision about their location and the place they are finding themselves at, at the moment. They are produced both for the Czech Republic (86,790 MHz frequency) and for Slovakia (87,100 MHz and 87,050 MHz frequencies).

Common parameters of the command receivers EPNEV	
Received frequency	86,790 MHz – CZ version | 87,100 MHz a 87,050 – SK version
Type of receiver	**Dual conversion to narrowband FM modulation**
Selectivity	-40 dB / ± 35 kHz, -80 dB / ± 350 kHz
Sensitivity	0,4 µV
Relative frequency instability	± 20 ppm / -20°C to +70 °C
Modulation	FSK
Frequency deviation	+3 KHz
Input impedance	50 Ω
Operation temperature range	from -20 °C to +60 °C
Antenna	AN-1N or AN-2N
Consumption	to 20 mA
Power supply	12 V to 36 V - for power supply of 24V
	up to 56V from EPNEV 3.18 (PoE)
Protection against polarity reversal	Diode
Surge Protection	Protective resistance and tranzil
Mechanical Dimensions (L x W x H)	106 x 55 x 34 mm
Method of fixing	DIN rail
Used bus	IBIS, RS 485 or Ethernet

A new line of EPNEV receivers EPNEV 3.1x compared with the present version has significantly higher selectivity and resistance against unwanted near frequencies which other receivers at the market do not have (both ours and from other companies). This ensures a receiver functionality even when there is a high-performance FM radio transmitter in the surroundings.

EPNEV 3.1x command receivers (a new line)

Within the new series we have prepared the innovations of all types of receivers and furthermore we extend this series with command receiver with the interface for crossroads control units and with Ethernet interface. The version EPNEV 3.14, 3.15 and 3.16 receivers are fully compatible with an older type EPNEV 3.0x.

- **EPNEV 3.14** - for public transportation vehicles that use the IBIS (IPIS) busbar to communicate.
- **EPNEV 3.15** - with external beeps for the ČD trains – meant mainly for trains of the 814 type belonging to the ČD.
- **EPNEV 3.16** – receivers with the RS 485 interface, door opening and beeps.
- **EPNEV 3.17** – for crossroads control units.
- **EPNEV 3.18** - receivers with the Ethernet busbar and the ability to work with the voltage from +12V to +60V (a standard version and an HV version (High Voltage – 60V).

Pic. 23: EPNEV 3.14 IW

Preference in public transport at crossroads / junctions

As a part of our supplied systems, we have developed several ways to implement the preference of public transport vehicles:

Public transportation vehicle preference at crossroads using the BSV system

This method uses the BSV induction system for contactless throwing of switches and it is based on transmitting to the crossroads information regarding the position of the vehicle in relation to the schedule. This information is included in every data packet sent form the vehicle to the rails (trams) or to the trolleybus line (trolleybuses).

Transferred vehicle-schedule states:

- the vehicle **travels according to the schedule** - there is no need for vehicle preference (0 to -2 minutes),
- the vehicle **is mildly delayed** - it will help if the vehicle is preferred (-2 to -5 minutes),
- the vehicle **requires preference** - the vehicle is delayed therefore it is necessary to speed up its driving through the crossroads (-5 to -10 minutes),
- **reserve state –** the delay is so significant that it is not necessary to deal with it.

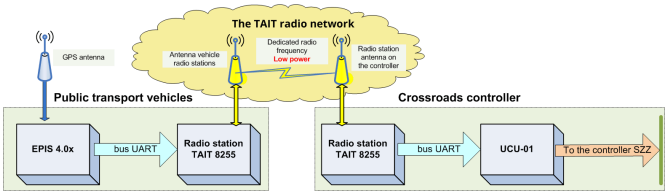
Public transportation vehicle preference at crossroads using radio transmissions

The method of sending vehicle position information to the crossroads control unit using radio transmissions on a reserved band is included in our complex vehicle system - **EPIS 4.0X on-board computer** and in our **FD NET radio network control**. This method prevents the necessity of using another communication infrastructure in the vehicle and the communication (both voice and radio) including crossroads control is controlled by **one vehicle radio station** which can be equipped with fast channel switching.

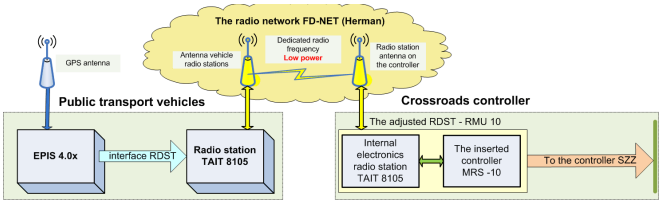
Crossroads control units and systems

Our company produces two types of crossroads control units and systems using different types of radio network:

- for the TAIT radio network, where the controlling function is performed by **UCU 01 units** (versatile communication units) and by a TAIT radio station using the THSD module. This preference type is included in the **EPIS 4.0. on-board computer.**



Pic. 24: The schema of vehicle-crossroads communication in the TAIT radio network.



Pic. 25: The schema of vehicle-crossroads communication using the FD NET radio network.

- for systems using the FD NET radio network, where the control function is performed by **RMU 10 units (radiomodem units)**. This preference type is integrated in **the EPIS 4.0A. on-board computer.**

Program for creating crossroads data – JunctionPrefEditor

The **JunctionPrefEditor** program edits crossroads data at the basis of which it is possible to create links needed for crossroads preference. Another function of the SW is creating exports from the assembled data for the EPIS 4.0A on-board computer.

The result of these actions is a file which is uploaded via depot update systems to the on-board computer. The on-board computer then behaves according to the commands set by the JunctionPrefEditor program.

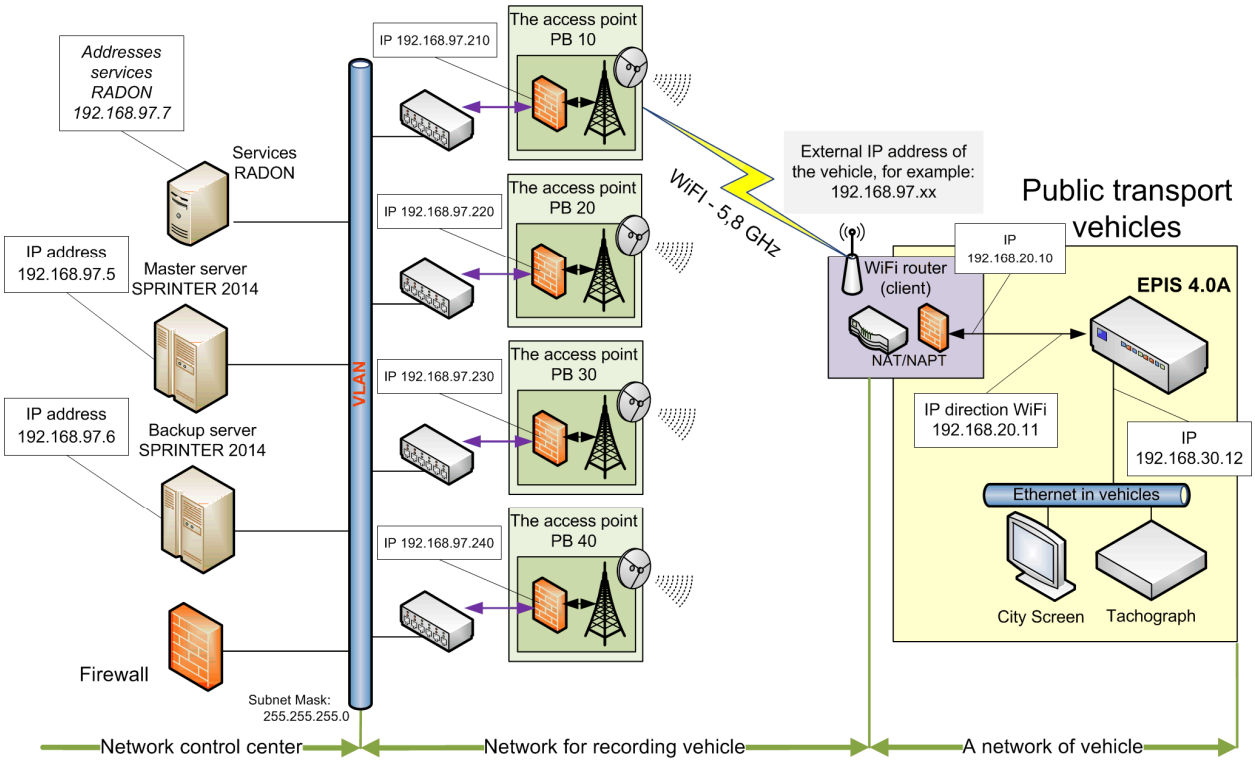
Wireless solutions in depots

In cases where vehicle does not contain SIM card or where big data packets are to be transmitted, wireless technology using WiFi solution is suitable for tram, trolleybus and bus depots.

Radio communication system in depots is based on SPRINTER-RADIUM software which runs on the designed computer in depot. The system uses 2 radio bands. One of them is used for activation radio signals of the vehicles that operates with technology FHSS (Frequency Hopping Spread Spectrum) and is not basically able to be disturbed. The second band is used for WiFi at frequency range 5.2 – 5.8 GHz. Actual communication speed between two antennas is 8 Mbit/s (in theory up to 27 Mbit/s using UDP).

Communication systems for depots are used for:

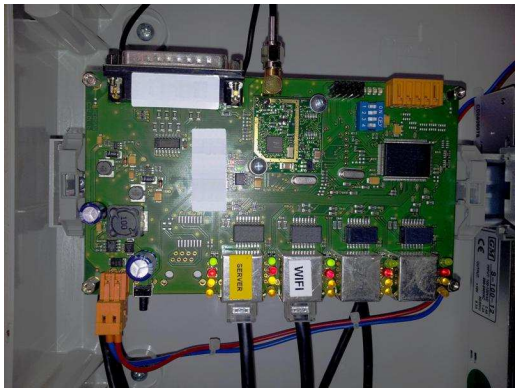
- Uploading data into vehicles
- Downloading data from vehicles
- Status determination of resting vehicles (e.g. voltage of accumulators)



Pic. 26: Wireless solutions in depots

Depot Access Point – ECU – 01

The access point (pillar) contains control electronic board ECU-01 (Ethernet communication unit) to control WiFi antennas. To one access point it is possible to connect up to 3 WiFi antennas that are supplied using PoE. The unit is equipped with controlled supply PoE (Power over Ethernet). This enables to turn on and off each antenna separately in a controlled way. The unit contains one communicator to communicate using activation radio frequency. The whole unit can be remotely controlled using firm protocol via Ethernet interface.



Pic. 27: Depot Access Point – ECU – 01

Contactless Point Switching System for trolleybuses and trams – BSV

Contactless Point Switching System (BSV) is a system for data transfer using inductance loops. It is based on the transfer of the magnetic component of the electromagnetic field. Two principles are used in practice: transfer to the trolley´s overhead lines – for trolleybuses – or transfer to the rails or ground (road) – for trams and buses.

Basic parameters of BSV:	
Conforms to the standards	ČSN EN 50155, ČSN 34 1500 a ČSN 34 1510
Route of transmission	magnetic field induced by the inductive loop
Bandwidth	115 kHz to 130 kHz
Modulation	ASK transmission rate of 1200 bit/s or FSK transmission rate of
The range of receiver	80 cm – 4 m
Transfer of additional	YES
Security of data transmission	YES (CRC polynomial and multiple broadcast code)
Immunity to interference	YES - especially FM modulation
Vehicle speed	45 km/h
Temperature range	from -25°C to +70°C
Power supply	From +18V to +36V

The main parts of the BSV system

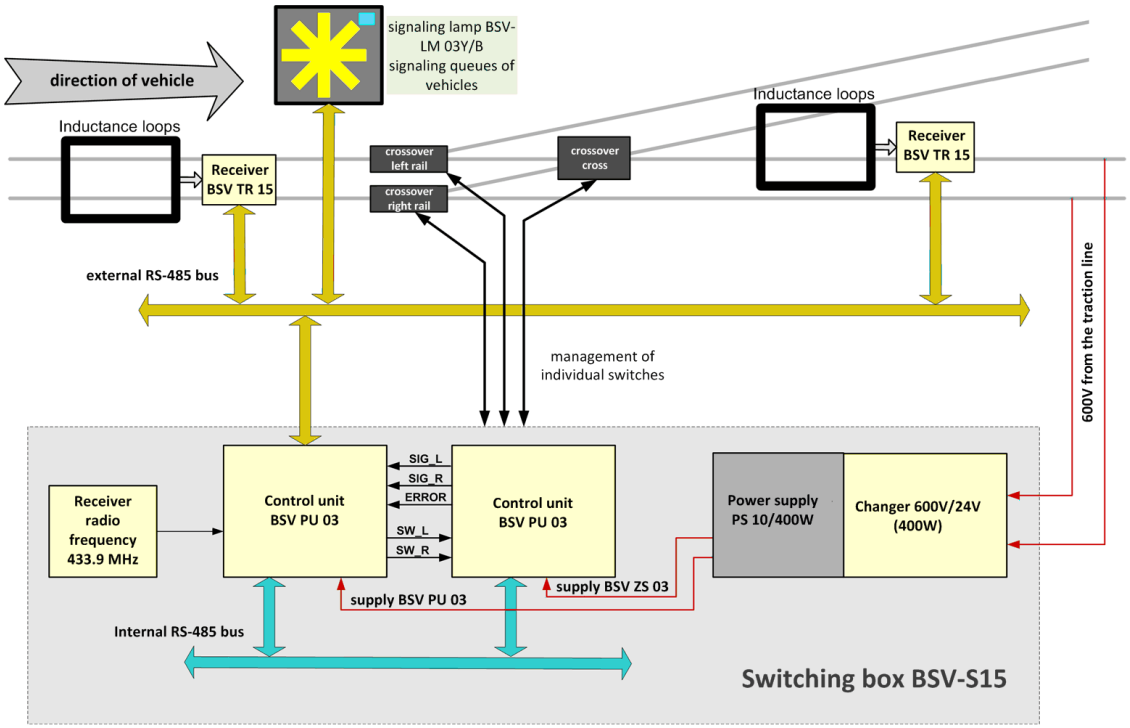
- Point switching control unit BSV-PU with the possibility to communicate with the main control unit of the switching point (e.g. for setting the system of point switches in depot). The units can be extended by the feature of monitoring the direction of vehicle.
- Vehicle control unit – EPIS 5x, EPIS 4x or EPIS 2.45.
- Transmitting vehicle units and induction coils BSV-TR – is used to generate magnetic field transmitted from vehicle
- Control keyboard BSV-KB03 – is used to enter the code of route target, line and public transport registration vehicle number for automatic or by hand setting of point switches.
- Receiving loops and receivers BSV-TR xx and BSV-RC xx – they are used to enable information transfer from vehicle to the control unit BSV PU-03 in the switching box BSV-S 15 for trolleybuses or as communication unit for tram control systems.
- Switch control box BSV-S xx – Switch boxes for contactless setting of point switches consist of several individual parts. These switch control boxes can be used for trams and trolleybuses.
- Switch state signalization lamps BSV-LM xx – signalization lamps display the current state of the switch, i.e. whether the switch is in the steady or temporary state, if it is blocked (the chosen direction is blinking) or is in failure.

Switching box BSV-S15

The circuitry of BSV-S15 switching box for controlling individual trolleybus point switches or trolleybus paths in depots:

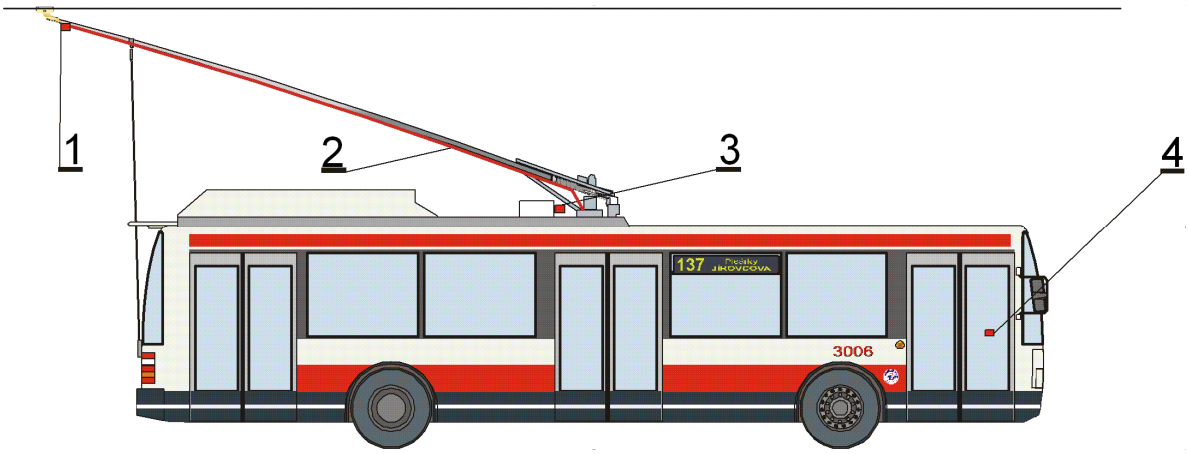
The system consist of the following components (logout coil on request):

- **BSV-RC 01B – re**ceiving trolleybus coil.
- **BSV-TR 15 AM –** FM and AM modulation receiver from vehicles.
- **BSV-LM 03 –** switch state signalization lamp (RS 485 or current loop interface).
- **BSV-PU 03 –** switch control unit or in case of trams of dual switch control unit.
- **BSV-ZS 03, 04 –** control unit for switch setting and their state evaluation.
- **BSV-PS 10/400 –** supply unit 24V/400W with protection filter.



Pic. 28: Principle of BSV system for trolley bus turnouts.

Sample involvement turnout system on a trolley



Pic. 29: Location BSV elements on a trolley

Location BSV elements on a trolleybus:

1. Transmitting coil - BSV TC-01A located at the end of the pantograph.
2. High Frequency signal cable with dual high-voltage insulation (shielded) located inside the skimmer.
3. The transmitting unit BSV-TR 14 (newest product with FM modulation and increased power) with 5 kV insulation separating the part of the vehicle and affixed to a collector.
4. Control unit - board computer EPIS 4.0 EPIS 2.45 or keyboard control BSV-KB 03.

LED digital clock

Clock system of accurate time is based on **GPS signal** receiver which it receives accurate time from. Accurate time unit with GPS interface contains FastEthernet 100 Mb interface, via it is connected to local network. Time information is periodically sent into it. In case of failure it works with the internal generator of accurate time.

Four sided digital clock – Q524E	
Resolution	24 x 80 points on all sides
Spacing between LEDs	8 mm, color according to request
Communication interface	Fast Ethernet 100Mb
Operating temperature	from -30 °C to +45 °C
Supply voltage	230 VAC
The average consumption	20 W
Maximum power	90W

Pic. 30: Four sided digital clock – Q524E.

Other systems for public transport

- DODK testers which enable to determine BSV transmitter´s state on inbound channel and simultaneously to check the operations of all radio communications.
- Trolleybus route management with the possibility to set target mark where trolleybus should be rest. This system also enables the use of multiple queues.
- In-built systems BSV in already operating systems. It is possible to install this system BSV in already built systems with minimal costs.
- Mobile exchange centers HU for dispatching control systems with the total amount of 52 connected voice channels with automatic roaming according to signal strength. This system can be built with the transmission lines solution.
- Modules monitoring radio traffic MRS, which are used to specify the evaluation function of public transport radio system.
- A solution of public transport vehicle preference passage, i.e. software for creating a plan of entry and exit points to the crossroad and with the possibility to generate data for on-board computer.
- IBIS bus buffer units – PSI 01, which will buffer the bus in case the number of devices connected to the bus exceeds its capacity (it allows programming of BUSE tables).
- Still manufactured units EPIS 2.45 UIR or NMR, or units IJN (Intelligent Power Supply Unit), power relay units NRJ and switched power supplies for power inverter for air condition units (MK series) or switched power supplies for radio stations (MR series).
- Vehicle Ethernet routers ECU 02 or ECU 10 TPoE, which provide vehicle LAN cabling, sensing vehicle state over Ethernet if necessary (router may contain control processor to provide communication with the surrounding buses RS 485, RS 232 or via one-bit inputs – with the application connector).
- Solution for bi-directional trams using A and B cabin adapters. System is designed to contain only one on-board computer. System must contain 2 LCD terminals. For the video distribution in trams, LVDS amplifiers are supplied.
- Software for displaying the vehicle passage on large LCD or plasma screens, which displays vehicle departures according to data from dispatching (equivalent to LED panels at stops).